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Hobby Electronics

FEBRUARY 1982
Vol 5 No 2

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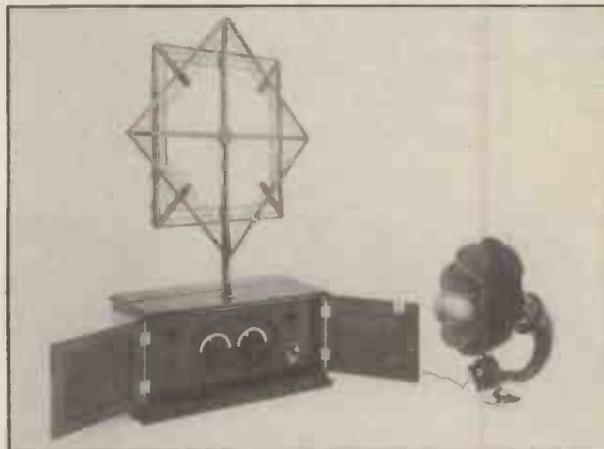
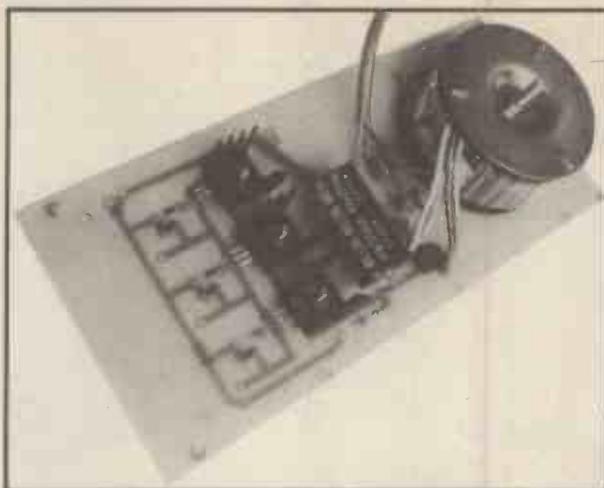
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Due to the unexpectedly large response to our Kits and Modules Survey (more than 70 companies replied), Radio Rules has been held over until next month.

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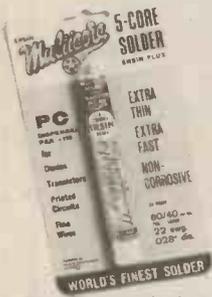
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MONITOR

Getting A Smaller Sound

AKG Acoustics are taking the lead in miniature stereo headphone design with two new models and a promise of more to come.

The AKG K4 is a development from the K340, which was generally acknowledged to be a leader in the mini headphones field; it incorporates two separate hi-fi units, known as a dynamic and an electrostatic unit, one providing treble and one for bass. Clearly, this is a great improvement over using one unit to handle such a wide range of sounds.

The K4's specification gives a frequency range of 20-25000Hz, nominal sound pressure of 92dB, power handling of 200mW and distortion of less than 1%. It's designed to be connected to any headphone output of 5 to 600R impedance via a 6.3mm stereo plug, but an adaptor of 3.5mm is included. As the K4 weighs only 65 grams it's equally suitable for indoor or portable listening. At £62.10 (including VAT) this is obviously one for the serious music lover.



Going down the line a bit, AKG's other new model, the K1, is out to win by thinking small. As shown in our photograph, the K1 actually folds up into its own unbreakable storage box for travelling — a handy alternative to a tangle of cable in the bottom of your holdall. The extensible headphone frame looks fragile but is designed to be robust and comfortable, though I have some doubts about listeners with curly hair! And the earpieces are swivelling for a good fit, and the foam cushions are changeable. Cobalt-samarium magnets in the earpieces give high-quality sound.

Frequency response on the K1 is 30-18,000Hz and power handling is 100mW, with distortion at less than 1%. The weight is 45 grams and they come with a 3.5mm stereo jack plus a 6.3mm adaptor. They're designed for an output impedance of 5 to 600R, and the price, £17.25 (with adaptor included) makes it well worth listening to. For any more information, contact AKG Acoustics Ltd., 191 The Vale, Acton, London W3 7QS. Tel: 01 749 2042.

One More Time

Another one for the Sinclair ZX80/81, this time with an option for home constructors: Ground Control's 16K RAM and Input/Output board gives the user 16K of dynamic RAM for program and data storage and can interface with a wide range of peripherals via an 8855 PPI.

The I/O is memory mapped and can be controlled either by PEEKs and POKEs, or by machine code for faster applications.

The board itself measures 155 x 146 mm and comes with its own power supply at £53.00, or with a wire link (which enables it to be run without a separate power supply) at £47.00. It is designed to plug into the rear expansion connector of the ZX, without preventing the use of the printer, and has two 14-pin DIL sockets for connection to the outside world.

For the home constructor, the board is available as a bare plated-through-hole (PTH) PCB, including construction data, but with no components supplied, for just £10.75.

You can order the board built and tested, or bare for building, from Ground Control, Alfreda Avenue, Hullbridge, Essex SS5 6LT. Tel. 0702 230324. Please send SAE or IRCs for further details.

... Like A Switch To Water

NSF Ltd. have added a set of slider switches to their 'Circuitboy' range of miniature washable switches (push-button and lever variations already available). Particularly suitable where space is short and high performance at low power is important, the switches are available in single and double pole, double-throw circuits, and straight-mounting, straight with support bracket

or right-angle mounting PCB terminations. The terminations are moulded in to withstand contamination (dirt being the major cause of switch malfunction) and the body construction withstands rinsing in hot water and detergent. The smallest, two-pole model is small enough to fit entirely within a space of 1 cubic centimetre.

The whole series is being made available through Farnell, Semicomps and ITTES, and also from the makers, NSF Ltd., Keighly, W. Yorkshire BD21 5EF. Tel: (0535) 61144. Prices range from 60p for the simplest switch to £1.05 for the most complex, in lots of 1 to 49.

Learn Electronics Here

The University of Kent at Canterbury has arranged an adult study course (this doesn't of course mean that there's an age limit, only the course is held in the evenings) titled 'Electronics, History and Applications', second part, which they call 'A look at how some of it began, what you can use it for, including 'Hand on' experience with kits, projects and measurements.' It's being held from 7 to 9 pm, Wednesday evenings, from the 12th of January, for ten weeks.

It's not clear from UKC's letter how much the course costs, exactly where it's being held or what was covered in Part One, but anyone who doesn't want to pass up what looks like a good opportunity to extend their electronics skill and judgement can discover all by contacting the office at Westmount Adult Education Centre, Folkstone Rd., Dover, Kent (Tel: Dover 202413). Courses like this are often very popular, so don't delay!

Custom Keypads

A stock of lightweight membrane keypads in almost-finished condition, awaiting only the final instructions for the legend layout, is the basis of a custom keypad service that can handle even one-off quantities at a reasonable price. DP Products can print, test and despatch keypads to order from a stock of basic calculator/computer-style symbols. At present, only 12-contact keypads are available, but 16- and 20-contact versions are in the pipeline, and the range of symbols may be extended if there is enough demand.

Prices are £7.24 each for quantities of one to nine, £6.69 for 10 to 24 and £6.15 for 24 to 99. For specifications and more details contact DP Products Ltd., PO Box 7, Clacton-on-Sea, Essex CO15 6ED. Tel: (0255) 433643.

Directory Update

Grimby Electronics of 95 Lambert Rd., Grimby, South Humberside have contacted us to say that they stock a large selection of components, and also large stocks of surplus components and hardware (motors, switches, sheet materials, etc.). They also specialise in switches of all kinds.

MONITOR

Aerial Advice

Viewers in some areas, Antiference of Aylesbury tell us, will be unable to receive Channel 4 television because they will have an aerial of the wrong group for the local transmission. As you have exactly 33 1/3 % more chance of appearing on telly now that there's one more channel, you'd better get your aerials adjusted. Most people have Group B aerials designed to receive transmission channels 39 to 53, but in some areas Channel 4 will be on higher frequencies, on channels 65, 66 or 67. These require shorter aerial elements and to receive all four channels Group E aerials are needed.

Another solution in some areas is to use high-gain aerials for fringe-area reception. Antiference manufacture three suitable type: the TC18 for shorter ranges, the XG8 for medium ranges and the XG14 for longer ranges. Local TV firms such as retailers, aerial installation firms or television rental companies are the first people to go to for advice on reception and aerials, but if necessary contact Antiference Ltd., Aylesbury, Bucks HP19 3BJ. Tel: Aylesbury 82511.



Electroantimigraine

What is it? An electronic headbanger for immobilised Metal maniacs? A deprogramming device for victims of the personal stereo cult? Not quite... according to Beam Components of Rochester, the Antache is "a unique new instrument to assist sufferers from tension headaches", which is good news. Working on a biofeedback principle, the Antache monitors the electrical impulses given out by the muscles on the wearer's forehead (the "electromyogram"), and produces an electrical tone in accordance.

By listening to the tone changing, the wearer can learn to relax the muscles in his or her face and neck, where tension headaches build up. By practising, headache sufferers can learn to relax consciously and so control the onset of headaches even when not wearing the Antache. Good news indeed. The device even has tone and volume controls so that a pleasing tone can be selected, and weighs only 300 gm (9 oz) complete with batteries.

For more information, contact Beam Components Ltd., 108 High St., Strood,

Rochester, Kent ME2 4TR. Tel: 0634 79821.



Running On Air

Battery fanatics, it seems, are ever on the prowl in search of the higher-energy, longer-living, more minute energy pack. Well, it now appears that the latest thing in lithium batteries is already being out-paced by a new generation of zinc-air batteries. Gould Activair have produced a zinc-air battery with an operating voltage of 1.4V, so that two cells can be combined to give 2.8V output suitable for electronic equipment, and compatible with standard battery sizes.

The batteries have a performance level equivalent to lithium batteries, but give a very even voltage discharge curve, superior to lithium and other battery types. They also have a very long shelf-life: the semi-permeable plastic membrane which allows oxygen out of the air into the battery (where it reacts with the zinc anode material) is covered by an adhesive tape seal until the battery is needed for use, so that batteries will store in a stable condition for many years.

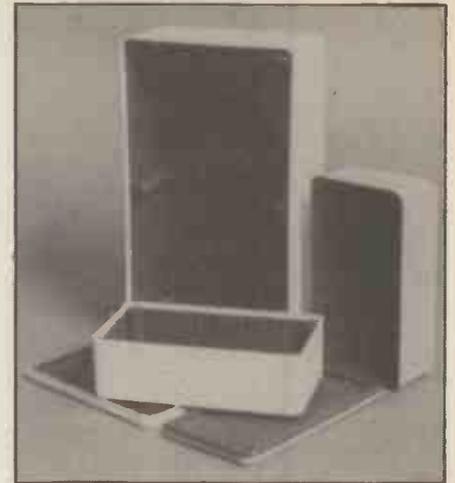
The batteries come in a range of sizes. Industrial uses suggested by Gould include hearing aids, hand-held personal computers, and calculators and paging systems. We're sure ingenious uses will occur to hobbyists. For information contact Gould Activair UK, 11 Ash Rd., Wrexham Industrial Estate, Wrexham LL13 9UF, Clwyd, UK. Tel. (0978) 617080.

Black In The Box

Boss Industrial Mouldings have added a range of fully screened plastic (ABS) boxes with the kind of electrical screening normally associated with steel or cast aluminium boxes. The protection is an internal coating, 0.05mm thick, of black EMI and RFI conductive shielding. The attenuation of the boxes over 5 to 1800MHz is 50 to 90dBs, with a total conductivity throughout a box not exceeding a 1" point-to-point reading of 2R, even when subject to humidity, freezing and heat ageing tests. The lids secure with brass hank bushes, making the boxes moisture proof and so suitable for a wide range of hostile conditions.

The boxes score on lightness, ease of drilling and resistance to impact,

chemicals, temperature extremes and interference, coupled with comparative cheapness. They come in seven sizes from 100 x 50 x 25mm (2 1/2 x 1 1/4 x 1"") to 190 x 110 x 90mm (4 3/4 x 2 3/4 x 2 1/4""). For prices, etc. contact Boss Industrial Mouldings, James Carter Rd., Mildenhall, Suffolk IP28 7DE. Tel: (0638) 716101.



Down in Black and White

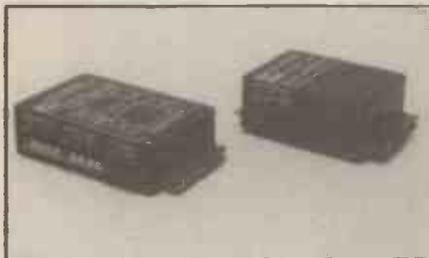
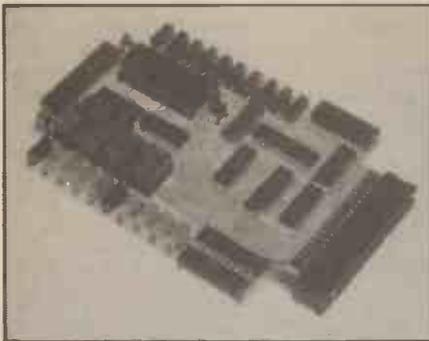
Computer Chess addicts, especially those just starting to venture into the fray, will be interested to know that Silica Shop have produced a report on their Silica Computer Chess Symposium 1982, which incorporates a full analysis of the machines which they assessed as the strongest in the field: the Scisys Mark V, Fidelity Champion Voice Sensory Challenger and the Applied Concepts Great Game Machine, with information also on the Mephisto 2, Fidelity Elite and Fidelity Prestige, and Sensory 9.

The report takes the form of a 32pp, A5 litho printed pamphlet on glossy paper, and is available for three 15 1/2p stamps from Chess Report, The Mews, Hatherley Rd., Sidcup, Kent DA14 4DX. You can ask about future reports, or apply to play in the next symposium (if you are a rated player), as well. Tel: 01 301 1111.

**SILICA
COMPUTER
CHESS SYMPOSIUM**
1982

Additional copies of this report can be obtained by writing to:
Computer Chess Report, 1 The Mews, Hatherley Road, Sidcup, Kent DA14 4DX
Please state your name and address, and enclose three 15 1/2p stamps as a contribution
towards the cost of postage and production

MONITOR



If You Can't Talk, Just Bleep

Computer buffs who like to have their micros talk back to them will be pleased to hear that there is now a speech pack available for the Sinclair Spectrum from **DCP Microdevelopments** along the same lines as the ZX Speech Pack they released in April 1982. The new pack includes all the features from the ZX81 pack, including built-in speaker, expandable vocabulary, volume control and ZX connector at the rear for other computer accessories. The Spectrum pack is controlled by simple OUT commands. The cost of the unit is **£49.95** all inclusive, with additional word packs at **£14.95** each.

The speech packs are supplied fully assembled, tested and guaranteed, and are available either direct from **DCP Microdevelopments Ltd.**, 2 Station Close, Lingwood, Norwich NR13 4AX (Tel. Norwich (0603) 712482) or from ZX dealers. Schools and Colleges should contact **Griffin and George Ltd.**, 285 Ealing Rd., Alperton, Wembley, Middx. HA0 1HJ (Tel. 01 997 3344).

For the ZX81 come a new 16k RAM pack from **Ground Control**. According to GC this pack overcomes all wobble and disconnection problems normally associated with RAM packs. In fact they say, the ZX81 can be picked up and shaken and the RAM pack will not drop off or lose its data.

You can also get the pack with a keyboard sounder fitted in the case which bleeps whenever a key is pressed. This helps with the fast entry of programs and means that you have to look at the VDU less often, which is less tiring for the eyes, at any rate.

Both these units are available now, by return for PO or credit card payment, and allowing 3-4 days' extra for clearance of cheques. The all-inclusive prices are **£19.95** for the 16k RAM pack and **£24.95** for the same with sounder. Eventually GC hope to have a 'Beep' program in machine code available with the

keyboard sounder, so that the sounder can be used from within a program, but this is not available yet. Contact **Ground Control**, Alfreda Ave., Hullbridge, Essex SS5 6LT (Tel. 0702 230324).

The Camel's Back

Not so shakeable, perhaps, but reputedly an equally safe place for data, **Cambridge Microelectronics'** MEMIC-81 and MEMIC-81.2 2k and 4k RAM packs use the same kind of CMOS memory chips used in some wrist watches and pocket calculators: This enables the memory to store data securely using very little power, and lithium batteries provides power for around 10 years. A switch on the unit allows a choice of overnight or over-the-years data storage.

MEMICs can be connected into the 8k to 16k area of the ZX81's memory map by a pluggable links arrangement. Although this area of the map is not addressable by BASIC in the ZX81, BASIC programs can be saved and retrieved by means of 12 byte codes, and, for longer-term data storage, the load and save routines can be programmed into the MEMIC. Entering a USR statement then automatically copies the BASIC program into the user's RAM pack.

Machine code programs do not need to be relocated and can be run directly from the MEMIC just a few seconds from switch-on. Data only has to move from one chip to another, so that the likelihood of mis-loading is virtually non-existent.

The MEMICs come complete with user notes and the listing of a program example, already programmed with load and save relocation codes and a demonstration program. Prices are **£24.95** for the MEMIC-81 and **£29.95** for the MEMIC-81.2. Contact **Cambridge Microelectronics Ltd.**, 1 Milton Rd, Cambridge, CB4 1UY (Tel. Cambridge (0223) 314814).



Also from Cambridge Microelectronics come a pair of printer stands designed to hold fan-fold paper, forms, mailing labels etc. for direct feeding. The Camel PSS is about 360 x 48 x 102mm (15 x 12 x 4.25") and takes printers such as the Microline 80/82/83 and the Epson MX80. It costs **£15.95 + VAT**. The larger PSL is about 408 x 348 x 90mm (17 x 14.5 x 3.75") and takes printers of the Microline 84, Epson MX-82 type. It costs **£17.95 + VAT**. Both models come with mains cable and printer ribbon cable retaining clips, and are made of 6 mm (1/4") tinted Perspex.



In The Scenery, Change . . .

Pulse Induction's new Eurodec metal detectors operate (naturally) on the pulse induction principle, the practical result of which is that no adjustments are needed to take into account the nature of the ground (from concrete to clay), or salt or fresh water conditions in the soil. Ferrous and non-ferrous metals produce an equal response, and the Eurodecs are said to be typically able to detect a 2p coin buried up to 400 mm (16") underground.

Independent controls include search coil power, gain/sensitivity, and threshold level, allowing output and response to be optimised for any particular search. The more advanced Eurodec Mk. 2 has additional controls for noise sample delay (which minimises electrical background noise) and signal sample delay, which optimises the response for small or large buried objects.

Pulse tells us that Eurodec comes as a 227 x 215 x 80 mm (8.93 x 8.46 x 3.15") unit on a shoulder-strap, connected by a plug-in lead to the telescopic fibreglass wand which carries the search coil, making it accessible and easy to carry. The Mk. 1 has a 10"/254 mm search coil and the Mk. 2 has both a 5"/127 mm and a 15"/381 mm coil, which are optionally available for the Mk. 1 as well. The detector speaker can be augmented with optional, jack-connected headphones, and the batteries can be re-charged overnight (about 6 hours) on a standard charger and will power the detector for several hours. A battery state indicator is included on the unit.

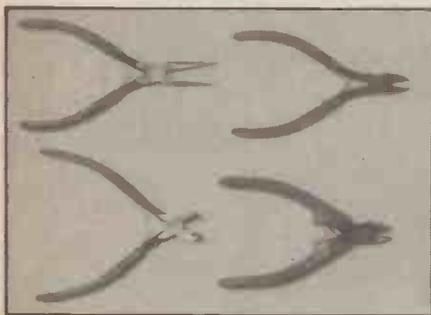
Full technical and other details from: **Pulse Induction Ltd.**, Unit S11 SE, Rectory Lane Industrial Estate, Kingston Bagpuize, Abingdon, Oxford OX13 5AS (Tel: (0865) 820945).

MONITOR

Cutting Remarks

You'll never know how much a rotten pair of wirecutters can set you back until you've used a good pair. Stotron now supply a range of tools by Bahcos including three kinds of cutters, and long-nosed and cable-stripping pliers.

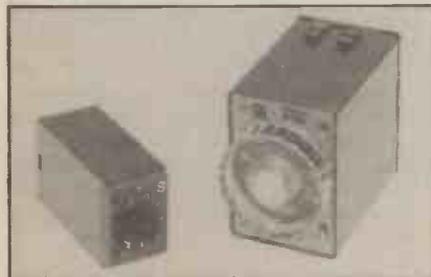
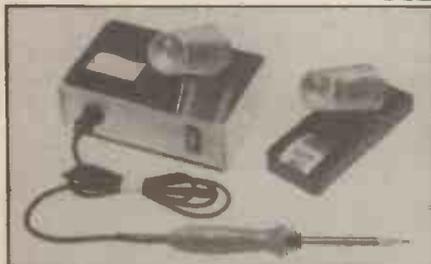
Of the cutters, one style will cut copper wire of up to 1.5mm diameter, the second will cut copper only to 1.2mm but has an adjustable joint and replaceable wire holder, and the third cuts copper of up to 1.5mm, diagonally, with blades set at 70° to the handles. For prices contact Stotron Ltd., 72 Blackheath Rd., London SE19 8DA. Tel: 01 691 2031.



And Now, A Brief Interval . . .

Talking of timers, for the rather more delicate control of electronic instruments, etc., Stotron are now supplying two ranges of low-cost, high precision timer controllers by National. The units have operating voltages of 200/240VAC or 24VDC, an operating frequency of 50-60Hz and operating temperature ranges of -10 to +50°C. There are LED indicators on ON and UP, and reset times are less than 0.1 second.

The PDX types are available for periods of 0.1 to 3.0 seconds and 0.5 to 10.0 seconds; these units have the same terminal arrangement as HC relays, and the same accessories can be used. The PMH types have switch variable time ranges of 0.05 seconds to 10 minutes, and 0.15 seconds to 30 minutes. Mounting frames and octal bases are also available.



★★ BIG NEWS ★★★★★ BIG NEWS ★★

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Only brand new and useful values included

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• 5V 1A TO220	48p
• 5V 1.5A TO3	140p
• 5V 1A TO330	40p
• 5V 1.5A TO3	190p
• 6V 0.5A TO220	35p
• 12V 0.5A TO220	35p
• 12V 1.5A TO3	140p
• 12V 1A TO220	40p
• 12V 1.5A TO3	190p
• 15V 1A TO220	40p
• 15V 1A TO220	40p
• 24V 1A TO220	70p

TRANSISTORS

AC 107	30p	BF 115	29p	2N3705	10p
AC 126	30p	BF 194	13p	2N3904	15p
AC 188	27p	BF 197	13p	2N4051	10p
ACY 17	65p	BF 198	13p	2N5172	15p
ACY 19	65p	BF 199	15p	2N5179	30p
BC 149	7p	BFR 40	20p		
BC 159	12p	BFX 29	25p		
BC 171	10p	BFY 90	60p		
BC 173	10p				
BC 212	9p				
BC 212L	9p				
BC 213L	9p	2N 706	15p		
BC 237	12p	2N1131	20p		
BC 308	13p	2N1132	20p		
BC 327	18p	2N2222A	20p		
BC 337	13p	2N2369A	15p		
BC 558	14p	2N3702	10p		

P.S.U. COMPONENTS

2N4347 (120V)	150p
2N6258 (250w)	180p
400mW Zeners	5p
723	30p
2N3055	35p

Special Offer

TMS2516JL 8 - 2048 EPROM £14.90
 TMS4030JL 4096 RAM £3.00
 TMS3409SMC £2.50
 MK4006 P 6 1K RAM £0.78
 8255 P.I.A. £1.80
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Stepping Motors - Details on request

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CMOS

4000	10p	4051	41p	4543	99p
4001	9p	4052	45p	4555	49p
4002	10p	4053	45p	4556	49p
4006	35p	4054	106p	4566	99p
4007	12p	4055	123p	4584	56p
4008	29p	4056	93p	4585	92p
4009	49p	4066	39p		
4010	49p	4068	12p		
4011	9p	4069	12p		
4012	13p	4070	19p		
4013	33p	4071	19p		
4014	67p	4072	19p		
4015	35p	4073	19p		
4016	34p	4075	19p		
4017	59p	4076	72p		
4018	61p	4077	19p		
4019	21p	4078	12p		
4020	37p	4081	12p		
4021	37p	4082	19p		
4022	35p	4086	50p		
4023	10p	4089	172p		
4024	10p	4093	18p		
4026	125p	4094	136p		
4027	17p	4095	93p		
4028	66p	4096	93p		
4029	39p	4098	93p		
4030	12p	4502	55p		
4031	99p	4503	59p		
4032	95p	4507	37p		
4033	130p	4508	37p		
4034	199p	4510	69p		
4035	40p	4511	65p		
4036	239p	4512	63p		
4038	89p	4514	99p		
4040	36p	4515	172p		
4041	36p	4516	69p		
4042	58p	4518	69p		
4043	81p	4519	25p		
4044	35p	4520	96p		
4045	130p	4521	80p		
4046	85p	4526	77p		
4047	73p	4527	77p		
4048	35p	4532	45p		
4049	33p	4539	80p		

74 TTL

7400	10p	7482	55p
7401	9p	7483	62p
7402	9p	7485	69p
7403	10p	7486	26p
7404	13p	7488	140p
7405	13p	7490	17p
7406	24p	7491	47p
7407	24p	7492	23p
7408	12p	7495	49p
7409	22p	7496	57p
7413	14p	74107	31p
7414	15p	74121	30p
7415	16p	74122	27p
7417	16p	74126	55p
7420	34p	74128	58p
7421	34p	74132	59p
7422	17p	74141	73p
7423	23p	74145	35p
7425	23p	74150	45p
7426	23p	74151	32p
7427	15p	74153	49p
7428	15p	74154	40p
7430	12p	74155	32p
7432	15p	74157	49p
7433	19p	74159	65p
7437	17p	74160	69p
7438	15p	74161	32p
7440	10p	74162	69p
7442	25p	74163	69p
7445	81p	74164	35p
7446	86p	74165	40p
7447	33p	74173	91p
7448	22p	74174	67p
7450	22p	74175	17p
7451	17p	74185	80p
7453	22p	74191	40p
7454	22p	74192	40p
7460	22p	74195	52p
7470	26p	74199	72p
7472	26p	74221	49p
7473	26p	74284	140p
7474	6p	74298	90p
7475	19p	74366	28p
7476	29p	74368	28p

74LS

LS00	9p	LS85	35p
LS01	9p	LS90	20p
LS02	9p	LS93	21p
LS03	21p	LS95	35p
LS04	21p	LS107	40p
LS05	21p	LS109	27p
LS08	10p	LS112	27p
LS09	10p	LS113	27p
LS10	10p	LS114	27p
LS11	10p	LS123	32p
LS12	10p	LS138	22p
LS14	19p	LS151	35p
LS15	22p	LS153	35p
LS20	10p	LS156	33p
LS21	22p	LS157	25p
LS22	22p	LS160	32p
LS26	12p	LS163	34p
LS27	22p	LS175	36p
LS28	12p	LS191	33p
LS30	10p	LS192	33p
LS32	11p	LS194	31p
LS37	11p	LS195	31p
LS40	12p	LS197	44p
LS42	25p	LS242	54p
LS47	32p	LS257	28p
LS51	22p	LS295B	70p
LS55	22p	LS368	25p
LS73	27p	LS374	45p
LS74	14p	LS395	84p
LS76	27p		
LS78	27p		

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CMOS	4016 20	4034 140	4054 78	4081 12	40193 86	4528 45
	4017 30	4038 240	4059 430	4082 12	4502 60	4529 150
	4019 24	4039 240	4062 40	4086 60	4507 35	4534 400
4001 10	4020 42	4041 40	4063 80	4089 125	4508 110	4538 60
4002 12	4021 40	4042 38	4066 22	4093 18	4510 45	4543 50
4006 50	4022 45	4043 40	4067 225	4094 68	4511 40	4549 360
4007 14	4023 16	4046 40	4068 14	4095 65	4512 40	4553 215
4008 36	4024 13	4047 40	4069 13	4097 290	4514 115	4556 35
4009 24	4025 12	4048 38	4070 13	4098 70	4515 115	4556 35
4010 24	4026 75	4049 31	4071 13	4099 70	4516 55	4559 390
4011 10	4027 20	4049 20	4072 13	40106 40	4518 40	4560 140
4012 15	4028 40	4050 21	4073 13	40109 110	4520 60	4584 35
4013 20	4029 45	4051 42	4075 13	40163 60	4521 130	4585 60
4014 45	4030 14	4052 44	4076 43	40173 100	4526 60	4724 140
4015 40	4031 125	4053 48	4077 14	40175 75	4527 60	

LS TTL	LS20 12	LS75 20	LS123 34	LS160 35	LS197 45	LS353 60
	LS21 12	LS76 17	LS125 24	LS161 35	LS221 50	LS365 28
	LS22 12	LS78 17	LS126 25	LS162 35	LS240 60	LS368 28
LS00 11	LS26 14	LS83 35	LS132 35	LS163 35	LS241 55	LS367 28
LS01 11	LS27 12	LS85 48	LS136 26	LS164 40	LS242 55	LS368 28
LS02 11	LS30 12	LS86 16	LS138 30	LS165 35	LS243 55	LS373 58
LS03 12	LS32 13	LS90 24	LS139 30	LS166 35	LS244 55	LS374 58
LS04 12	LS37 14	LS92 25	LS145 70	LS170 75	LS245 70	LS375 43
LS05 12	LS38 15	LS93 24	LS146 150	LS173 85	LS247 48	LS377 60
LS08 12	LS40 13	LS95 38	LS148 75	LS174 45	LS248 57	LS378 60
LS09 12	LS42 78	LS96 95	LS151 38	LS175 45	LS252 32	LS390 45
LS10 12	LS47 35	LS107 40	LS153 38	LS180 35	LS258 32	LS393 40
LS11 12	LS48 45	LS109 21	LS154 75	LS191 36	LS259 55	LS399 156
LS12 12	LS51 14	LS121 21	LS155 33	LS192 35	LS266 20	LS417 80
LS13 19	LS55 14	LS123 21	LS156 36	LS193 36	LS273 58	LS467 135
LS14 15	LS58 18	LS124 32	LS157 18	LS195 32	LS279 58	
LS15 12	LS74 17	LS125 35	LS158 29	LS196 45	LS283 38	

TTL	7413 17	7444 85	7483 30	74122 38	74161 46	74190 40
	7414 23	7446 58	7485 60	74123 38	74162 46	74191 40
	7416 19	7447 38	7486 190	74125 33	74163 46	74192 40
7400 11	7417 19	7448 38	7488 190	74126 33	74164 45	74193 40
7401 11	7420 14	7450 14	7490 19	74132 30	74165 46	74194 40
7402 11	7421 19	7451 14	7491 34	74141 54	74167 60	74195 40
7403 12	7422 19	7453 14	7492 24	74145 48	7417 18	74196 40
7404 12	7427 18	7454 14	7493 24	74147 75	74173 58	74197 40
7405 14	7428 25	7450 14	7494 33	74148 60	74174 53	74198 80
7406 19	7430 13	7472 22	7495 45	74150 45	74175 45	74199 80
7407 19	7432 20	7473 24	7496 38	74153 38	74176 35	
7408 13	7433 20	7474 19	7497 86	74154 47	74177 42	
7409 13	7437 23	7475 26	74100 78	74155 36	74179 75	
7410 13	7438 24	7476 25	74107 22	74156 36	74180 38	
7411 15	7440 14	7480 45	74109 24	74157 28	74181 100	
7412 17	7442 30	7482 65	74121 24	74160 55	74182 55	

CAPACITORS	Polyester, radial leads, 250v. C280 Type: 0.01, 0.015, 0.022, 0.033 - 6p; 0.047, 0.068, 0.1 - 7p; 0.15V, 0.22 - 9p; 0.33, 0.47 - 13p; 0.68 - 20p; 1u - 23p. Electrolytic, radial or axial leads: 0.47/63V, 1/63V, 2.2/63V, 4.7/63V, 10/25V - 7p; 22/25V, 47/25V - 8p; 100/25V - 9p; 220/25V - 14p; 470/25V - 22p; 1000/25V - 30p; 2200/25V - 50p. Taps and power supply electrolytics: 2200/40V - 110p; 4700/40V - 160p 2200/63V - 140p; 4700/63V - 230p Polyester, miniature diameters PCB: 1n, 2n, 3n, 4n, 7n, 10n, 15n, 22n, 33n, 47n, 68n, 80n, 100n, 9p; 150n, 11p, 220n, 13p; 330n, 20p; 470n, 26p; 680n, 29p; 1u; 33p; 2u, 2, 50p. Tantalum bead: 0.1, 0.22, 0.33, 0.47, 1.0 @ 35V - 12p; 2.2, 4.7, 1.0 @ 25V - 20p; 15/16V - 30p; 22/16V - 27p; 33/ 16V - 45p; 47/16V - 27p; 47/16V - 70p; 68/16V - 40p; 100/16V - 20p. Cer. disc, 22p-0.01u 50V, 3p each, Mullard miniature ceramic plate: 1.8pF to 100pF 6p each.
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REGULATORS	78L05 30	79L05 65
	78L12 30	79L12 65
	78L15 30	79L15 65
	7805 35	7905 40
	7812 35	7912 40
	7815 35	7915 40
LM309K 130	LM723 35	
LM317K 270	LM338K 475	
LM317T 120	78H05 5A	
LM323K 350	±5V 550	

TOOLS	Small trimming tool 22
	Small pocket screwdriver 16
	Large pocket screwdriver 13
	6 piece precision screwdriver set in plastic case 170
	Low cost die cutters 160
	High quality die cutters 650
	Low cost pliers 160
	High quality pliers 650
	Wire strippers 120
	Exp. retent. drill 695
	Exp. Titan drill 1025
	Drill stand 1200
	Reduced Shank drill bits for above 0.8mm, 1mm, 1.4mm 60

SOLDERING IRONS	Antex CS 17W Soldering Iron 460
	CS 17W Iron: 450, element: 210
	Antex CS 25W 480
	3.3 and 4.7mm bits to suit 65
	Solder pump desoldering tool, 480
	Spare nozzle for above 70
	10 metres 22swg solder 100

RESISTORS	½W 5% Carbon film E12 series 4.7 ohm - 1M, 1p each.
	½W 5% Carbon film E12 series 4.7 ohm to 4M7, 2p each.
	½W 1% metal film E24 series 10 ohm - 1M, 6p each.

SOCKETS	Low profile	Wire-wrap
8 pin	6p	25p
14 pin	9p	35p
16 pin	9p	42p
18 pin	12p	52p
20 pin	13p	60p
22 pin	16p	70p
24 pin	18p	70p
25 pin	23p	80p
40 pin	25p	98p
Sulliner 3 pin	60P/100	

COMPONENT KITS	An ideal opportunity for the beginner or the experienced constructor to obtain a wide range of components at greatly reduced prices. ¼W 5% Resistor kit. Contains 10 of each value from 4.7 ohms to 1M (total of 650 resistors) 480
	Ceramic Cap. kit, 5 of each value - 22p to 0.01u (135 caps) 370
	Polyester Cap. kit, 5 of each value from 0.01 to 1uF (65 caps) 575
	Print. kit, Contains 5 of each value from 100 ohms to 1M (total of 65 resistors) 425
	Nut and Bolt kit (total 300 items): 180p
	25 68A ¼" bolts 50 68A nuts 50 68A washers
	25 68A ½" bolts 25 68A ¼" bolts 50 68A washers
	50 68A nuts 25 68A ½" bolts

SWITCHES	Submit toggle: SPST 55p, SPDT 60p, DPDT 65p. Miniature toggle: SPDT 80p, SPDT centre off 90p, DPDT 90p, DPDT centre off 100p. Standard toggle: SPST 35p, DPDT 40p. Miniature DPDT slide 12p. Push to make 12p. Push to break 22p. Rotary type adjustable stop. 1P1 2W, 2PW, 3P4W all 55p each. DIL switches: 4PSPT 80p 6 SPST 80p, BSPST 100p.
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TRANSFORMERS	Miniature mains: 606V, 909V, 12021V all @ 100mA 100p each. PCB mounting. Miniature: 3VA 0-6, 0-6 @ 0.25A; 0-9, 0-9 @ 0.15A; 0-12, 0-12 @ 0.12A 200p each. 6VA 0-6, 0-6 @ 0.5A; 0-9, 0-9 @ 0.3A; 0-12, 0-12 @ 0.2A 270p each. High quality. Split bobbin construction. 6VA 0-6, 0-6 @ 0.5A; 0-9, 0-9 @ 0.4A; 0-12, 0-12 @ 0.3A 220p each. 12VA 0-6, 0-6 @ 1A; 0-9, 0-9 @ 0.8A, 0-12, 0-12 @ 0.5A; 0-15, 0-15 @ 0.4A 250p (plus 40p carriage). 25VA 0-4, 0-4 @ 1.5A; 0-9, 0-9 @ 1.2A; 0-12, 0-12 @ 1A; 0-15, 0-15 @ 0.8A 330p each (plus 60p carriage). 50VA 0-12, 0-12 @ 2A, 0-15, 0-15 @ 1.5A, 440p each (plus 75p carriage)
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VERO	VEROBLOC 350
	Size 0.1 matrix:
	2.5 x 1 22
	2.5 x 3.75 75
	2.5 x 5 95
	VO board 160
	Veropins per 100:
	Single sided 50
	Double sided 60
	Spot face cutter 105
	Pin insertion tool 182
	Writing pen and spool 310
	Spare spool 75p Combs 6

DIODES	BY127 12	1N4001 3
	0A47 10	1N4002 5
	0A90 8	1N4006 7
	0A91 7	1N4007 7
	0A200 8	1N5401 12
	0A202 8	1N5404 16
	1N914 4	1N5406 17
	1N1418 2	400mW zen 6

SCRs	1C106D 30
	400V 8A 70
	400V 12A 96

BRIDGE RECTIFIERS	2A 200V 40
	2A 400V 45
	6A 100V 80
	6A 400V 95
	1A 50V 20
	1A 400V 35
	1A 50V 20
	1A 400V 35

CABLES	20 metre pack single core connect- ing cable ten different colours, 65p
MIN. D CONNECTORS	9 way 15 way 25 way 37 way
Plugs	Solder lugs 75p 110p 150p 240p
	Right angle pcb mount 150p 200p 240p 350p
Sockets	Solder lugs 105p 200p 240p 350p
	Right angle pcb mount 160p 210p 290p 440p
	Covers 100p 90p 110p

LINEAR	555C005 80	ICL7106 790	LM339 45	LM3911 120	NE566 140	TL064 96
	555C005 150	ICL7611 95	LM348 45	LM3914 175	NE567 100	TL071 30
	741 34	ICL7621 180	LM358 50	LM3915 195	NE570 370	TL072 50
	748 35	ICL8038 295	LM377 170	LM13600 105	NE571 370	TL074 95
	94000 380	ICL8211A 200	LM382 120	MC3400 350	PC4136 55	TL081 25
	AY-3-1270 720	ICM7224 200	LM387 120	MF10CN 380	PC4568 60	TL082 45
	AY-3-8910 370	ICM7555 80	LM392 100	PL400N 350	PC4568 60	TL084 95
	AY-3-8912 540	LF351 45	LM393 100	PL400N 350	PC4568 60	TL084 95
	CA304A 60	LF353 95	LM709 25	PL400N 350	PC4568 60	TL084 95
	CA3080 65	LF353 95	LM711 80	PL400N 350	PC4568 60	TL084 95
	CA3089 190	LM301A 25	LM725 350	PL400N 350	PC4568 60	TL084 95
	CA3090A 375	LM301A 25	LM733 75	PL400N 350	PC4568 60	TL084 95
	CA310E 95	LM311 70	LM741 14	PL400N 350	PC4568 60	TL084 95
	CA310E 95	LM311 70	LM747 60	PL400N 350	PC4568 60	TL084 95
	CA3161E 100	LM324A 50	LM1458 40	PL400N 350	PC4568 60	TL084 95
	CA3189 290	LM334Z 500	LM2917 200	PL400N 350	PC4568 60	TL084 95
	CA3240E 110	LM335Z 125	LM2917 200	PL400N 350	PC4568 60	TL084 95
			LM339 45	PL400N 350	PC4568 60	TL084 95
			LM348 45	PL400N 350	PC4568 60	TL084

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IS YOUR CAR AS GOOD AS IT COULD BE ?



- ★ Is it **EASY TO START** in the cold and the damp? Total Energy Discharge will give the most powerful spark and maintain full output even with a near flat battery.
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- ★ Do the **PLUGS** and **POINTS** always need changing to bring the engine back to its best. Total Energy Discharge eliminates contact arcing and erosion by removing the heavy electrical load. The timing stays "spot on" and the contact condition doesn't affect the performance either. Larger plug gaps can be used, even wet or badly fouled plugs can be fired with this system.

Most **NEW CARS** already have **ELECTRONIC IGNITION**. Update **YOUR CAR** with the most powerful system on the market - 3½ times more spark power than inductive systems - 3½ times the spark power of ordinary capacitive systems, 3 times the spark duration.

Total Energy Discharge also features:
EASY FITTING, STANDARD/ELECTRONIC CHANGE-OVER SWITCH, LED STATIC TIMING LIGHT, LOW RADIO INTERFERENCE, CORRECT SPARK POLARITY and **DESIGNED IN RELIABILITY.**

- ★ **IN KIT FORM** it provides a top performance system at less than half the price of competing ready built units. The kit includes: pre-drilled fibreglass PCB, pre-wound and varnished ferrite transformer, high quality 2µF discharge capacitor, case, easy to follow instructions, solder and everything needed to build and fit to your car. All you need is a soldering iron and a few basic tools.

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The basic function of a spark ignition system is often lost among claims for longer "burn times" and other marketing fantasies. It is only necessary to consider that, even in a small engine, the burning fuel releases over 5000 times the energy of the spark, to realise that the spark is only a trigger for the combustion. Once the fuel is ignited the spark is insignificant and has no effect on the rate of combustion. The essential function of the spark is to start that combustion as quickly as possible and that requires a high power spark.

The traditional capacitive discharge system has this high power spark but, due to its very short spark duration and consequential low spark energy, is incompatible with the weak air/fuel mixtures used in modern cars. Because of this most manufacturers have abandoned capacitive discharge in favour of the cheaper inductive system with its low power but very long duration spark which guarantees that sooner or later the fuel will ignite. However, a spark lasting 2000µs at 2000 rev/min. spans 24 degrees and 'later' could mean the actual fuel ignition point is retarded by this amount.

The solution is a very high power, medium duration, spark generated by the **TOTAL ENERGY DISCHARGE** system. This gives ignition of the weakest mixtures with the minimum of timing delay and variation for a smooth efficient engine.

- ★ **SUPER POWER DISCHARGE CIRCUIT** A brand new technique prevents energy being reflected back to the storage capacitor, giving 3½ times the spark energy and 3 times the spark duration of ordinary C.D. systems, generating a spark powerful enough to cause rapid ignition of even the weakest fuel mixtures without the ignition delay associated with lower power 'long burn' inductive systems.
- ★ **HIGH EFFICIENCY INVERTER** A high power, regulated inverter provides a 370 volt energy source - powerful enough to store twice the energy of other designs and regulated to provide sufficient output even with a battery down to 4 volts.
- ★ **PRECISION SPARK TIMING CIRCUIT** This circuit removes all unwanted signals caused by contact volt drop, contact shuffle, contact bounce, and external transients which, in many designs, can cause timing errors or damaging un-timed sparks. Only at the correct and precise contact opening is a spark produced. Contact wear is almost eliminated by reducing the contact breaker current to a low level - just sufficient to keep the contacts clean.

TYPICAL SPECIFICATION

	Total Energy Discharge	Ordinary Capacitive Discharge
SPARK POWER (Peak)	140W	90W
SPARK ENERGY	36mJ	10mJ
STORED ENERGY	135mJ	65mJ
SPARK DURATION	500µS	160µS
OUTPUT VOLTAGE (Load 50pF, equivalent to clean plugs)	38kV	26kV
OUTPUT VOLTAGE (Load 50pF + 500k, equivalent to dirty plugs)	26kV	17kV
VOLTAGE RISE TIME TO 20kV (Load 50pF)	25µS	30µS

TOTAL ENERGY DISCHARGE should not be confused with low power inductive systems or hybrid so called reactive systems.



ELECTRONIZE DESIGN

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Tamworth · B77 5BY
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HE Incremental Timer

Graeme Teesdale

This timer is based on the popular LM3914 LED display driver IC, rather than a 'timer' IC, and provides period timing in preset increments.



MANY electronic timers make use of a timing device, such as the 555 IC, or UJTs like the 2N2646, to generate pulses at pre-determined intervals which are used to operate a relay or alarm. Some employ digital counting techniques, using the mains frequency as a timing reference. This project employs an LM3914 LED display driver IC in an unusual way. The input is driven with a voltage that increases linearly with time. That is, the voltage increases by equal amounts in equal periods of time.

The outputs of the LM3914 go 'active' in turn, lighting a LED; further circuitry detects when a selected output goes active, setting off an audible alarm, tripping the relay circuit and resetting the timing.

At the one time, we obtain all the usual features included in many other timers, plus a ' bargraph ' indication of how the timing period is progressing. This is very useful in the timing of many processes - particularly photographic processing, such as print development and resist development in the manufacture of printed circuit boards. You can also coordinate a sequence of activities as the process continues, using the display to prompt you.

The total time, and thus the period between increments, may be varied by means of a potentiometer and the circuit has been arranged so that this provides about a 10:1 variation. The maximum period may be chosen by selecting the value of one capacitor. Accuracy is typically 1% over a wide temperature range.

Circuit Timing

Now, let's get down to circuit details. First, the constant current source that charges C1. Transistor Q1 plus LED1, R2, RV1, and R1 form the constant current source. Figure 1 shows the

collector characteristics of a typical silicon transistor. This shows that, if you hold the base current constant, the collector current will remain substantially constant for a widely varying range of collector voltages. Figure 2 shows the general circuit of a 'constant current generator' using an NPN transistor, as in our circuit. The voltage between the base and the emitter return (the +ve supply rail) is held fixed by a Zener diode. Thus, the voltage (V_e) across the emitter resistor, R_e , is fixed at a value equal to the Zener voltage (V_z) minus the base-emitter voltage drop of the transistor (about 0.6V for a silicon transistor). With a fixed voltage across R_e , the current through it will be constant. Thus the emitter current of the transistor, and therefore the collector current, will be constant. The resistor supplying current

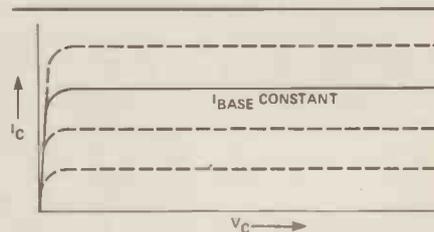


Figure 1. The collector current of a silicon transistor is constant for a fixed base current.

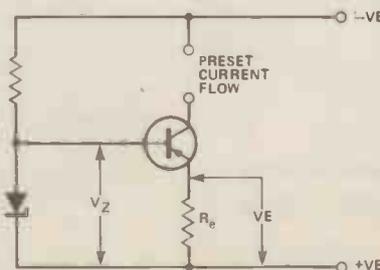


Figure 2. A generalised constant current generator circuit.

to the Zener is generally chosen so that the Zener current is five to ten times the base current of the transistor.

When you charge a capacitor with a fixed current, the voltage across the capacitor will rise linearly with time. As we want to drive IC1 with a voltage that increases linearly with time in order to obtain equal time increments, C2 is charged from the constant current generator formed by Q1, R2, RV1, R2 and LED1. Note that, in the circuit of Figure 3, LED1 (a green LED - as an 'on' indicator) replaces the Zener. The forward voltage drop of a LED behaves much like a Zener, the LED used having a voltage drop of around 2V5. To vary the rate of charge (and thus the time it takes to charge C1 to a particular voltage) the current supplied by the constant current generator can be varied by varying the emitter resistance of Q1; RV1 performs this function.

The maximum period can be determined approximately from the following formula:

$$\text{Total Time} = 5 \times C1$$

where C1 is in μF . Thus, a 33 μF capacitor (as specified) will charge to 5V in around 165 seconds with RV1 set at maximum resistance. The tolerance on tantalum capacitors is quite broad, so the formula is only approximate.

The voltage across C1 'ramps' upward as it charges. As the input to IC1 is quite a high impedance, it has little effect on the charging rate of C1.

Let us now consider the overall operation of the timer, commencing at switch-on.

At switch-on, the output (pin 10) of the RS flip-flop formed by gates c,d will be low as the inputs, pins 8 and 13, are low. No bias is applied to the base of Q3 and the relay will not be operated; its collector voltage will be the same as the positive supply rail and thus the base of Q2 will draw current via R20, and Q2

How It Works

The LM3914 LED display driver, IC1, is connected as a zero-to-5V (full scale) voltmeter to display in the bargraph mode. Thus, each LED will turn on at increments of 0V5 as the input of IC1 is driven by the voltage across capacitor C1. This is charged with a constant current so that the voltage across it will rise linearly with time. That is, the voltage across C1 rises, the LEDs will light up one by one until the voltage reaches 5V or until C1 is discharged.

A relay and alarm circuit is built around IC2 plus Q3 and associated

components. SW2 selects at which 'increment' the relay and alarm are operated by selecting one of the outputs of IC1. When the output goes 'active' (when the LED lights) the alarm sounds, the relay drops out and the timer is reset by discharging C1. For example, if the third increment is selected (pin 17, IC1) then LEDs 2, 3 and 4 only will light, the alarm sounding when LED 4 lights. C1 is then discharged at that time, resetting the timer ready for its next use.

removing gate bias from Q3, which turns off, de-activating the relay. When this happens, the collector voltage of Q3 goes high and C3 charges via R19. Now, gate IC2b is connected as an inverter, its input being connected to R19 and C3. When pins 5,6 of IC2b go high, pin 4 goes low and the piezoelectric beeper sounds. C3 takes a second or two to charge, the voltage across R19 decreasing as it does so; when it falls below the 'low' threshold of IC2b, pin 4 goes high once more and the beeper ceases to sound.

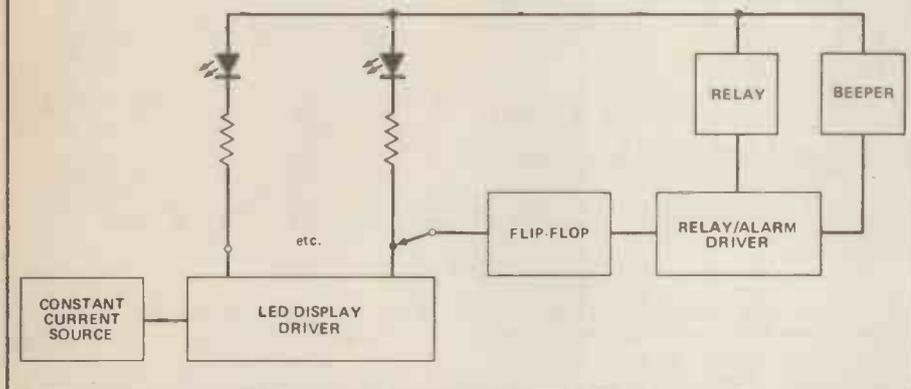
When the collector of C3 goes high (when LED 5 lights - remember?), Q2 receives base bias once more via R20. It turns on again, shunting the collector current of Q1 to 0V and discharging C1. Thus the timer is reset at the end of the selected period.

By varying RV1, the time it takes C1 to charge to a particular voltage is varied and thus the period of each increment and the total period can be varied. The time interval of the first increment is slightly shorter than the subsequent increments, as Q2 is not capable of discharging C1 completely due to its collector-emitter saturation voltage (about 200mV or so).

The power supply uses a conventional diode bridge rectifier, and C4 provides smoothing. A PCB mounting transformer is employed to drop the 240VAC mains to a suitable voltage. Only one secondary winding from this transformer is used, providing 9VRMS to the rectifier, which thus gives a DC supply of around 13-15 volts.

Resistors are used from each output of IC1 to each LED cathode to ensure that the outputs of IC1 drop below the 'low' threshold of the inputs to gate IC2a when IC1 outputs are 'active'.

The relay contacts are rated at 5A and will switch a load of up to 1200 watts, providing the load has a unity power factor (ie it's resistive).

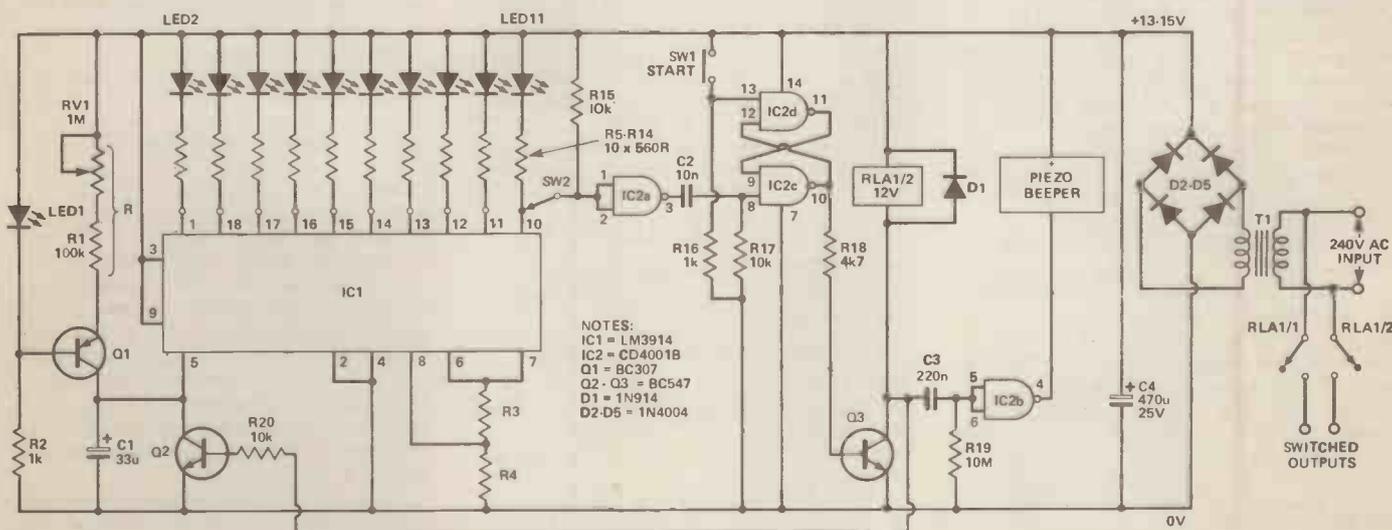


will be on. C1 will be unable to charge as the collector-emitter junction of Q2 will shunt the collector current of Q1 to the 0V rail. As there is no input to IC1, no LEDs will be lit.

When the Start button (SW1) is pressed the output of the RS flip-flop (pin 10) will go high, turning on Q3 and operating the relay. The collector voltage of Q3 will fall to nearly 0V and the base of Q2 will no longer be forward-biased, Q2 will so turn off. The collector current of Q1 will then commence to flow into C1 and the voltage across it will rise. As the voltage

at the input of IC1 rises, LEDs 2 to 11 will turn on at 0V5 increments.

If we now assume that SW2 was set to select the fourth increment (pin 16 of IC1, driving LED 5), then the input gate IC2a, connected as an inverter, would go low when LED 5 turns on. Initially, the input to IC2a is held high by R15, its output will be low and C2 will be discharged. When its input goes low (at the selected increment), its output goes high and C2 charges rapidly via R17. Thus a voltage pulse is applied to pin 8 of IC2c - one input of the RS flip-flop. This causes pin 10 to go low again,



C1 SELECTED TO OBTAIN DESIRED PERIOD - SEE TEXT

Figure 3. The complete circuit of the Incremental Timer. See the text for a full explanation.

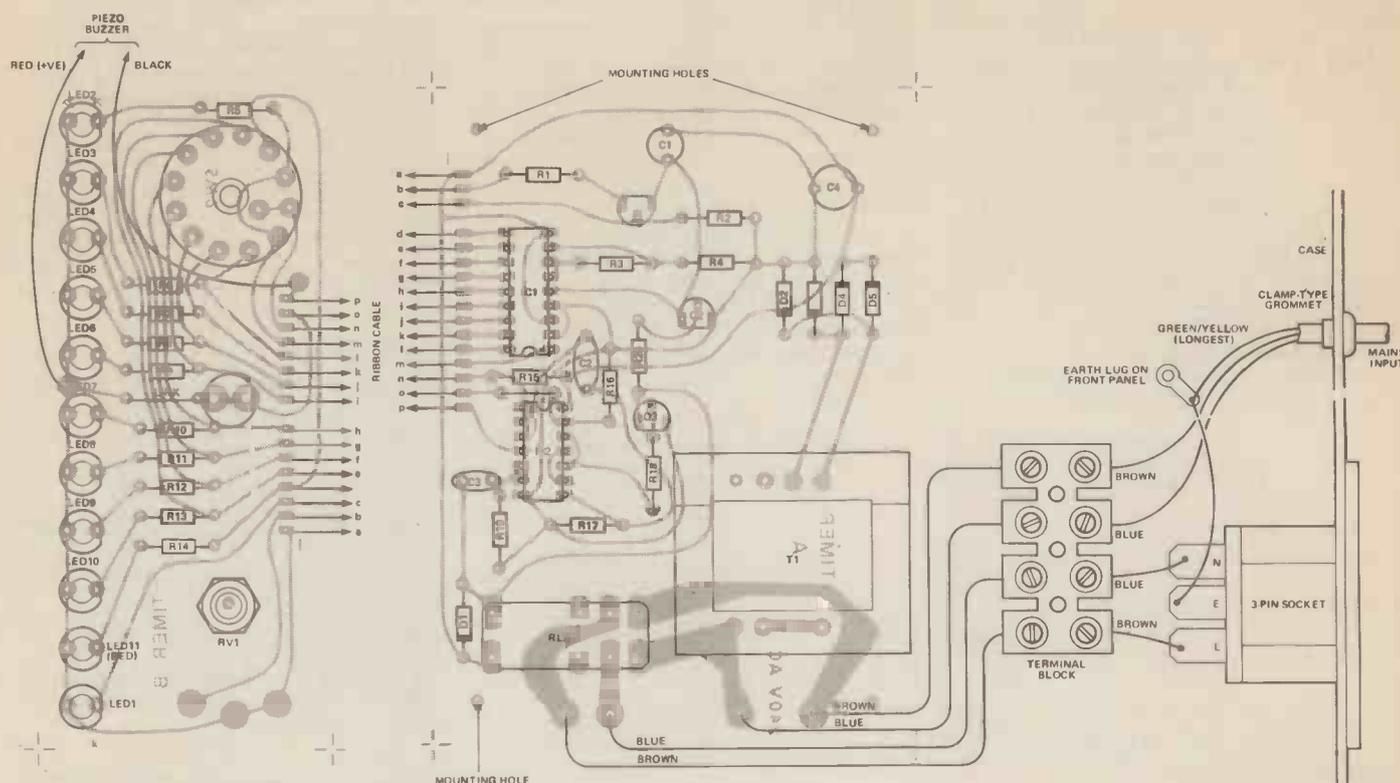


Figure 4. The component overlays for the Timing and Display PCBs; they are linked by a short length of ribbon cable, as indicated.

Construction

Two printed circuit boards are employed and the whole unit is housed in a standard box measuring 160 x 110 x 60mm. Although not absolutely essential, we recommended you use the PCBs designed for this project. The boards simplify construction and help ensure that there are few wiring errors. One board holds the power supply, relay and most of the electronics. This is the larger board, and is mounted in the bottom of the box. The other smaller board holds all the display LEDs, the potentiometer, the increment selector switch, the Start pushbutton and a few resistors. It is connected to the other board by two ribbon cables. This board is mounted on the front panel of the box via the securing nuts of the Start button and the increment selector switch. The piezoelectric buzzer is separately mounted on the front panel.

Commence construction by drilling the box and front panel. The larger PCB should be used as a template to mark the hole positions for the four mounting bolts it requires. Also, mark hole positions for the 240VAC mains input cable. We strongly recommend you use a clamp-type grommet to secure the cable where it enters the box. Also mark out the hole positions for the three-pin mains output socket. The terminal block may be bolted to the bottom of the case or super-glued.

The front panel artwork, reproduced on page 78, may be used as a template to mark out the hole centres for drilling

the front panel. Leave the panel at this stage, as it will be completed later.

The three-pin mains outlet socket may be mounted to the box at this stage. We recommend you use an IEC type classic socket. Attach mains wire to each pin connection, using the appropriate colour coding (brown—active, blue—neutral, green/yellow—earth). Each wire needs to be about 70-80mm long. Now secure the mains input cable; strip the end first and cut the blue and brown wires so that they are 120-150mm shorter than the green/yellow wire. This ensures that, should the cable ever be pulled out of the case, the earth wire will be the last to break.

The two may now be assembled. Start with the smaller board; install the link first — it's in the middle of the board. The resistors should come next; these are all the same value — 560 ohms. Mount the LEDs next, inserting them in the board one by one and making sure you have each the right way round, as indicated on the overlay — cathode lead faces into the board. Each LED should be positioned so that the distance between the board and the base of the LED is 12mm. When distanced correctly, solder the leads in place.

The increment selector switch, SW2, may be mounted next. The holes in the PCB for its pins should be the correct size — check this. The switch can only go in one way; carefully line up the pins and insert the switch in the board, pushing it all the way home.

Solder the pins. Now the Start pushbutton may be mounted. Make sure the holes for its pins have been drilled oversize, too. You will need to trim the lugs on the pushbutton so that they fit in the PCB holes. Mount the pushbutton, making sure that the distance between the board and its mounting shoulder (with washer) is the same as that for SW2. You could temporarily mount the board to the front panel, using SW2 to secure it, and then solder the pushbutton's pins when the board is parallel to the panel.

The potentiometer is mounted last. Position it so that its lugs are over the appropriate pads on the board and then secure it to the board with its nut. Use a spring washer or a star washer under the nut, then bend the lugs down to the PCB pads and solder them in place.

Attach two pieces of eight-way ribbon cable. These should each be about 130-150mm long.

The front panel assembly may now be completed. Label the panel, using rub-down lettering and spray it with a coat of protective lacquer. Insert the LED mounts in their holes next. Now you can mount the PCB, making sure that the LEDs all seat correctly in the mounts. Carefully tighten the nuts on the shafts of the Start pushbutton and SW2 so as not to damage the panel. A large solder lug was secured between the washer for the pushbutton, and the front panel, to provide a mains earth point. Now mount the piezoelectric buzzer and solder its leads in place, as shown on the overlay. Attach knobs to the shafts of SW2 and RV1 last of all.

The next stage of construction is the large PCB. All the resistors and capacitors should be mounted first, taking care that you get C1 and C4 the right way round. Next, mount the diodes and the three transistors, again taking care with orientation. Mount IC1 (the LM3914) next — get it the right way round too, followed by IC2. The latter is a CMOS IC and should only be handled by the ends of the package. When soldering it in place, solder pins 7 and 14 first, followed by the other pins. Use a hot iron with a clean tip; solder each pin quickly and pause every few joints to let the IC package cool down a little.

Parts List

RESISTORS

(All ½ watt 5% carbon)

R1	100k
R2,3,16	1k
R4	3k3
R5-14	560R
R15,17,20	10k
R18	4k7
R19	10M

POTENTIOMETERS

RV1	1M linear pot
-----	------------------

CAPACITORS

C1	33u 16V tantalum
C2	10n polyester
C3	220n polyester
C4	470u 25V electrolytic

SEMICONDUCTORS

IC1	LM3914 LED display driver
IC2	CD4001B quad NOR
Q1	BC307
Q2,3	BC107
D1	1N914
D2-5	1N4002
LED1	0.2" green high intensity
LED2-11	0.2" red

MISCELLANEOUS

T1	9-0-9V/6VA PCB mounting transformer
SW1	push-to-make switch
SW2	12-way single pole rotary switch
RL1	12VDC DPCO relay contacts rated 240VAC @ 5A
X1	piezo buzzer

Case, 190 x 110, 60mm (see Buylines); PCBs; four-way mains terminal block; mains cord, cable clamp and plug; IEC mains chassis socket; LED panel mounts; nylon nuts and bolts, spacers; ribbon cable, wire etc.

BUYLINES page 34

Mount the relay next. We used a type which can be readily soldered in place — although the board has been laid out to take several other common types. Make sure the board has been drilled out to accept the relay before commencing construction.

The transformer can now be mounted to the board and its pins soldered in place. Last of all, the ribbon cable from the smaller board can be attached, and then two pairs of mains wires, each about 40-50mm long. These are the mains input and switched mains output leads. Use colour-coded wires, cut from mains cord, to avoid wiring errors.

The main PCB may now be mounted in the case, using nylon nuts and bolts. Raise the board off the bottom of the box a few millimetres, using fibre spacers, and use nylon nuts and bolts for the terminal block if it is bolted to the box too. Now complete the mains wiring as indicated in the overlay/wiring diagram. The earth lead from the mains input cord goes to the solder lug attached to the front panel (under the pushbutton). A lead from this lug goes to the earth pin on the three-pin mains output socket.

After a careful final check, you're ready to test the unit.

Testing

Set the 'Timer Delay Adjust' control to minimum and the 'Increments' switch to ten. Plug the timer into the mains and turn it on. Wait five seconds or so for the power supply to reach full voltage and press the Start pushbutton when the sweep second hand of your watch, or the seconds display on your digital watch, is at a convenient point. The LEDs 1 to 10 will light up, the piezoelectric buzzer sounding when LED 10 signals the end of the timing

period. If you have used a 33u capacitor for C1, as per the parts list, then this should take close to 15 seconds. The relay should pull in when you press the Start button, dropping out when LED 10 lights. You can calibrate the Timer Delay Adjust potentiometer to suit the applications for which you use the project, so that you obtain the required period.

A little experimentation and practice will show you how to use the unit to best advantage.

Changing The Period

The total timer period may be altered by changing the value of C1. The approximate maximum period may be found from this formula:

$$\text{Period (approx.)} = 5 \times C1$$

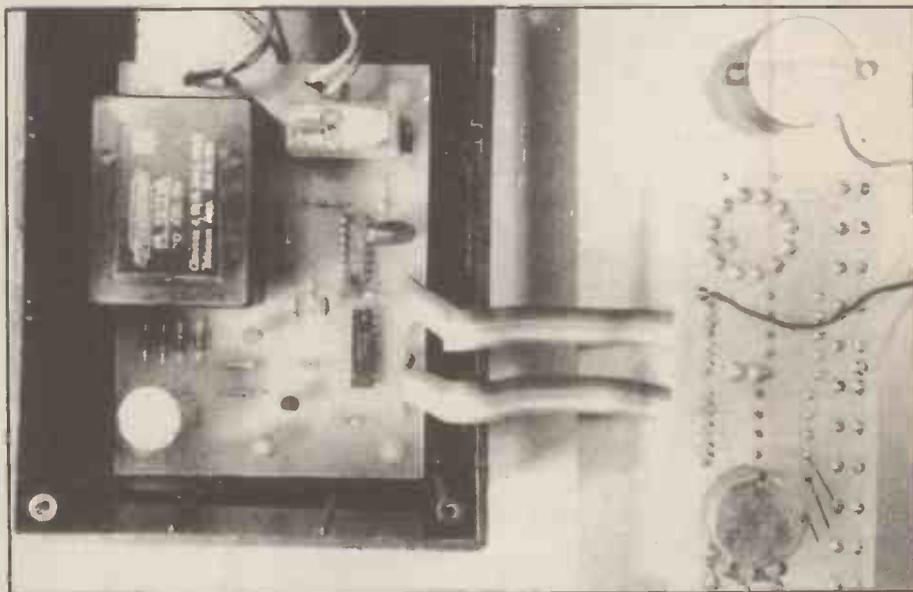
where the value of C1 is in uF. It's only approximate as the tolerance on tantalum capacitors is quite broad. Thus with a 33u capacitor for C1, as specified, the maximum period is around 165 seconds or so. Given a desired period, calculate the capacitor value from:

$$C1 = \text{period}/5$$

and the value will be in uF. Choose the next highest preferred value, for safety's sake. You can then set the maximum period, and thus the period of the increments, using RV1, calibrating the unit with your watch. It's advisable not to use a capacitor any greater than about 120u — but this will give you a maximum period of 10 minutes!

Note that an electrolytic may be used for C1, but accuracy may suffer a little compared to tantalum types. The voltage never gets above 5V, so a capacitor rated at 6V, 10V or 16V is perfectly adequate.

HE



The inside story! Note that the transformer shown here is not readily available in the UK. The PCB has been modified to accept a type recommended in Buylines (page 34), but this does not effect the construction in any way. The front panel artwork for the Incremental Timer is reproduced at full size on page 78, and may be used as a template for drilling the case.

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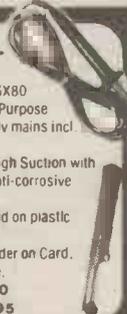
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AUDIO AMPLIFIER

Audio Amplifier, 50W R.M.S., with integral heat sink and short circuit protection. Introduced to fulfil the demand for a fully protected power amp, capable of driving high quality speaker systems at up to 50w with distortion levels below 05%. Ideal for domestic use. Discos, P.A. systems, electronic organs, etc. The generously rated components ensure continuous operation at high output levels. AL120 50 watt Audio Amp Module 50-70v supply

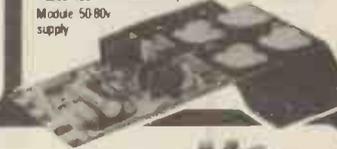
£13.14.



AUDIO AMPLIFIER

125 watts (RMS). AL250. A power amplifier providing an output of up to 125w RMS, into a 4 ohm load. Four 115w transistors in the output stage makes it extremely rugged while damage from incorrect or short circuit loads is prevented by a four transistor protection circuit. For use in many applications such as disco units, sound reinforcement systems, background music players etc.

£19.60.



POWER SUPPLIES

PS12 24v Supply Suit: 2 x AL10 2 x AL20 2 x AL30 & PA12/S453 £1.86. SPM40 33v Stabilised supply Suit: 2 x AL60 PA100 to 15 watts £4.94. SPM120/45 45v Stabilised supply Suit: 2 x AL60 PA100 to 25 watts £8.38. SPM120/55 55v Stabilised supply Suit: 2 x AL80 PA200 £9.38. SPM120/65 65v Stabilised supply Suit: 2 x AL120 PA260 1 x AL250 £13.38. SG30 150-15 Stabilised power supply for 2 x AL60 MKII £3.00.

SPM120 is a fixed voltage stabiliser with an output voltage of either 45v, 55v, or 65v. Designed for use in audio applications, the stabiliser which provides output currents up to 2.5A operates direct from a mains transformer requiring only the addition of two electrolytic capacitors to complete the power supply.



STEREO PRE-AMPLIFIERS

PA12 Supply voltage 22-32v input sensitivity 300mv Suit: AL10/AL20/AL30 £3.95. PA100 Supply voltage 30-55v inputs: Tape Tuner Mag P.U. Suit: AL60/AL80 £17.85. PA200 Supply voltage 35-70v inputs: Tape Tuner Mag P.U. Suit: AL80/AL120/AL250 £18.24.



The PA200 is basically our popular PA100, modifications being made to make it compatible with the higher output amplifiers i.e. AL120 & AL250. The unit boasts six push button selectors giving a choice of 3 inputs, 2 filters, for both high and low frequencies and a stereo or mono button, all combining to give a top quality stereo pre-amplifier and tone control.

COMPLETE AUDIO CHASSIS

STEREO 30 Complete 7 watt per channel Stereo amp board - includes amps, pre-amp, power supply, front panel, knobs etc - requires 2039 Transformer £18.00.

MAGNETIC CARTRIDGE PRE-AMPLIFIER

Enjoy the quality of a magnetic cartridge with your ceramic equipment using the MPA30 which is a quality pre-amp, enabling magnetic cartridges to be used where facilities exist for ceramic cartridges only. With a DIN input socket & full, easy to follow instructions MPA30 Stereo Mag Cartridge, Pre-amp, - input 3.5mv Output 100mv £3.27.



MONO PRE-AMPLIFIERS

MM100 suitable for disco mixer, MM100G suitable for guitar pre-amp mixer. The MM100 and MM100G mono pre-amplifiers are compatible with the AL60, AL80, AL120 and AL250 power amplifiers and their associated power supplies. MM100 Supply voltage 40-65v inputs: Tape Mag P.U. Microphone Max output 500mv £12.43. MM100G Supply voltage 40-65v inputs: 2 Guitars, Microphones Max output 500mv

£12.43.



GE100 MKII

10 Channel, Monographic Equaliser. Only 155mm x 65mm x 50mm including the 10 x 10K 45mm slider potentiometers and knobs which are mounted on a board above the circuitry. In the range of 31Hz to 10KHz you can cut and boost $\pm 12dB$ with the 10 sliders, each with frequency marked on the circuit board. The GE100 uses include mixers, P.A. systems and discos. It will also improve the sound reproduction of your existing audio equipment. Power supply for GE100 old SG30 Together with Transformer no: 2043. GE100 MKII 10 Channel mono-graphic Equaliser with sliders & Knobs £20.00.



PUSH BUTTON STEREO FM TUNER

Fitted with Phase locked loop decoder. S453 Provides instant programme selection at the touch of a button ensuring accurate tuning of 4 pre-selected stations, any of which may be altered as often as you choose, simply by changing the settings of the preset controls. Features include FET input stage, Varicap diode tuning. £19.00.



Transformers are not included with power supplies. SPM120 Range also require reservoir and output capacitors

TRANSFORMERS

2034 1.7 amp 35v suit SPM40 £4.90. 2035 2 amp 55v £8.05. 2036 750mA 17v Suit PS12 £2.05. 2040 1.5 amp 0-45v 55v Suit SPM120/45 SPM120/55v £8.45. 2041 2 amp 0-55v 65v Suit SPM120/55 SPM120/65v £8.48. 2039 1 amp 0-20v Suit Stereo 30 £3.50. 2043 150mA 15-0-15v Suit SG30 £1.80.

ACCESSORIES

FP100 Front Panel for PA100 & PA200, £1.80. BP100 Back Panel for PA100 & PA200, £1.50. GE100 FP Front Panel for 1 GE100 Mk II, £1.86. TC800 Kit of Parts including: Front and back panels, chassis, sockets, and knobs etc to house STA15 Amplifier, £3.50. PS250 consists: 1 capacitor and 4 diodes for constructing unbalanced power supply for AL250 to 125 watts £2.80.



DIGITAL VOLT METER MODULE

3x7 segment displays. Basic Circuit 0-2V. Instructions provided to extend voltage and currency ranges. Operating voltage 9-12V. Typ Power Consumption 50mA. ONCE ONLY PRICE £9.95 Order No. SX99

BI-KITS

STA5 5 watts per channel Stereo Amplifier Kit consisting of 2 x AL20 amplifiers 1 x PA12 pre-amplifier 1 x PS12 power supply 1 x 2036 transformer and necessary wiring diagram £18.82. STA10 10 watts per channel Stereo Amplifier Kit consisting of 2 x AL30 amplifiers 1 x PA12 pre-amplifier 1 x PS12 power supply 1 x 2036 transformer and necessary wiring diagrams £20.63.

STA15 15 watts per channel Stereo Amplifier Kit consisting of 2 x AL60 amplifiers 1 x PA100 pre-amplifier 1 x SPM80 power supply 1 x 2034 transformer 2 x coupling capacitors for 8 ohms 470 mfd 50v and necessary wiring diagrams £38.78. STA25 25 watts per channel Stereo Amplifier Kit consisting of 2 x AL80 amplifiers 1 x PA100 pre-amplifier 1 x SPM120/45 power supply 1 x 2040 transformer 2 x coupling capacitors for 8 ohms 470 mfd 45v 1 x reservoir capacitor 2200 mfd 100v and necessary wiring diagram £46.76. STA35 35 watts per channel Stereo Amplifier Kit consisting of 2 x AL80 amplifiers 1 x SPM120/55 power supply 1 x PA200 pre-amplifier 1 x 2035 transformer 2 x coupling capacitors 470 mfd at 50v for 8 ohms 1 x reservoir capacitor 2200 mfd 100v and necessary wiring diagram £46.76.

REGULATED VARIABLE STABILISED POWER SUPPLY

Variable from 2-30 volts and 0.2 Amps Kit includes: 1 - VPS30 Module, 1 - 25 volt 2 amp transformer, 1 - 0-50v 2" Panel Meter, 1 - 0-2 amp 2" Panel Meter, 1 - 470 ohm wirewound potentiometer, 1 - 4K7 ohm wirewound potentiometer. Wiring Diagram included. VPS30 KIT £20. MINIATURE FM TRANSMITTER MODULE. Freq: 95-106 MHz Range: 1/4 mile. Size: 45mm x 20mm. Add 9v. batt. Not licensed in UK. Ideal for: 007-M19-FBI-CIA-KGB-etc. Price: £5.50.

BI-PAK

BI-PAK AUDIO EQUIPMENT LTD
100, WARE ROAD, WARE, HERTS, SG12 0NF
TELEPHONE: 0438 511111 (10 Lines) (09.00-17.00)
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Use your credit card. Ring us on Ware 3182 NOW and get your order even faster. Goods normally sent 2nd Class Mail. Remember you must add VAT at 15% to your order. Total. Postage add 50p per Total order.

COMING SOON TO . . .

Hobby Electronics

FINISHING TOUCHES

Continuing our irregular Introduction to Electronics Series with a description of how to put a professional finish on a project.

OVERVOLTAGE PROTECTOR

An "electronic crowbar" circuit that can be connected into the DC supply lines to any other circuit. If the power supply should go faulty, putting excess voltage on the lines, the protection circuit instantly puts the equivalent of a "crowbar" across the supply to reduce the voltage to a safe level. It won't help the power supply — but will prevent damage to more expensive equipment!

SIGNAL POWERED LOUDSPEAKER PROTECTOR

Small enough to be mounted inside any loudspeaker cabinet, this circuit is powered directly from the loudspeaker lines so that a separate mains DC or battery supply is not needed. The circuit is triggered either by the presence of DC on the speaker lines, or by audio power in excess of the preset limit. It resets automatically after about one minute.

COMPONENTS FOR COMPUTING

The third in our "nuts and bolts" of computers series, wherein Paul Kelly explains the internal working of Read Only Memories.

EPROM PROGRAMMER

Put theory into practice with this simple EPROMmer for 6502-based home computers.

Please reserve copies of the February issue of

**Hobby
Electronics**

for
Name

Address

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**Hobby
Electronics**

**March issue on sale at
your newsagent
from 11th February
Place your order now!**

Although these articles are being prepared for the next issue, circumstances may alter the final content.

MINI-MULTI TESTER Deluxe pocket size precision moving coil instrument, Jewelled bearings - 2000 o.p.v. mirrored scale. 11 instant range measures:

- DC volts 10, 50, 250, 1000.
- AC volts 10, 50, 250, 1000.
- DC amps 0 - 100 mA.



Continuity and resistance 0 - 1 meg ohms in two ranges. Complete with test leads and instruction book showing how to measure capacity and inductance as well. Unbelievable value at only £8.75 + 60p post and insurance.

FREE Amps range 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.

SUPER HI-FI SPEAKER CABINETS

Made for an expensive Hi-Fi outfit - will suit any decor. Resonance free. Cut-outs for 5 1/2" woofer and 2 1/2" tweeter. The front material is Dacron. The completed unit is most pleasing. Supplied in pairs, price £6.90 per pair (this is probably less than the original cost of one cabinet) carriage £3.00 the pair.



GOODMANS SPEAKERS

6 1/2" 8 ohm 25 watt £4.50. 2 1/2" 8 ohm tweeter. £2.50. No extra for postage if ordered with cabinets. Xover £1.50.

DITTO but for 8" speaker and 4" tweeter. £7.50 + £3.50.



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 without case but we can supply a plastic base £1.75 or metal case £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/off per 24 hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is £2.30.

THERMOSTAT ASSORTMENT

10 different thermostats. 7 bi-metal types and 3 liquid types. There are the current stats which will open the switch to protect devices against overload, short circuits, etc., or when fitted say in front of the element of a blow heater, the heat would trip the stat if the blower fuses; appliance stats, one for high temperatures, others adjustable over a range of temperatures which could include 0 - 100°C. There is also a thermostatic pad which can be immersed, an oven stat, a calibrated boiler stat, finally an ice stat which, fitted to our waterproof heater element, up in the loft could protect your pipes from freezing. Separately, these thermostats could cost around £15.00 - however, you can have the parcel for £2.50.

50 THINGS YOU CAN MAKE

or do and still have hundreds of parts for future jobs. **LEARN** the practical way with our 10 kilo parcel of useful parts. Minimum 1,000 items includes panel meters, timers, thermal trips, relays, switches, motors, drills, taps and dies, tools, thermostats, coils, condensers, resistors, etc. etc. Parcel with data on 50 projects.

YOURS FOR ONLY £11.50 plus £3.00 post.

EXTRACTOR FAN

Mains operated - ex-connector
 6" Woods extractor £8.75, Post £1.25. 4" x 4" Muffin 115v. £4.50, Post 75p.
 5" Planal extractor £6.50, Post £1.25. 4" x 4" Muffin 230v. £5.75, Post 75p.



SEAT BELT REMINDER

Buzzer sounds when you switch on Ignition - stops when you handle seat belt - Complete kit £3.00.

200 OHM EARPIECE

If you are a user of earphones then you really must try these, they do give far superior results to the usual 4 ohm model, this is due to very superior construction. Price 65p each.

RECHARGABLE NICAD BATTERY

By Deac, their reference number 150 DK. Made up as a battery of 4 cells with a nominal total voltage of 4.88. Two types: type one has pp3 battery clip at each end, price £1.75. Type two without the snap connectors price £1.50. All new and unused.

PROJECT CASE

All metal construction. Tubular body. Size approx 7 x 3 x 5" long with removable ends, blue hammer paint finish. £1.75 each + 60p for postage.



MINI MONO AMP on p.a.b., size 4" x 2" approx. Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amplifier. Brand new, perfect condition, offered at the very low price of £1.15 each, or 10 for £10.00.



THIS MONTH'S NEW KITS:

MULTI-CHANNEL OR ROBOT CONTROLLER

This is two kits. The 8 channel transmitter kit and the 8 channel receiver kit. Each kit comes with diagrams and notes, but no circuit boards, the component layout being left to you. The data shows how to drive, reverse and steer two or more motors. With spare channels to perform other functions. Price £9.50 for both kits.

'BIG EAR'

As in December Hobby Electronics. Designed originally for listening to wildlife this could also be used to listen through walls or from long distances. Complete kit including the case at £9.50.

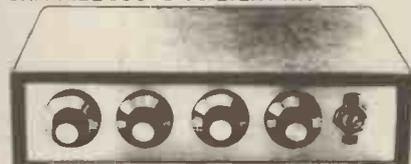
I.T.V. 4 PRE-AMP

Experiencing difficulties in getting a good picture on the new I.T.V. Channel 4? An aerial pre-amp may be the answer. Uses 2 special transistors and has its own internal power supply. All you have to do is fit this into the TV down lead and plug into the mains. Complete kit including the case at £9.50.

THE HE MICROLOG

This is a bigish project but you build a complete computer! Full constructional details appear in December Hobby Electronics. We will supply the complete kit less the rather expensive case for £18.50. We feel sure you can make a case yourself just as efficiently and save most of the cost.

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 1/4" sockets and three panel mounting fuse holders provide thyristor protection. A four-pin plug and socket facilitate ease of connecting lamps. Special price is £14.95 in kit form or £25.00 assembled and tested.

TANGENTIAL BLOW HEATER

2.5 Kw quiet, efficient instant heating frond heater. Kit consists of blower as illustrated, 2.5 Kw element, control switch and data all for £4.95, post £1.50.



CAR STARTER AND CHARGER KIT

In an emergency you can start car off mains or bring your battery up to full charge in a couple of hours. The kit comprises: 250 watt mains transformer, 40 amp bridge rectifier, start/charge switch and full instructions. You can assemble this in the evening, box it up or leave it on the shelf in the garage, whichever suits you best. Price £12.50 + £3.00 post.

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. (not licencable in the U.K.)

RADIO MIKE

Ideal for discos and garden parties, allows complete freedom of movement. Play through FM radio or tuner amp. £6.90 comp. kit. (not licencable in the U.K.)

FM RECEIVER

Made up and working, complete with scale and pointer needs only headphones, ideal for use with our surveillance transmitter or radio mike. £5.85. or kit of parts £3.95.

3 - 30v VARIABLE VOLTAGE POWER SUPPLY UNIT

With 1 amp DC output, for use on the bench, students, inventors, service engineers, etc. Automatic short circuit and overload protection. In case with a volt meter on the front panel. Complete kit £13.80

INTERRUPTED BEAM

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 £2.30

IONISER KIT

Refresh your home, office, shop, work room, etc. with a negative ION generator. Makes you feel better and work harder - complete mains operated kit, case included £11.95 plus £2.00 post.

RADIO STETHOSCOPE

Easy to fault find - start at the aerial and work towards the speaker - when signal stops you have found the fault. Complete kit £4.95.

INVISIBLE AND SILENT SENTINEL

Ultra sonic beam when broken could warn you of visitor - two complete kits - transmitter & receiver & relay, to operate light or bell £9.50.

BURGLAR ALARM

Complete kit includes 6" external alarm bell, mains power unit, control box with keyswitch, 10 window/door switches, 100 yards of wire. With instructions £29.50.

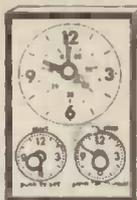
J. BULL (Electrical) Ltd.

(Dept. HE), 34 - 36 AMERICA LANE, HAYWARDS HEATH, SUSSEX RH16 3OU. Established 30 YEARS

MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £10 add 60p service charge. Monthly account orders accepted from schools and public companies. Access & B/card orders accepted day or night. Haywards Heath (0444) 454563. Bulk orders: write for quote. Delivery by return. Shop open 9.00 - 5.30, mon to Fri, not Saturday.

STEREO HEADPHONES

Very good quality, 8 ohm, padded, terminating with standard 1/4" jack plug. £2.99 plus 60p post.



TIME SWITCH BARGAIN

Large clear mains frequency controlled clock, which will always show you the correct time + start and stop switches with dials. Complete with knobs **FOR ONLY £2.50.**

MUSICAL BOX MOVEMENT

Swiss made normal square shank key wound, (key not supplied). Large quantity for disposal. 45p each or 4 for £1.25.

TINIEST MICROPHONE

Latest condenser type. Not much bigger than a pea, 600 Ohm, ideal for bugging and similar applications. 50p each, 10 for £4.50.

ZX81 OWNERS

Make yourself a full size keyboard! Key switches complete with plain caps. 6 for £1.15. Easily divisible.



WATERPROOF HEATING WIRE

600 ohms per yard, this is a heating element wound on a fibre glass coil and then covered with p.v.c. Dozens of uses - around water pipes, under grow boxes in gloves and socks. 23p a metre.

COMPUTER PRINTER, ONLY £4.95 YOUR LAST CHANCE

Japanese made Epson 310 - has a self starting brushless drive motor. Complete with electronics - uses plain paper, Brand new with data. **ONLY £4.95 plus £1.25 Post.**

ROTARY WAFER SWITCHES

5 amp silver plated contacts. 1/4" shaft. 1" dia. wafer. Single wafer types, 29p each, as follows:

1 pole 12 way	2 pole 6 way	3 pole 4 way
4 pole 3 way	6 pole 2 way	4 pole 3 way

Two wafer type, 59p each, as follows:

2 pole 12 way	4 pole 5 way	4 pole 6 way
6 pole 2 way	8 pole 3 way	12 pole 2 way

3 wafer types 99p each.

9 pole 4 way	6 pole 5 way	6 pole 6 way
	12p 3 way	18p 2 way

POCKET AUDIO COMPONENT TESTER

With it you can quickly test diodes, rectifiers, transistors, capacitors, check wiring and p.c. boards for open circuits, find the anode and cathode of a diode or rectifier and whether a transistor is PNP or NPN, which are the base collector and emitter connections. Condensers, if bad give a continuous signal but if good, give intermittent signals of varying length depending on their value. The test current is very low (2uA) and the voltage only 1.4v, so it is also possible to check MOS devices, as well as sensitive transistors with out fear of damaging them. The unit is supplied complete with internal battery, which should last many months. Price £3.45p.



8 POWERFUL BATTERY MOTORS (all different)

For models, maccanos, drills, remote control planes, boats etc. £2.95.

12v MOTOR BY SMITHS

Made for use in cars, these are series wound and they become more powerful as load increases. Size 3 1/2" long by 3" dia. These have a good length of 1/4" spindle - price £3.45. Ditto, but double ended £4.25. Ditto, but permanent magnet, £3.75.



EXTRA POWERFUL 12v MOTOR

Made to work battery lawn mower, this probably develops up to 1/4 h.p., so it could be used to power a go-kart or to drive a compressor, etc. etc. £6.90 + £1.50 post. (This is easily reversible with our reversing switch - Price £1.15).

GO KART MOTOR

24 Volt operated easily very speed and reverse - terrific power. Price £9.50 + £1.50 post.

SPIT MOTORS

These are powerful mains operated induction motors with gear box attached. The final shaft is a 1/2" rod with square hole, so you have alternative coupling methods - final speed is approx. 5 revs/min, price £5.50. - Similar motors with final speeds of 80, 100, 160 & 200r.p.m. same price.



REVERSIBLE MOTOR WITH CONTROL GEAR

Tremendously powerful motor, almost impossible to stop. Ideal for operating stage curtains, sliding doors, ventilators, etc., even garage doors if adequately counter-balanced. We offer the motor complete with control gear as follows:

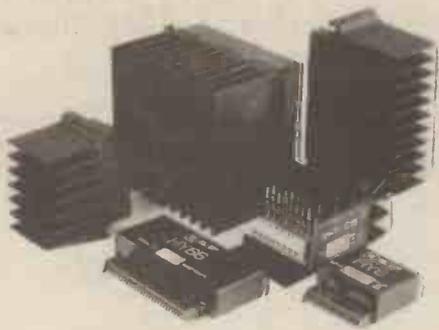
- 1 Framco motor with gear box
- 1 manual reversing and on/off switch
- 1 push to start switch
- £19.50 plus postage £2.50.
- 1 x 100w auto transformer
- 2 limit stop switches
- 1 circuit diag. of connections.

DISC OR TAPE DRIVE MOTOR

Precision made with balanced rotor. This is reversible, has a speed of 1,500 rpm and is approximately 2 1/2" long by 3" diameter. Made by famous Japanese Company (NIPPON DENSAI). The original rrp was over £20 each, our price, however, is £4.60 + £1 postage. Quantity orders invited.

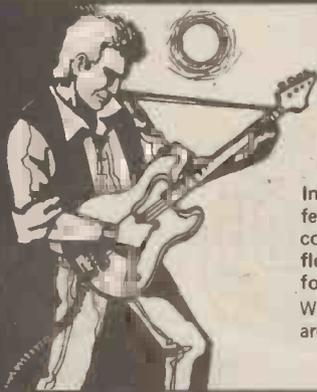
FREE OUR CURRENT BARGAIN LIST WILL BE ENCLOSED WITH ALL ORDERS.

GET BIG POWER



Modular Amplifiers the third generation

Due to continuous improvements in components and design ILP now launch the largest and most advanced generation of modules ever.



WE'RE INSTRUMENTAL IN MAKING A LOT OF POWER

In keeping with ILP's tradition of entirely self-contained modules featuring, integral heatsinks, no external components and only 5 connections required, the range has been optimized for efficiency, flexibility, reliability, easy usage, outstanding performance, value for money.

With over 10 years experience in audio amplifier technology ILP are recognised as world leaders.



BIPOLAR MODULES

Module Number	Output Power Watts rms	Load Impedance Ω	T.H.D. Typ at 1KHz	I.M.D. 60Hz/7KHz 4:1	Supply Voltage Typ	Size mm	WT gms	Price inc. VAT
HY30	15	4-8	0.015%	<0.006%	± 18	76 x 68 x 40	240	£9.40
HY60	30	4-8	0.015%	<0.006%	± 25	76 x 68 x 40	240	£9.55
HY6060	30 + 30	4-8	0.015%	<0.006%	± 25	120 x 78 x 40	420	£18.69
HY124	60	4	0.01%	<0.006%	± 26	120 x 78 x 40	410	£20.75
HY128	60	8	0.01%	<0.006%	± 35	120 x 78 x 40	410	£20.75
HY244	120	4	0.01%	<0.006%	± 35	120 x 78 x 50	520	£25.47
HY248	120	8	0.01%	<0.006%	± 50	120 x 78 x 50	520	£25.47
HY364	180	4	0.01%	<0.006%	± 45	120 x 78 x 100	1030	£38.41
HY368	180	8	0.01%	<0.006%	± 60	120 x 78 x 100	1030	£38.41

Protection: Full load line. Slew Rate: 15v/ μ s. Rise/fall: 5 μ s. S/N ratio: 100db. Frequency response (-3dB) 15Hz - 50KHz. Input sensitivity: 500mV rms. Input Impedance: 100K Ω . Damping factor: 100Hz > 400.

PRE-AMP SYSTEMS

Module Number	Module	Functions	Current Required	Price inc. VAT
HY6	Mono pre amp	Mic/Mag. Cartridge/Tuner/Tape/Aux + Vol/Bass/Treble	10mA	£7.60
HY66	Stereo pre amp	Mic/Mag. Cartridge/Tuner/Tape/Aux + Vol/Bass/Treble/Balance	20mA	£14.32
HY73	Guitar pre amp	Two Guitar (Bass Lead) and Mic + separate Volume Bass Treble + Mix	20mA	£15.36
HY78	Stereo pre amp	As HY66 less tone controls	20mA	£14.20

Most pre-amp modules can be driven by the PSU driving the main power amp. A separate PSU 30 is available purely for pre-amp modules if required for £5.47 (inc. VAT). Pre-amp and mixing modules in 18 different variations. Please send for details.

Mounting Boards

For ease of construction we recommend the B6 for modules HY6-HY13 £1.05 (inc. VAT) and the B66 for modules HY66-HY78 £1.29 (inc. VAT).

POWER SUPPLY UNITS (Incorporating our own toroidal transformers)

Model Number	For Use With	Price inc. VAT
PSU 21X	1 or 2 HY30	£11.93
PSU 41X	1 or 2 HY60, 1 x HY6060, 1 x HY124	£13.83
PSU 42X	1 x HY128	£15.90
PSU 43X	1 x MOS128	£16.70
PSU 51X	2 x HY128, 1 x HY244	£17.07

Please note: X in part no. indicates primary voltage. Please insert "0" in place of X for 110V, "1" in place of X for 220V, and "2" in place of X for 240V.

MOSFET MODULES

Module Number	Output Power Watts rms	Load Impedance Ω	DISTORTION T.H.D. Typ at 1KHz	I.M.D. 60Hz/7KHz 4:1	Supply Voltage Typ	Size mm	WT gms	Price inc. VAT
MOS 128	60	4-8	<0.005%	<0.006%	± 45	120 x 78 x 40	420	£30.41
MOS 248	120	4-8	<0.005%	<0.006%	± 55	120 x 78 x 80	850	£39.86
MOS 364	180	4	<0.005%	<0.006%	± 55	120 x 78 x 100	1025	£45.54

Protection: Able to cope with complex loads without the need for very special protection circuitry (fuses will suffice). Slew rate: 20v/ μ s. Rise time: 3 μ s. S/N ratio: 100db. Frequency response (-3dB) 15Hz - 100KHz. Input sensitivity: 500mV rms. Input impedance: 100K Ω . Damping factor: 100Hz > 400.

'NEW to ILP' In Car Entertainments

C15

Mono Power Booster Amplifier to increase the output of your existing car radio or cassette player to a nominal 15 watts rms.

Very easy to use.

Robust construction.

£9.14 (inc. VAT)

Mounts anywhere in car.

Automatic switch on.

Output power maximum 22w peak into 4 Ω .

Frequency response (-3dB) 15Hz to 30KHz, T.H.D. 0.1% at 10w 1KHz

S/N ratio (DIN AUDIO) 80dB, Load Impedance 3 Ω .

Input Sensitivity and Impedance (selectable) 700mV rms into 15K Ω . 3V rms into 8 Ω .

Size 95 x 48 x 50mm. Weight 256 gms.

C1515

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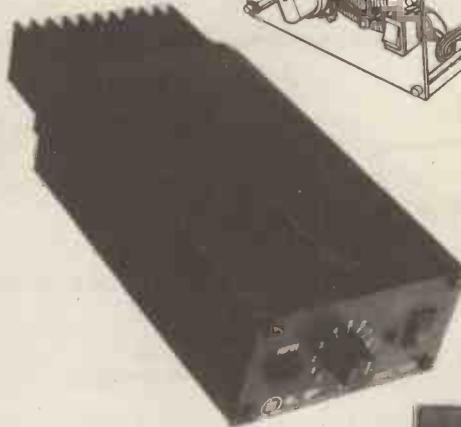
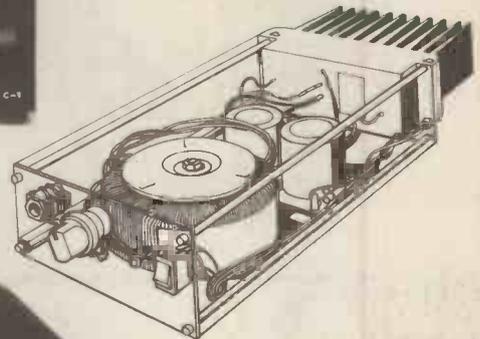
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THE BIRTH OF BROADCASTING



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Broadcasting began almost simultaneously in both Britain and the USA; two years later, there were over 300 stations broadcasting throughout America. Meanwhile, a "string and sticky tape compromise" had been worked out to control broadcasting in the UK: it was called the BBC . . .

THE THING about radio broadcasting in the years after the First World War is that, like Topsy, 'it just grew'. Although the development of instant, worldwide mass-communication was the most revolutionary turn of human affairs since the invention of printing, and although its long-term effects are still only beginning to work themselves out sixty years later, none of the people who brought broadcasting to birth in the years 1919-22 had much idea of what they were doing or where it might eventually lead. Even David Sarnoff, the RCA executive who did most to set up broadcasting in the USA during 1920, thought that the service would never amount to much more than a sort of wireless gramophone for playing recorded music and that, at best, perhaps one American home in three might one day own a wireless set. As Cromwell once remarked, he goes furthest who knows not whither he is going.

The basic technology of broadcasting, obviously, was voice-radio, or radio telephony to give it its proper title. But whatever else happened in the crucial early years of broadcasting, there was certainly no breakthrough drive to develop the technology to make broadcasting

possible. It was, rather, a case of the technology having lain around for nearly twenty years before people began to realise that it could be used to pass messages to a mass audience. The idea of broadcasting itself was not new, of course; it had been realised from the very earliest days of wireless telegraphy that any receiver within range of the transmitter could pick up the signal, whether they were supposed to or not. Even before the First World War, a growing number of amateur experimenters all over Europe and the USA had been building their own wireless installations and making contact with each other over the air. But these were still largely one-to-one conversations in Morse Code. If broadcasting were ever to break out from the tiny circle of key-tappers into the world of the great newspaper-reading public it had to take up radio telephony.

Microphonics

Voice-transmission by wireless was nothing new, even in 1914. The American radio pioneer Fessenden had achieved 25-mile transmissions as early as 1902 and in 1906, when he rigged up

a telephone mouthpiece to a continuous wave arc-transmitter on Long Island, the brief programme of speech and music was picked up not only by ship's radio operators out on the Atlantic but also by one station in Scotland. Tricks of this kind were displayed every couple of years up to the First World War, but radio telephony remained a kind of wireless party-piece, without any practical value. The reasons for this were partly technical, in that the modulating power of the microphones of the day was so slight in relation to the power radiated by an arc transmitter that the receiver headphones tended to burn out after an hour or so! However the main reason for the neglect of radio telephony, in the years before 1914, was that nobody could see much use for it. The main users of wireless in those days - in fact pretty well the sole users - were the world's navies and government communications agencies. By the late 1900s, seafaring radio users were well on their way to turning wireless telegraphy into a fine art, with meticulous procedures, extremely rapid transmission rates and elaborate protective codes which could obviously not be used with voice transmission. The result was a

notable coolness towards radio telephones, which tended to be returned to stores marked "unusable" whenever the British or American navies were ordered to carry out trials on them. The First World War only served to reinforce this high naval opinion of W/T, and if it had been left to the admirals radio would probably never have progressed beyond enormously powerful long wave arc transmitters, with someone tapping a key in a hut nearby.

The War had slowed down radio development work quite drastically. Amateur experimenters were silenced, all over Europe, by government security regulations as soon as war was declared, and most of them were clapped into uniform for the duration. Between 1914 and 1918 there were really only two major developments in radio. One was the design of compact but powerful and reliable radio telephones for use in aircraft. The other was the research work done on valve design and performance by General Ferrie's French Army supply department in the last two years of the War, after the Allies had decided to pool their wireless production efforts. This was the first systematic large scale study of the valve and it proved very useful to civilian experimenters in the years immediately after the War.

At the beginning of 1919, armies were rapidly demobilising all over Europe. The surviving pre-War radio enthusiasts reclaimed their sets from the local police station — and, not infrequently, scrapped them as being hopelessly out-of-date. There was also the tempting prospect of vast quantities of government surplus radio equipment being sold off at giveaway prices; so much of it, in fact, that for years afterwards, British wireless component catalogues used to put a star against items which were *not* ex-W.D. Most important of all, tens of thousands of bright young men were now flooding back into civilian life after having been given several years concentrated experience of wireless operation and at least a nodding acquaintance with the elementary radio theory of the day. They were determined to start up again where they had left off, once the wartime security restrictions were lifted (not until the beginning of 1920 in the UK) but for the time being they were happy to tour the burgeoning wireless clubs, giving lectures on their wartime work.

Hamming It Up

The ex-servicemen were the leading rank of that great legion of the 1920s, the radio hams — a swarming band of wild-eyed fanatics, brandishing soldering irons and sticks of Chatterton's Compound in attics and tool-sheds up and down the land as they drove wives and mothers to tears with aerials strung across gardens, clothes burnt with battery acid and seaside holidays ruined by the effort of scrambling around the cliffs looking for galena crystals. They scraped together shillings to buy the latest valves, they devoured the radio enthusiast's bible, *Wireless World*, every week and they bragged endlessly in the local wireless club about their success in picking up distant and exotic-sounding stations. It was

all glorious fun, as many an old man still living will bear witness. But more than that, it was vital development work. Probably for the last time a major new technology was developed largely through the efforts of ordinary, non-specialist members of the public and it is likely that, but for the efforts of the amateurs, broadcasting would never have come into being at all. Certainly the world's governments and armed forces were not very interested in it in 1919; on the contrary, they had invested huge amounts of money and effort, both before and during the War, on powerful long-wave spark and arc transmitters and had no wish to see all this work written off by valves and voice-radio. There was also the fact that, at the end of the First World War, electronics barely existed as a science. Universities and technical colleges were interested only in the purest of theoretical physics, or in heavy electrical engineering. The theory of radio was sketchy in the extreme — as late as 1932, no one had the foggiest idea how a crystal receiver worked, so anyone's theory was pretty well as good as anyone else's until it could be tested in the field which, in effect, meant making a series of test-transmissions and collecting the QSL postcards which came back from the

listeners. The reign of the amateur experimenter came to an end in the late 1920s, as electronics began to cohere into an exact science, but up until about 1925, they ruled the airwaves. And as if to drive that point home, the amateurs achieved a major triumph over the theorists in 1921-22 when they proved conclusively that, whatever the equations said, medium and short wave radio signals *could* be heard clearly on the other side of the Atlantic. Like Marconi two decades earlier, the amateurs didn't know that it couldn't be done, so they just did it!

Anarchy in the USA

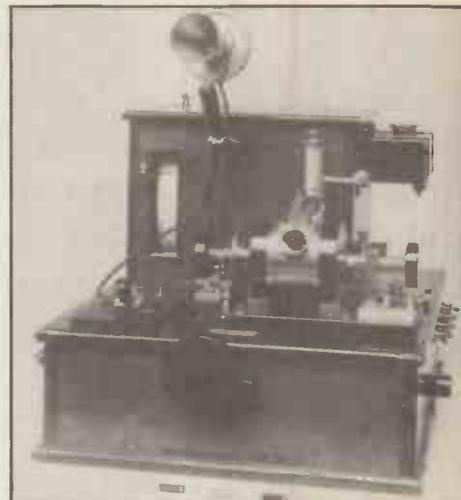
It is impossible to say exactly when and where regular public service broadcasting began. Amateur began chattering to amateur in Britain as soon as the wartime restrictions came off, at the beginning of 1920. Over in the United States, the ban was lifted a year earlier, at the very beginning of 1919, and the country was soon covered coast-to-coast with an amateur radio relay network relying increasingly on plain voice transmission. With enormous geographical space to help them and minimal government restrictions to hold them back, the American amateurs

Right, a modulated-arc radio telephony transmitter, of the type developed by Poulsen and current before 1914.

(Photo, Science, Museum, London.)

Below, an amateur wireless transmitter from about 1920.

(Photo, Science, Museum, London.)



were soon filling the ether with homemade news broadcasts and music, the latter starting out as a means of testing the quality of receivers but soon becoming an entertainment, pure and simple. Early in 1920 the Michigan Agricultural College began broadcasting weather reports and, later, crop prices to the growing number of local farmers who thought it worthwhile to make or buy a receiver. In November that year, the Westinghouse company at Pittsburg began music broadcasts from its own makeshift transmitter station, KDKA. Like most other governments, the US administration had been worried during the War by the fact that production of wireless equipment for the armed forces was enmeshed in the notorious Marconi world-wide patents (152 in all) which covered just about every aspect of contemporary wireless technology and which the Marconi company was quite ruthless in enforcing.

The Navy Department encouraged the two main US manufacturers, GEC and Westinghouse, to buy out the patents once and for all in 1919. To do this, they formed the RCA company and acquired an executive, Sarnoff, who had some hazy idea that public broadcasting might have a future albeit a rather modest one.

As early as 1916, he suggested marketing a 'radio music-box' and had been ignored for his trouble. But things were different now. Like all the world's radio manufacturers except Philips, based in neutral Holland, Westinghouse and GEC were not at all pleased that the War had ended if this meant the end of large and profitable government supply contracts. They had to find some means of keeping the production lines moving and a mass-market for receivers might be one way of doing it, even though no-one expected anything more than modest sales. The problem to be overcome was the familiar Catch 22: No Broadcasting Station = No Demand for Sets, No Sets = No Point in Setting Up a Broadcasting Station. Once Westinghouse had summoned up the nerve to dip a toe in the water with KDKA, though, the results were spectacular.

The station broadcast the presidential election results nationwide, by means of landline relays, at the beginning of November 1920 and a month later it achieved its greatest coup by doing the same thing for the Dempsey-Carpentier fight in New York. Hundreds of thousands of people listened to this broadcast, huddled around loudspeakers in pool-halls and barber's shops right across the nation. All who heard it — and many more

who didn't — spoke of it in the highest terms, and the result was an immediate boom in sales of wireless sets. By the end of 1921, the USA had 90 broadcasting stations, by mid-1922 it had 344 and by about early 1926, the number had peaked at around 1,100, all operating in conditions of the most savage competition and employing every dirty trick against rival stations, from simply driving them off the wavelength by turning up the power to taking out contracts on them with members of the Chicago business community! By the mid-1920s, the chaos was so great that the Federal Government had to cast aside the sacred principle of free enterprise and step in to allocate wavelengths and broadcasting times.

The British Way

Apart from being highly entertaining in itself, this hectic brawl in the United States was one of the main reasons for the setting up of the BBC in Britain during 1922. If several hundred competing stations were barely tolerable even in the wide open spaces of North America, how much less convenient were they likely to be in the crowded airspace of the British Isles, where the services were already complaining bitterly about interference not only from amateurs but also from the Marconi experimental transmitters both at the company's headquarters on the Strand and at Writtle, just outside Chelmsford — not to speak of the music broadcasts from Philips at Eindhoven and the Eiffel Tower station. Marconi had begun music broadcasts "for testing purposes", in June 1920 with a recital by Dame Nellie Melba, but in November the Postmaster-General had intervened, wielding the 1904 Wireless Telegraphy Act to put a stop to these programmes after complaints from the Admiralty and Marconi's numerous enemies. But progress was unstoppable, even by PMGs; even if Marconi could be silenced, the thousands of amateur experimenters were a different matter altogether. A number of conflicting interests had to be balanced against each other to set up public service broadcasting in the UK. Marconi wanted to build the transmitters for the Government and they also wanted to keep the near-monopoly on receivers which the patents gave them — in fact they wanted to enlist the Post Office to enforce it more effectively on the swarms of amateur set-builders who were using the company's patents without paying a farthing in royalties. The other manufacturers wanted to break the Marconi monopoly and cash in on a market which could be as profitable as the one in the USA. The wireless enthusiasts wanted something to listen to and the Postmaster-General, for his part, wanted a quiet life and interference-free channels for the Government's own uses!

Negotiations began in earnest early in 1922, at the same time as the Post Office lifted its ban to allow transmissions from Writtle and also from the station which Metropolitan-Vickers had just set up at Trafford Park on the edge of Manchester. By November 1922, a typical British string-and-sticky-tape compromise had been worked out: Marconi agreed to come into a public company, the British

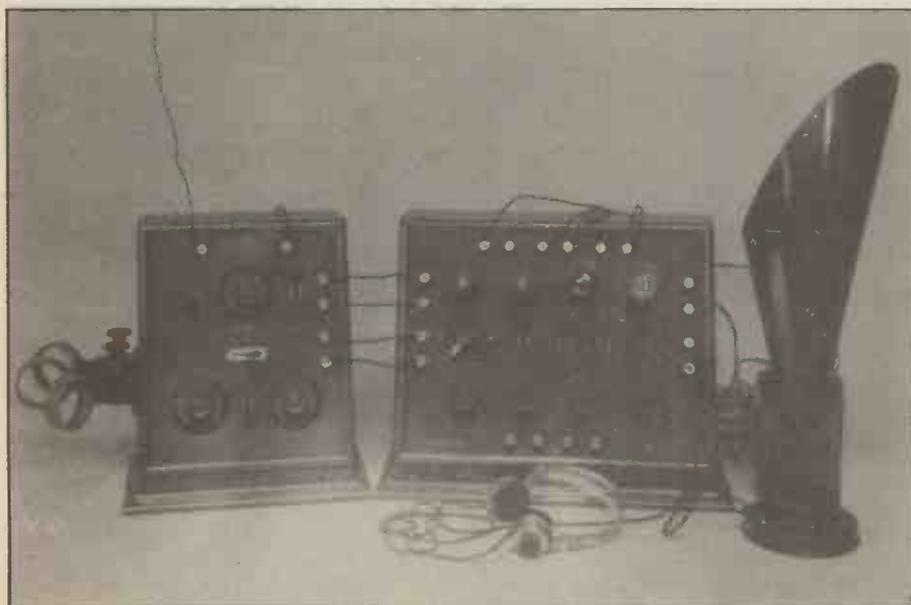


Left, a state-of-the-art (in the early 1920s) crystal receiver from the British Thomson-Houston Co. Ltd., of Rugby.

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Below, a Burndept four-valve receiver as used in 1925. Note the "modular" construction!

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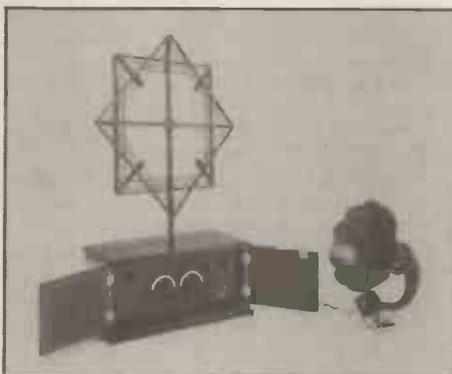
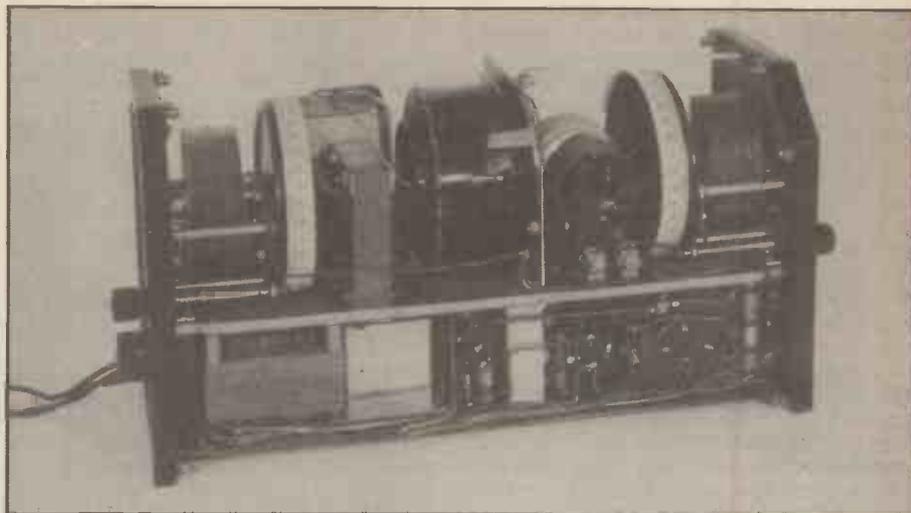
Broadcasting Company Ltd. (it became a Corporation in 1926) along with the other six wireless manufacturers. It agreed to make its patents available to the others in return for royalties on each set sold. The BBC as a whole was to be funded by half the licence fee, plus a levy on sets sold to the public. Listeners who built their own sets — in fact the great majority until the early 1930s — were to pay a special experimenter's licence fee and also pay royalties to Marconi when they used the company patents. The BBC was officially set up on 14 December 1922 but, in fact, its first transmitter, 2LO in London, had begun broadcasting six hours each evening (except for Sundays) a month earlier. After this, progress was scarcely less rapid than it had been in the USA. By mid-1924 there were upwards of 100,000 licence-holders, — plus an estimated twice as many listeners with no licence — eight transmitters operating and a national long-wave transmitter just about to open at Daventry. News summaries began early in 1923 and, as the year went by, talks, sport and drama began to supplement music as the basic material for programming.

Radio Stars

The mid-1920s were the great pioneering age of broadcasting in Britain. When the BBC started work, it had acquired some highly accomplished engineers, like the famous Capt. P.P. Eckersley, late of the Writtle transmitter, but no one had any idea of how to run a public broadcasting service. Technical problems were solved purely by trial and error: for instance, what sort of microphones do you use for particular jobs and how do you set them up? What shape of studio is best? How do you deal with echoes? How do you connect up a gramophone to the transmitter? (Answer: stuff the studio microphone down the horn!).

However, broadcasting technique was not so simple. There were some dreadful mistakes at first, and some of the BBCs 'informative talks' from 1923-24 are small masterpieces of mind-numbing boredom. The wonder is that broadcasting skills evolved so quickly and that, despite the hostility of the actors' and musicians' unions, so many natural radio performers were found so quickly: people like the Yorkshire comedian John Henry or the enigmatic ex-Civil Servant A.J. Alan, whose ten-minute mystery tales remain classics of broadcasting, even half a century later.

Perhaps the BBC had an easy ride in those first few years, as far as its audience went. In the mid-1920s the mere fact of picking up a faint, chirping signal in the ex-W.D. headphones of a home-made crystal receiver was vastly more important to its schoolboy owner than the quality of the programme itself. It was these hordes of young hobbyists who did most to turn wireless from a crankish pastime into a public service. Their great contribution to broadcasting was to act as a great army of unpaid PR agents for the BBC, gradually selling the idea of radio to parents who were usually not only baffled by the principles of radio, but also deeply suspicious of new-fangled and expensive crazes. Not many people in 1925 or



Above, a Philips mains-powered receiver of 1928.

(Lent to the Science Museum by Philips Lamps Ltd.)

Left, a Burndep't "Ethodyne" receiver of 1925. Elaborate frame aerials of the type shown here were also used for early television reception and can still be found in lofts, here and there.

(Photo, Science Museum, London.)

Below, a Murphy AS2 receiver, with push-button tuning for Manual selection, Athlone, the London Region, Midland Region, Normandie, North Region, P. Parisien and Radio Lyon.

(British Crown Copyright. Science Museum, London.)

thereabouts would have been prepared to invest several weeks' wages in a factory-built wireless receiver, but a 14-year old son putting together a crystal set for a few shillings, scraped together out of his pocket money, was a different matter. Placing the headphones in a glass bowl on the living-room table for a few evenings might induce Dad to shell out a couple of quid for a proper loudspeaker, and if the rest of the family came to like the Savoy Orpheans or Tales of Toytown, they might gang up later to twist the old man's arm until he promised to buy one of the latest valve-receivers — especially after the General Strike in 1926 had stopped the newspapers for two weeks.

Vox Populi

By the later 1920s, wireless was well on its way to becoming a popular amenity rather than a hobby. Nonetheless, the receivers of the day had severe limitations of design. Firstly there was the sheer bulk of any set which aspired to a range

greater than the 20-odd miles of the crystal set. The wireless was no longer the sprawling, chaotic jumble of coils and valve-boards, knobs and trailing wires which it had been back in 1919, but it was still a bulky, obtrusive contraption, even when it stood in the corner pretending to be a Jacobean Oak Cabinet. Then there was the problem of the loudspeaker and the aerial, both of which were free-standing dust-collectors in the room until integral loudspeakers and ferrite aerials began to come in, about 1929. Above all, there was the problem of power supply. Unless owners had 110 Volt DC local mains which could be reduced by means of a string of light-bulb resistances, it had to be batteries: a lead-acid accumulator for the valve anode supply and a smaller dry battery to provide bias for the valve grid. AC mains supply sets — some of them lethally unreliable — began coming onto the UK market in 1928 but for many listeners, for many years to come, the trudge down to the cycle shop to charge the battery was a weekly ritual. Tuning

was also a problem: until the advent of single-knob superheterodyne tuning, about 1931, 'resolving the frequency' had the unfortunate effect of making the receiver's valves act as small transmitters until the correct wavelength had been found, thus creating an irritating loud whistle on any set within about a mile range. As broadcasting turned more and more into a public service, the oscillator became a public enemy, the subject of BBC pamphlets and target of special GPO detector squads.

By 1930, the great days of the radio amateur were clearly drawing to a close. Wireless theory was catching up with practice and had even overtaken it to the extent that valve characteristics could be accurately predicted before the valve was tested or even built. At the Washington International Radio Conference in 1928, it was only the protests of the US and British radio societies which prevented the world's broadcasting services and armed forces from liquidating the amateur once and for all. The amateur wireless constructor is still with us today, but the necessity of doing it yourself was fast disappearing as mass-produced bakelite-cased wireless sets came onto the market at prices which even a farm-labourer could afford, if he saved up for a while or took out one of the new hire-purchase contracts. Vestiges of the amateur tradition lingered on for years however particularly the notion that the quality of a set could be judged by the

number of stations which could be picked up on it. Even at the end of the 1950s, some of the last commercially-produced valve receivers still had elaborate tuning dials bearing a mass of half-forgotten names like Konigsberg, Kaunas and Radio Colonial, Paris.

Wireless Wars

Wireless had become a public amenity over most of the civilised world by 1930, and in the increasingly uncivilised atmosphere of the times, many governments and would-be governments were quick to spot its potential for relaying voices a good deal less benevolent than that of Larry the Lamb. The Kremlin's Agitprop department latched onto the possibilities of wireless, in the mid-1920s, as a means of spreading unrest abroad and inducing a suitably terrorised frame of mind at home. But it was really the Nazi Party which developed radio propaganda to its finest pitch. Hitler's wireless oratory played a large part in the great bluff which brought him to power in January 1933 and, once he had seized power, the Party's propaganda department got to work at once, developing the external radio-war techniques which were so effective in shattering the nerve of the French during the Munich crisis in the summer of 1938. As the skies darkened over Europe, the transmitters poured out a swelling, bilious stream of lies and cooked statistics, screaming

speeches and blaring martial music to an increasingly panic-stricken humanity. The pressure was felt even in the relative safety of the United States, as Orson Welles demonstrated accidentally on that scarcely credible October evening in 1938 when his reading of H.G. Wells's 'War of the Worlds' had half the population of New York State jamming the roads in flight from a supposed invasion of the Martians (or the Nazis or the Reds or the Japs; it was never quite made clear whom).

When the world went to war for the second time, in the small hours of the morning of Friday, 1 September 1939, it was appropriate that broadcasting should have provided the pretext in the form of an elaborately faked attack on a German border transmitter at Gleiwitz in Silesia. Over the next six years, the BBC was to have its finest hour, broadcasting to occupied Europe. Then, proclaimed to be nearly dead in the 1950s, radio underwent a remarkable revival at the end of the decade when cheap Japanese transistor sets began to do for the Third World what wireless had done for Europe a generation earlier, bringing even the most primitive and isolated villages into the life of the nation for the first time. Even so, by the autumn of 1939, radio's great days were over. The pioneering work had been done and the leading-edge of broadcasting was about to be taken over by television, once the War's rubble had been cleared away.

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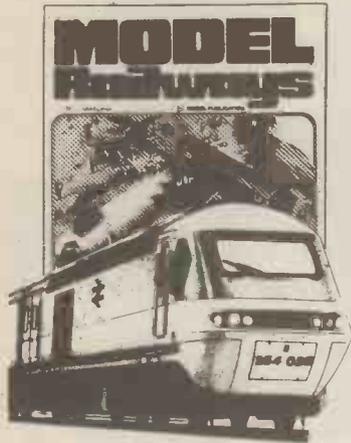
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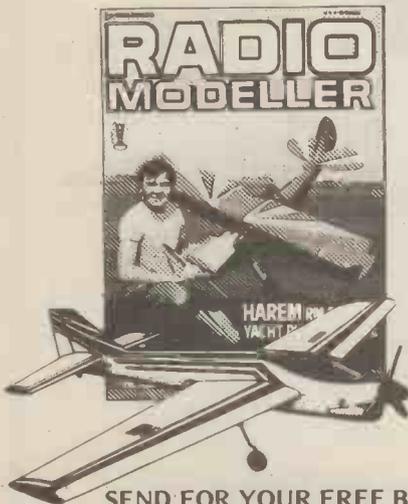
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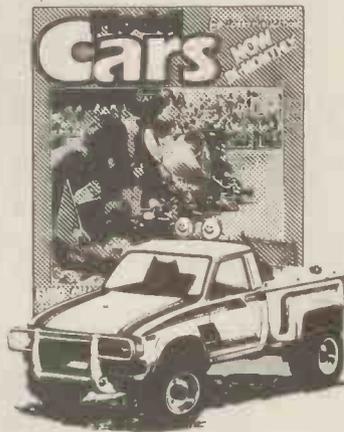
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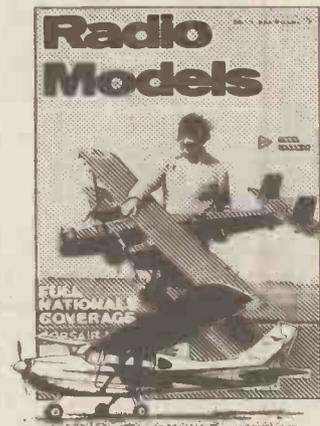
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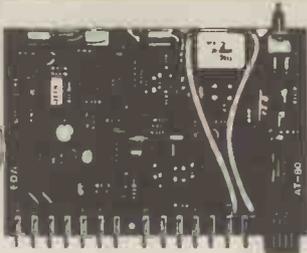
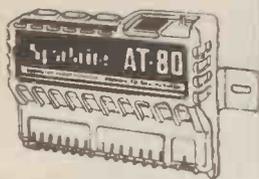
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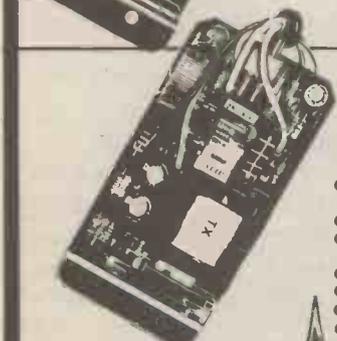


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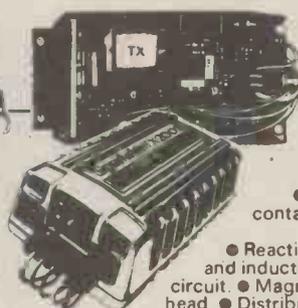
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- Over 145 components to assemble.



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**AT YOUR
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POP AMPS

Owen Bishop

Simple measuring circuits based on operational amplifiers

No. 4: Very high impedance voltmeter

ONE PROPERTY of operational amplifiers that is of special importance, in this application, is that their input terminals have very high impedance; for example, the input impedance of the 741 is 2M Ω . But the CA3140 op-amp chosen for this circuit is a CMOS IC with the almost infinitely high impedance of 1 teraohm (10^{12} ohms). The effect of this is that if one input is connected to a point in a circuit which has potential, say, of 5V, the amplifier behaves as a 1T Ω resistor between that point and ground. The current flowing away from that point is only 0.000000000005A (or 5 picoamps), which is good since, when measuring voltages, our aim is to draw as little current as possible from the circuit; a cheap testmeter with a 2K Ω /V coil, working on the 10V range, would draw 250 μ A under the same circumstances.

If this was a circuit with high resistances and small currents, taking as much as 250 μ A from it might cause much disturbance. The potential at that point would fall and the voltmeter reading would be seriously in error — perhaps showing only half of the correct value. In addition, the operation of the circuit might be totally upset, and the reading could be completely meaningless. Even a more expensive meter with a 20k Ω /V coil would draw 25 μ A. This is still relatively large and the readings would still be in error. The high-impedance input of the operational amplifier, therefore, is a great asset in voltage measurement, especially in circuits in which impedances are high and currents are small.

Feedback

The circuit diagram shows that the output of the op-amp is connected directly to the inverting input. If the non-inverting input (the input to the circuit as a whole) is at zero volts, and if the output is at zero volts, the inverting input is also at zero volts. There is no difference between the inputs, so output stays at zero volts. Then if, for example, the input to the circuit is raised to +2V, the non-inverting input is temporarily higher than the inverting input so the amplifier output swings positive until it reaches +2V. This output voltage is fed back to the inverting input so we now find that both inputs are at 2V, and no further swing occurs.

The effect of feedback is to force the voltage at the inverting input to follow

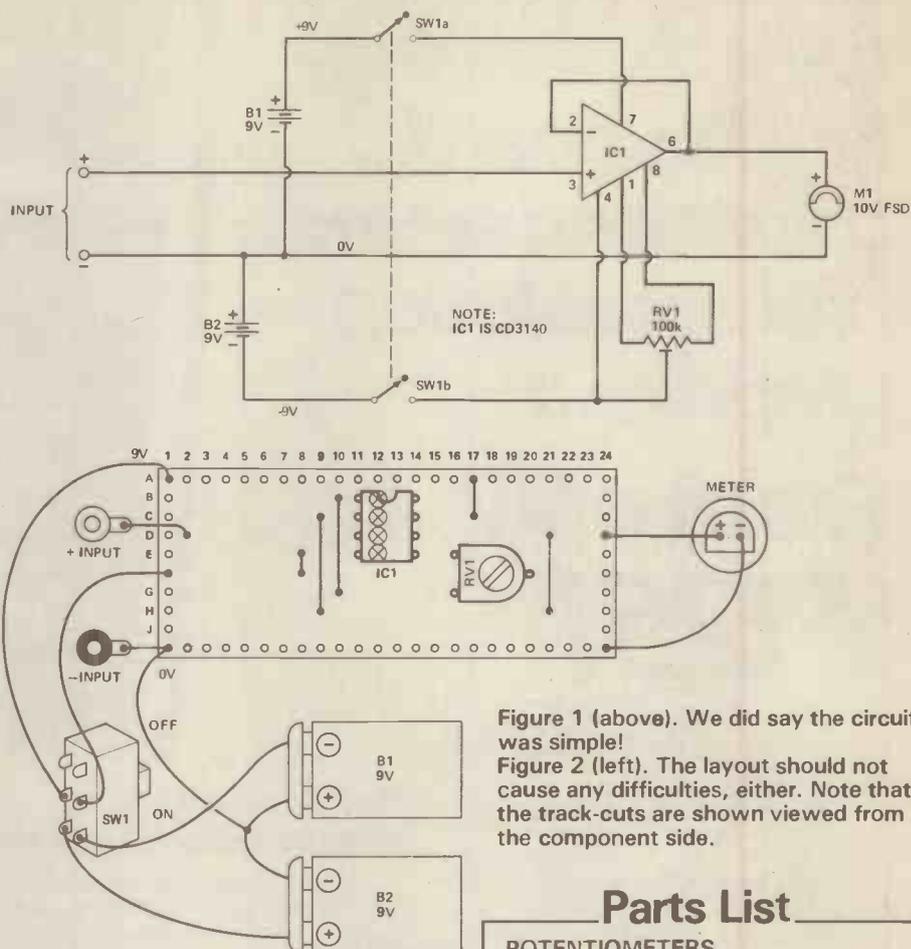


Figure 1 (above). We did say the circuit was simple!

Figure 2 (left). The layout should not cause any difficulties, either. Note that the track-cuts are shown viewed from the component side.

Parts List

POTENTIOMETERS

RV1 100k
min. horiz. preset

SEMICONDUCTOR

IC1 CA3140
CMOS op-amp

MISCELLANEOUS

M1 10V FSD meter
SW1 DPST switch
toggle or slide

Stripboard, 63 × 25 mm (24 holes × 10 strips); 2 × PP3 battery clips; 4 × 4 mm sockets; terminal pins, wire, solder etc.

the voltage at the non-inverting input exactly. Since the voltage at input and output are equal, we call this circuit a "unity-gain voltage follower". The crucial point is that the input terminal has high impedance; it can be connected to an external circuit without unduly upsetting the voltage levels of that circuit. On the other hand, the output of the op-amp has low impedance (about 100 Ω) so it can sink or source a relatively large current without its output voltage level being affected. When connected to a cheap testmeter, it provides all the current required to drive the meter coil. A really reliable voltage reading is obtained in this way.

Using The Circuit

Switch on the power, then select the voltage range required. Join the input terminals together; both inputs of the IC are now at zero volts and RVs should be adjusted to bring the output to zero. Now the circuit can be used just as you would use a multimeter. Although voltages down to a few millivolts may be measured, remember that, with a

± 9 V supply, voltages greater than about ± 8 V saturate the circuit, so that the maximum voltage that can be measured is about ± 8 V. If you want to measure higher voltages, increase the power supply to ± 18 V, when input voltages up to ± 13 V may be measured. This circuit can also be built around the 741 op-amp with a 10k preset for RV1. The input impedance of the 741 is much lower (about 2M Ω) though still considerably better than that of a low-cost meter used alone.

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There's no need to stop there. The ZX Printer—available now—is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232 / network interface board.



Key features of the Sinclair ZX Spectrum

- Full colour—8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound—BEEP command with variable pitch and duration.
- Massive RAM—16K or 48K.
- Full-size moving-key keyboard— all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution—256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
- ASCII character set—with upper- and lower-case characters.
- Teletext-compatible—user software can generate 40 characters per line or other settings.
- High speed LOAD & SAVE—16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC—incorporating unique 'one-touch' keyword entry, syntax check, and report codes.

BUYLINES

DigiTester PSU

A toroidal transformer by ILP has been used in this project. They are readily available from, eg Technomatic and Electrovalue. The regulator heatsinks are also fairly easily obtainable — the slotted general purpose type, to fit TO126 — TO220 packages, used for our prototype came from Bradley Marshall in Edgware Road. The diode bridge is specified as a W005 type but, again, any higher-rated device will do the trick.

The PCB is laid out to accept a 20mm PCB mounting cartridge fuse holder, so try to get that size — and we strongly recommend the use of a 'p-clamp' to secure the mains cable to the PCB.

The cost of the DigiTester PSU is in the neighbourhood of £9, excluding the PCB.

Check List

RESISTORS

1 x 1k2 ½ watt carbon.

CAPACITORS

1 x 2200U 35V radial electrolytic; 3 x 1u 25V tantalum.

SEMICONDUCTORS

3 x 7805, TO220 packaged regulators; 1 x 400mW/10V Zener (BZY8810V); 1 x 400mW/5V1 Zener (BZY885V1); 1 x 0.2" LED; 1 x W005 50V/1A bridge rectifier.

MISCELLANEOUS

1 x 0-15.0-15/30VA toroidal transformer (ILP type 12013); 1 x single pole 3-way switch; 20mm cartridge fuse holder, PCB mounting; 2A anti-surge fuse; p-clamp; PCB, wire etc.

Incremental Timer

A metal case is preferred for this project, securely earthed as described in the text, however any case of suitable dimensions will be OK for the purpose; try the BIM5006 BIMbox, or the slightly larger type 86-20104E from the Vero range. Equivalent sizes are also available in plastic boxes from those two manufacturers, and your friendly retailer will probably have his own stock of cases for you to choose from.

The semiconductors are all standard types, and there are many substitutes for Q1, 2 and 3 if you need them. The LED *must* be a high-intensity type, to produce the required 2V5 voltage drop

for the constant current source.

The transformer and relay are both standard PCB mounting types and are easily obtained; likewise, the single pole 12-way switch should not be hard to find.

Just about all the components and hardware can be obtained from a single supplier; if in doubt try Rapid Electronics, Ambit or Watford Electronics. Cost, excluding the PCBs should be about £18.

Check List

RESISTORS

(All ½ watt 5% carbon)

1 x 100k; 3 x 1k; 1 x 3k3; 10 x 560R; 3 x 10k; 1 x 4k7; 1 x 10M.

POTENTIOMETERS

1 x 1M linear.

CAPACITORS

1 x 10n, 1 x 220n polyester; 1 x 33u tantalum; 1 x 470u 25V electrolytic.

SEMICONDUCTORS

1 x LM3914; 1 x CD4001B; 1 x BC212L or equivalent; 2 x BC107 or equivalent; 1 x 1N914; 4 x 1N4002; 1 x 0.2" high intensity green LED; 10 x 0.2" red LEDs

MISCELLANEOUS

1 x 9-0-9V/6VA PCB mounting transformer; 1 x push-to-make switch; 1 x 12-way single pole rotary switch; 1 x 12V DPCO PCB mount relay, contacts rated 240VAC @ 5A; 1 x 12V buzzer; case, 190 x 113 x 60mm; 4-way mains terminal block; cable and clamp; IEC mains socket; LED panel mounts; nylon nuts and bolts, spacers; PCB; ribbon cable, wire solder etc.

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MK5 MAINS TIMER

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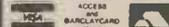
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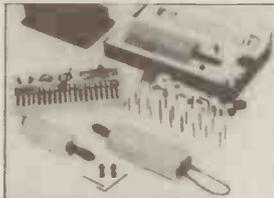
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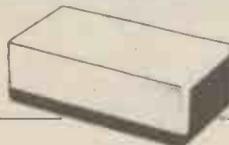
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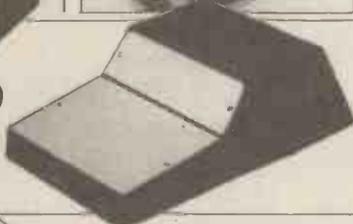
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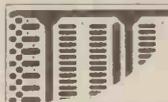
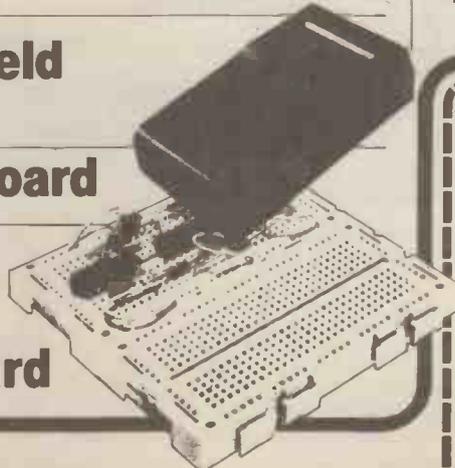
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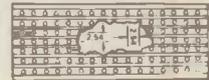
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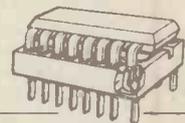


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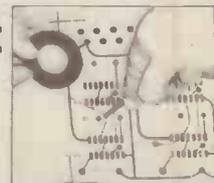
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DRUM SYNTHESIZER Dec 81. Full kit £21.37
GUITAR HEADPHONE AMPLIFIER Dec 81 £3.72
IN CAR CASSETTE POWER SUPPLY Dec 81 £4.77
SCRATCH FILTER Nov 81 Mono £5.82 Stereo £8.98
LED VU METER Nov 81 less case £4.87
SIMPLE SYLLUS ORGAN Nov 81 less case £4.98
METRONOME Nov 81 £12.71
TELEPHONE BELL REPEATER Oct 81 £13.67
Med linking wire extra 14p metre
COMBINATION LOCK Oct 81 less solenoid £18.65

BBY ALARM Oct 81 £8.70, Fig 8 linking wire 7p metre
'DIANA' METAL LOCATOR Sept 81 £34.50
REACTION TESTER GAME Sept 81 £12.81
VARIABLE BENCH POWER SUPPLY Aug 81 £26.98
ULTRASOUND BURGLAR ALARM July 81 £19.98
ELECTRONIC DOOR BUZZER July 81 £5.98
ELECTRONIC METRONOME July 81 £4.99
CONTINUITY CHECKER June 81 £5.71
ENVELOPE GENERATOR June 81 £17.98
AUDIO MIXER June 81 £5.33
PUBLIC ADDRESS AMPLIFIER March 81 £19.48. Extras - horn speakers £6.83 each, PA MIC £4.40
FUZZBOX March 81 £10.98
WINDSCREEN WIPER CONTROLLER March 81 £8.20
STEAM LOCO WHISTLE March 81 £12.98
PHOTOGRAPHIC TIMER March 81 £3.50
HEARTBEAT MONITOR Feb 81 £24.98
TWO-TONE TRAIN HORN Feb 81 £5.60 less case
medium wave radio Feb 81 £8.20
BENCH AMP Jan 81 £10.80
NICAD CHARGER Jan 81 £8.20
CHUFFER Jan 81, less case £7.53
BATTERY CHARGE MONITOR Dec 82 £5.77
MEMORY BANK - MINI SYNTHESISER Nov 8 Dedc 80 £29.98
TRANSISTOR TESTER Nov 81 £6.54 inc test leads
GUITAR PRE-AMP Nov 80 £6.65 case (diecast) extra £2.29
INTRUDER ALARM Oct 80 £20.98
TOUCH SWITCH Sept 80 £2.75 less case & contacts
GUITAR PHASER Sept 80 £16.28
SOUND OPERATED FLASH TRIGGER July 80 no skt £5.33
FOG HORN June 80 £6.64
SPEED CONTROLLER FUM H/C April 80 £17.55 (less case)
DIGITAL FREQUENCY METER April 80 £39.98
GUITAR TUNER Nov 79 £12.82
CAR ALARM Feb 79 £12.91

MORE PROJECT KITS - SIMILAR STYLE TO H.E.

INSTRUCTIONS INCLUDED (SEPARATELY 45p EACH)
PLEASE QUOTE REF. NO. WHEN ORDERING

B1 PEST CONTROL 'Ultrasonic cat scarer' £7.65
B2 COMPONENT TESTER £8.88
B4 GUITAR NOTE EXPANDER £17.98
B5 CAMERA OR FLASH GUN TRIGGER Infra red system £12.51
B6 SIMPLE INFRA RED REMOTE CONTROL £17.20
B7 0-12V POWER SUPPLY £17.98
B9 SOUND TO LIGHT - single channel £8.42
B10 THREE CHANNEL SOUND TO LIGHT £21.44

B11 IN SITU TRANSISTOR TESTER £6.98
B12 WEIRD SOUND EFFECTS GENERATOR £5.98
B13 AUDIBLE VISUAL METRONOME £5.98
B14 ELECTRONIC DICE £5.71
B16 MINI EGG TIMER £4.34
B18 LED JEWELLERY - Cross brooch £2.77 Star brooch £9.91 Spiral brooch £7.98

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CONTAINS LOTS MORE KITS, PCBs & COMPONENTS

1982 ELECTRONICS CATALOGUE

Illustrations, product descriptions, circuits all included. Up-to-date price list enclosed. All products are stock lines for fast delivery.
Sends 80p in stamps or add 80p to order.

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ADD 45p P&P TO ALL ORDERS. PRICES INC VAT

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OVERSEAS. Payment must be in sterling.
IRISH REPUBLIC and BFPO: UK PRICES.
EUROPE: UK PRICES plus 10%.
ELSEWHERE: write for quote.

SOLDERING / TOOLS

ANEX X5 SOLDERING IRON 25W £5.48
SOLDERING IRON STAND. £1.98
SPARE BITS. Small standard, large, 65p each. For X5 + X25
SOLDER. Handy size. 99p
SOLDER CARTON. £1.84
DESOLDER BRAID. 69p
HEAT SINK TWEEZERS. 29p
DESOLDER PUMP. £6.48
HOW TO SOLDER LEAFLET. 12p
LOW COST CUTTERS. £1.69
LOW COST LONG NOSE PLIERS £1.68
WIRE STRIPPERS & CUTTERS. £2.69

HELPING HANDS JIG £6.30

Heavy base. Six ball and socket joints allow infinite variation of clips through 360°. Has 2 1/2" diameter (25x) magnifier attached, used and recommended by our staff.
VERO SPOT FACE CUTTER £1.49
PIN INSERTION TOOL £1.98
VEROPINS (pk of 100) 0.1" 52p
MULTIMETER TYPE 1 (1,000 opv) £5.48
MULTIMETER TYPE 2 (20,000 opv) with transistor tester. Very good £14.75
CROCODILE CLIP TEST LEAD SET. 10 leads with 20 clips 99p

MULTIMETER TYPE 2 - YN360 TR, £14.75

RESISTOR COLOUR CODE
CALCULATOR 21p
CONNECTING WIRE PACK TYPE ED. 11 colours 49p
ILLUMINATED MAGNIFIERS
Small 2" dia. (5x mag.) £1.14
Large 3" dia. (4x mag.) £2.40
CAST IRON VICE £2.98
SCREWDRIVER SET £1.98
POCKET TOOL SET £3.98
DENTISTS INSPECTION MIRROR £2.85
JEWELLERS EYEGLASS £1.50
PLASTIC TWEEZERS 69p
PAIR OF PROBES WITH LEADS (cc) 77p



20,000 opv. Includes transistor tester. AC + DC volts. DC current. 4 very useful resistance ranges. We've used it and we like it.

SPEAKERS. Miniature, 8 ohm 87p
64-75 ohm 89p
CRYSTAL EARPIECE 65p
MONO HEADPHONES £2.96
TELEPHONE PICK-UP COIL 72p
MIN. BUZZERS. 6V. 50p. 9V. £1.10. 12V. 65p.
MAGNETIC EARPIECE 15p
STEREO HEADPHONES £4.35
F.M. AERIAL 49p

VEROBOARD 0.1" COPPER STRIPS
10 strips 24 holes £1.20 per 5
24 strips 37 holes 78p
24 strips 50 holes 89p
36 strips 37 holes 89p
36 strips 50 holes 99p
Terminal pins 0.1" 52p/100

PP3 CLIPS 10p
PP9 CLIPS 11p

EUROBREADBOARD £6.20
S DEC BREADBOARD £3.98
BIMBOARD 1 BREADBOARD £6.98
VEROBLOC BREADBOARD £4.20

PANEL METERS
50uA; 100uA; 1mA;
1A. 25V; 100uA-0;
100uA; 5A. AU
£4.98 each. State value.

BOOKS

SEMICONDUCTOR DATA BOOK Newnes £5.90
ELECTRONIC PROJECTS FOR HOME SECURITY £3.35
ELECT. PROJECTS IN PHOTOGRAPHY £3.35
110 ELECT. ALARM PROJECTS £5.35
MODEL RAILWAY PROJECTS £1.95
BASIC ELECTRONICS. Theory & practice £7.98
BEGINNERS GUIDE TO BUILDING ELECT. PROJECTS £1.50

ADVENTURES WITH MICROELECTRONICS

Similar to 'Electronics' below. Uses I.C.s. Includes dice, electronic organ, doorbell, reaction timer, radio, etc. Based on Bimboard 1 bread board.
Adventures with Microelectronics. £2.55
Component pack £29.64 less battery.

by Tom Duncan

ADVENTURES WITH ELECTRONICS

An easy to follow book suitable for all ages. Ideal for beginners. No soldering, uses an S-Dec breadboard. Gives clear instructions with lots of pictures. 16 projects—including three radios, siren, metronome, organ, intercom, timer, etc. Helps you learn about electronic components and how circuits work. Component pack includes an S-Dec breadboard and all the components for the projects.

Adventures with Electronics £2.40. Component pack £18.98 less battery.

ADVENTURES WITH DIGITAL ELECTRONICS

New book by Tom Duncan in the popular 'Adventures' series. This book of entertaining and instructive projects is designed for hobbyists, and students. It provides a stepping stone to the microprocessor.

The first part deals with the properties of some basic ICs used in digital electronics.

The second part gives details of how to build eight devices — shooting gallery, 2 way traffic lights, electronic adder, computer space invaders game etc.

For each project there is an explanation of 'how it works' and also suggestions for 'things to try'.

No soldering — all circuits built on 2 Bimboard 1 breadboards.

Adventures with Digital Electronics book £3.25. Component pack £42.50 ref EHDC. All the components needed including 2 breadboards and hexadecimal keyboard. Available less breadboards £29.98 ref EHDF. Both less battery.

DIRECTORY OF ELECTRONIC KITS AND MODULES

Fancy a new set of hifi speakers? What about electronic ignition — or a trip computer — for the motor? Or a computer-based central heating controller? The Hobby Electronics Directory of Electronic Kits and Modules is your guide to these and many other useful items available in kit or module form. This survey follows the format of our popular Directory of Electronic Components and Hardware Suppliers, published in our October '82 issue. The easy-to-read charts show 27 different categories of kits, and the sources from which they might be obtained, together with useful information on catalogues, mail order charges and so on.

Then the names and addresses of over 70 suppliers are listed, plus additional information which could not be included in the charts. Whatever it is you want, chances are you'll find a source for it through the Hobby Electronics Directory of Electronic Kits and Modules!

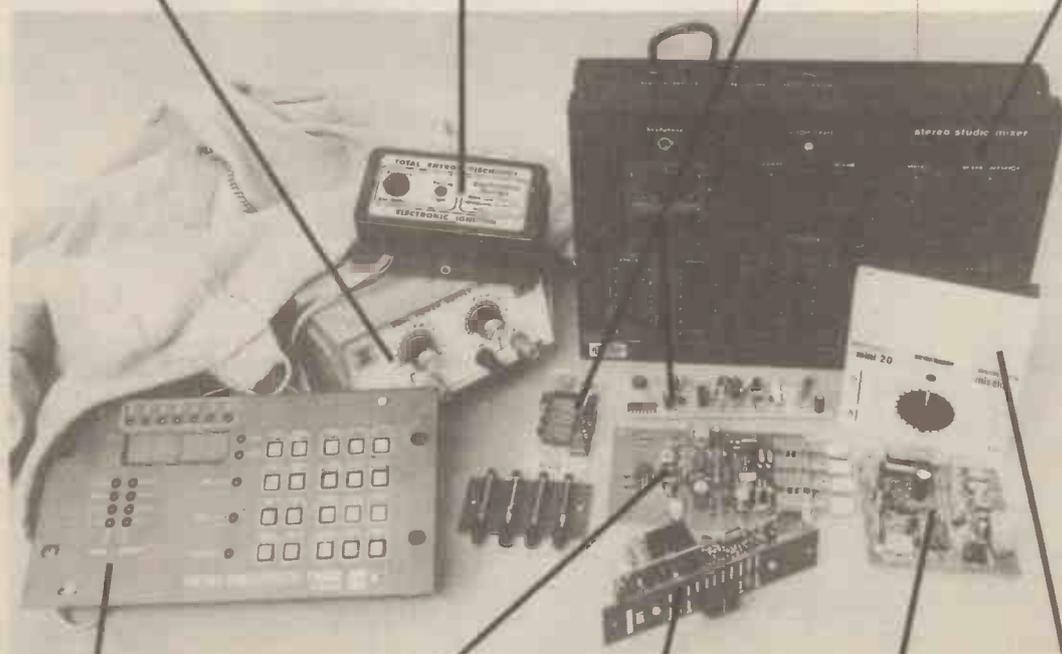
Our next survey, to be published later this year, will cover tools and test equipment for the electronics Hobbyist.

Dual Power Supply, from Branime Marketing Ltd.

Digital Voltmeter and Ultrasonic Alarm from Riscomp.

Electronic Ignition kit from
Electronize Design.

Audio Mixer kit by
Amtron (UK) Ltd.



BI-PAK FM Stereo Tuner modules.

TK Electronics'
Sound-to-Light Converter kit.

Microprocessor Controlled Timer,
by Velleman (UK) Ltd.

Power Dimmer, by L&B Electronics.

Modular Analog Multimeter
from Alcon Instruments Ltd.

NOTES

- (1) See Company listings, page 46 ff.
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- (4) P&P charges in pence, where applicable; R indicates included in prices; P = pro-rata or scale rate; W = write to enquire.
- (6) Barclay and Access, plus as noted.

	AERIALS	ALARMS	AMATEUR RADIO EQUIPMENT	AMPLIFIERS	CASSETTE UNITS	CB RADIO	CYBERNETICS	DISCO	EDUCATIONAL/SCIENTIFIC	ELECTRONIC GAMES	HIFI AMPLIFIERS	HOME ELECTRICAL/ELECTRONIC	LIGHTING EFFECTS	LOUDSPEAKERS	MAGAZINE PROJECTS	METAL DETECTORS	MICROCOMPUTERS
ACE MAILTRONIX																	
A.D. ELECTRONICS																	
AITKEN BROS.																	
AKHTER INSTRUMENTS																	
ALCON INSTRUMENTS																	
ALLWELD																	
AMBIT INTERNATIONAL																	
AMTRON (UK)																	
ANDERS ELECTRONICS																	
AUDIOTECH																	
BI-PAK																	
B.K. ELECTRONICS																	
BRADLEY MARSHALL																	
BRANIME MARKETING																	
S&R BREWSTER																	
J. BULL (ELECTRICAL)																	
CAMBRIDGE KITS																	
CAMBRIDGE LEARNING																	
CLEF PRODUCTS																	
CRICKLEWOOD ELECTRONIC																	
CRIMSON ELEKTRIK																	

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MICROCOMPUTER ADD-ONS	MOTORING	MUSICAL EFFECT UNITS	MUSICAL INSTRUMENTS	OPTO-ELECTRONICS	PCB MANUFACTURE	POWER SUPPLIES	REMOTE CONTROL	TEST EQUIPMENT	TURN TABLES	CATALOGUE/PRICE LIST (2)	MAIL ORDER MINIMUM (3)	P & P (4)	OVERSEAS ORDERS (5)	CREDIT CARDS (6)	SHOPS	OTHER	
										30	N	1	W				ACE MAILTRONIX
											N	N	W				A.D. ELECTRONICS
											N	1	W				AITKEN BROS.
											N	1	W				AKHTER INSTRUMENTS
												W	W				ALCON INSTRUMENTS
																1	ALLWELD
										70	01	60	1	1			AMBIT INTERNATIONAL
										SAE	1	50	W		1		AMTRON (UK)
										SAE	N	P	1				ANDERS ELECTRONICS
											N	P	1	1			AUDIOTECH
										100	N	75					BI-PAK
										SAE	N	W	W				B.K. ELECTRONICS
										75	N	60	1	1		1	BRADLEY MARSHALL
																	BRANIME MARKETING
											01	P	W			1	S&R BREWSTER
											1	1	W				J. BULL (ELECTRICAL)
												R	W				CAMBRIDGE KITS
											N	R	1	1			CAMBRIDGE LEARNING
											100	R	W				CLEF PRODUCTS
											N	70	1	1			CRICKLEWOOD ELECTRONIC
											N	R	W		1		CRIMSON ELEKTRIK

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	AERIALS	ALARMS	AMATEUR RADIO EQUIPMENT	AMPLIFIERS	CASSETTE UNITS	CB RADIO	CYBERNETICS	DISCO	EDUCATIONAL/SCIENTIFIC	ELECTRONIC GAMES	HIFI AMPLIFIERS	HOME ELECTRICAL/ELECTRONIC	LIGHTING EFFECTS	LOUDSPEAKERS	MAGAZINE PROJECTS	METAL DETECTORS	MICROCOMPUTERS
CYBERTRONIC		■					■										
DATAPLUS DEVELOPMENTS											■			■			
DECON LABORATORIES																	
DICON ELECTRONICS																	
DIGISOUND			■														
ELECTROLUBE								■			■						
ELECTRONIC HOBBIES	■							■			■					■	
ELECTRONI-KIT								■								■	
ELECTRONIZE DESIGN																	
EMOS								■									
ENFIELD ELECTRONICS		■		■				■	■	■				■		■	
EXPERIMENTAL ELECTRONICS		■						■									
GLOBAL SPECIALITIES								■									
GODDARDS COMPONENTS	■			■	■	■		■			■	■		■			
GREENBANK ELECTRONICS																	■
GREENWELD				■				■	■	■		■	■	■			
HART ELECTRONIC				■	■					■				■		■	
HARRIS & LOCKYER ASSOCIATES																	■
HEATH ELECTRONICS (UK)	■	■					■	■			■				■	■	
HENRY'S RADIO	■			■				■					■				■
HUNTER ELECTRONICS																	

NOTES

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MICROCOMPUTER ADD-ONS	MOTORING	MUSICAL EFFECT UNITS	MUSICAL INSTRUMENTS	OPTO-ELECTRONICS	PCB MANUFACTURE	POWER SUPPLIES	REMOTE CONTROL	TEST EQUIPMENT	TURNTABLES	CATALOGUE/PRICE LIST (2)	MAIL ORDER MINIMUM (3)	P & P (4)	OVERSEAS ORDERS (5)	CREDIT CARDS (6)	SHOPS	OTHER	
									■								CYBERTRONIC
									■			W			1		DATAPLUS DEVELOPMENTS
				■											1		DECON LABORATORIES
															1		DICON ELECTRONICS
		■	■			■			■	N	30	1			1		DIGISOUND
						■			■			W			1		ELECTROLUBE
■			■	■				■	■	N	P		1				ELECTRONIC HOBBIES
		■							25	N	P	W	■	1	1		ELECTRONI-KIT
	■								100	1	W	■		1			ELECTRONIZE DESIGN
						■			■	N	50	W					EMOS
				■	■				100	N	W	W	■				ENFIELD ELECTRONICS
				■					SAE	N	P	W	■				EXPERIMENTAL ELECTRONICS
								■	■	N	P	W	1	1			GLOBAL SPECIALITIES
■	■	■	■			■		■					■				GODDARDS COMPONENTS
									■	N	50	1	■				GREENBANK ELECTRONICS
		■				■			50	N	50	W	■				GREENWELD
■				■				■	■	N	P	W	■				HART ELECTRONIC
■	■								20	N	40	1	1				HARRIS & LOCKYER ASSOCIATES
■	■	■				■		■	28	N	R		1				HEATH ELECTRONICS (UK)
■				■		■		■	50	N	N	W	1	■			HENRY'S RADIO
■									£10	195	W						HUNTER ELECTRONICS

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	AERIALS	ALARMS	AMATEUR RADIO EQUIPMENT	AMPLIFIERS	CASSETTE UNITS	CB RADIO	CYBERNETICS	DISCO	EDUCATIONAL/SCIENTIFIC	ELECTRONIC GAMES	HIFI AMPLIFIERS	HOME ELECTRICAL/ELECTRONIC	LIGHTING EFFECTS	LOUDSPEAKERS	MAGAZINE PROJECTS	METAL DETECTORS	MICROCOMPUTERS
ILP ELECTRONICS			■							■							
INPUT DESIGN																	
JAYEN DEVELOPMENTS																	
KELAN ENGINEERING								■			■			■			
L&B ELECTRONIC MODULES							■					■					
LECTRO-LINES																	
LIGHTNING ELECTRONICS		■		■				■				■	■	■	■		
MAGENTA ELECTRONICS		■		■				■	■	■	■	■	■	■	■	■	■
MAPLIN	■	■		■	■			■	■	■	■	■	■	■	■	■	■
MERCIA ELECTRONICS																	
MIDWICH COMPUTER CO.								■	■	■					■		■
PHONOSONICS						■		■	■	■	■	■	■	■			
PHOTOETCH SERVICES																	
PIMAC SYSTEMS																	
POPS ELECTRONICAL	■		■	■				■			■		■				
PORTATIVE INSTRUMENTS													■				
T. POWELL															■		
POWERTRAN ELECTRONICS				■			■	■	■	■	■	■	■	■	■	■	■
RADIO COMPONENT SPECIALISTS				■			■	■	■	■	■	■	■	■			
RHEINBERG SCIENCE								■									
J.W. RIMMER				■			■			■							

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MICROCOMPUTER ADD-ONS	MOTORING	MUSICAL EFFECT UNITS	MUSICAL INSTRUMENTS	OPTO-ELECTRONICS	PCB MANUFACTURE	POWER SUPPLIES	REMOTE CONTROL	TEST EQUIPMENT	TURNTABLES	CATALOGUE/PRICE LIST (2)	MAIL ORDER MINIMUM (3)	P & P (4)	OVERSEAS ORDERS (5)	CREDIT CARDS (6)	SHOPS	OTHER	
										N	R	1		1			ILP ELECTRONICS
																	INPUT DESIGN
												R	1				JAYEN DEVELOPMENTS
										N	P	W					KELAN ENGINEERING
										N	75	W	1				L&B ELECTRONIC MODULES
															1		LECTRO-LINES
									70	N	50						LIGHTNING ELECTRONICS
									1	N	45	1					MAGENTA ELECTRONICS
									1	1	R	1	1	1			MAPLIN
										N	R						MERCIA ELECTRONICS
									25	N	50	1	1				MIDWICH COMPUTER CO.
									1	N	P	1	1		1		PHONOSONICS
									SAE	N	1						PHOTOETCH SERVICES
										N	100	W			1		PIMAC SYSTEMS
									150	60						1	POPS ELECTRONICAL
										N	P	W					PORTATIVE INSTRUMENTS
									100	50	W						T. POWELL
										N	N	W					POWERTRAN ELECTRONICS.
									31	50	50	1					RADIO COMPONENT SPECIALISTS
										N	1						RHEINBERG SCIENCE
									SAE	N	75	1	N				J.W. RIMMER

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	AERIALS	ALARMS	AMATEUR RADIO EQUIPMENT	AMPLIFIERS	CASSETTE UNITS	CB RADIO	CYBERNETICS	DISCO	EDUCATIONAL/SCIENTIFIC	ELECTRONIC GAMES	HIFI AMPLIFIERS	HOME ELECTRICAL/ELECTRONIC	LIGHTING EFFECTS	LOUDSPEAKERS	MAGAZINE PROJECTS	METAL DETECTORS	MICROCOMPUTERS
RISCOMP																	
ROADRUNNER ELECTRONIC																	
R.T.V.C.																	
SPARKRITE																	
SWIFT-SASCO																	
D.R. & J.G. TAYLOR																	
TECHNOMATIC																	
THURNAL ELECTRONICS																	
T.K. ELECTRONICS																	
UNILAB/RAINBOW																	
UNITECH (MIDLANDS)																	
VELLEMAN UK																	
WATFORD ELECTRONICS																	
WAVEBANDS																	
WERSI ORGANS & PIANOS																	
WILMSLOW AUDIO																	

NOTES

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MICROCOMPUTER ADD-ONS	MOTORING	MUSICAL EFFECT UNITS	MUSICAL INSTRUMENTS	OPTO-ELECTRONICS	PCB MANUFACTURE	POWER SUPPLIES	REMOTE CONTROL	TEST EQUIPMENT	TURNTABLES	CATALOGUE/PRICE LIST (2)	MAIL ORDER MINIMUM (3)	P & P (4)	OVERSEAS ORDERS (5)	CREDIT CARDS (6)	SHOPS	OTHER	
										N	50	W				1	RISCOMP
										1	1	1					ROADRUNNER ELECTRONIC
										£10	1		1				R.T.V.C.
										995	R	1					SPARKRITE
										N	N						SWIFT-SASCO
										N	1	W					D.R. & J.G. TAYLOR
										1	N	40	1				TECHNOMATIC
										1	1	W					THURNAL ELECTRONICS
										N	55	1					T.K. ELECTRONICS
										500	R	W					UNILAB/RAINBOW
										100	N	1				1	UNITECH (MIDLANDS)
										N	N	W	1	1			VELLEMAN UK
										50	N	50	1				WATFORD ELECTRONICS
										50	N	50	1				WAVEBANDS
										N	N	W	1	1			WERSI ORGANS & PIANOS
										150	N	P	1				WILMSLOW AUDIO

DIRECTORY OF ELECTRONIC KITS AND MODULES: COMPANY LISTINGS

Ace Mailtronix Ltd.,
3A Commercial St., Batley, West
Yorkshire WF17 5HJ. Tel:
(0924)441 129. Shop: Batley.
"Ace specialises in quotations for
projects in magazines."

A D Electronics,
217 Warbeck Moor, Aintree, Liverpool
L9 OHV. Tel: 051 523 8440. Shop at
this address.

Aitken Bros. & Co.,
35 High Bridge, Newcastle upon Tyne,
NE1 1EW. Tel: (0632) 326729.
Also do a full range of electronic
components.

Akhter Instruments,
Unit 19, Arlinghyde Industrial Estate,
South Rd., Harlow, Essex. Tel: (0279)
512639.

Alcon Instruments,
19 Mulberry Walk, London SW3 6DX.
Tel: 01 352 1897.

Allweld Engineering,
Unit 6, 232 Selsdon Rd., South
Croydon, Surrey. Tel: 01 681
6734/680 2995.
"We are the only manufacturers of
ALTRON products and sell direct to any
customer at trade price — this keeps
cost low and our prices competitive and
quality high. We also specialise in aerial
masts and towers — you can't suspend
your aerials in thin air!"

Ambit International,
200 North Service Rd., Brentwood,
Essex. Tel: (0277) 230909. Shop at
this address. Ambit say "We're just a
bunch of great guys, you know".
Overseas buyers write and enquire for
quotation, pay by credit card, or take a
guess at postal charges.

Amtron UK Ltd.,
7 Hughenden Rd., Hastings, East
Sussex, TN34 3TG. Tel: (0424)
436004. Shops: Amtronics, 8 Tollgate
Buildings, Tonbridge; Atel Electronics,
60 Gray St., Dundee; J. Birkett, 25 The
Strait, Lincoln; Basic Electronics, 18
Epsom Rd., Guildford; De La Salle

Electrical, 7 Sadlers Walk, Chichester;
Electronics World, la Dews Rd.,
Salisbury; Lee Electronics, 400 Edgware
Rd., London W2., Sternway Electrical, 6
Cathedral Place, London; Teleradio Co.
Ltd., 325 Fore St., Edmonton, London,
N9.

"Amtron UK Ltd. has been supplying
electronic kits to the British educational
market for the past ten years,
manufacturing special electronic devices
solely for their use.

The Manpower Services
Commission, Training Services Agency,
and education authorities chose to use
the Amtron range of kits because of the
excellent handbook which accompanies
each kit, giving full assembly
instructions, circuit diagrams, schematic
layout, the application the device can be
used for and a good description of how
the kit operates. It is not necessary for
the class instructor to be an engineer
himself.

The range of electronic kits exceeds
150, with new additions being added to
the range regularly. When the purchase
of an Amtron electronic kit is made,
there are no worries of finding extra
components to make the unit
operational as all kits are supplied with
printed circuit board and components.
Amtron also holds a very good supply of
spare parts should the need arise.

Amtron electronic kits have been
used in Europe for training purposes for
the past fifteen years. Each kit can be
supplied with assembly instructions
printed in French, English and Italian.

Each kit is attractively blister packed
with quality control inspection stamps
on each pack containing the
components. Only first class branded
components are used in each kit.

Amtron's technical staff are always
available to offer advice and technical
information on kits.

All kits are guaranteed to work when
assembled according to the supplied
instructions.

The range of kits varies from a simple
radio receiver, test equipment,
multimeters, disco lighting effects,
digital readout power supplies,
transmitters, audio amplifiers, mixers,
electronic music devices, digital clocks
etc."

Anders Electronics Ltd.,
48-56 Bayham Place, London NW1
OEU. Tel: 01 387 9092.

"Anders Electronics Ltd. is an
established supplier of electrical
measuring instruments to industry. Our
CEM-2 digital panel meter module and
many of our test and measuring
instruments (DMMs, AMMs, etc.) are
equally suited to the hobbyist's
requirements and are available from
stock." Overseas buyers should write,
stating requirements, for a proforma
invoice.

Audiotech,
8 Parsons Close, Church Crookham,
Aldershot, Hants GU13 OHL.
Tel: (02514) 22033.

Specialise in high-quality, state-of-the-
art audio products. Overseas carriage
charges listed in catalogue. Credit:
Access only.

Bi-Pak Semiconductors,
The Maltings, 63A High St., Ware,
Herts SG12 9AD. Tel: Ware 3442.

BK Electronics,
37 Whitehouse Meadows, Eastwood,
Leigh-on-Sea, Essex SS9 5TY.
Tel: (0702) 527572.

Bradley Marshall,
325 Edgware Rd., London W21BN.
Tel: 01 723 4242.

Specialise in Velleman kits and the
Crimson range of amplifier modules.
Overseas buyers write for quote on
bulky orders. American Express also
acceptable.

Branime Marketing Ltd.,
Balthane Industrial Estate, Ballasalla, Isle
of Man. Tel: (0624) 822705.

"Introducing a new concept in kits —
where all the design details are given so
that the enthusiast knows how and why
it works — education while you build!"

S & R Brewster Ltd.,
86-88 Union St., Plymouth PL1 3HG.

Tel: (0753) 665011.

"We stock a whole range of components for electronics; we stock kits by Velleman and Elektronikit, which cover most kit requirements.

J. Bull (Electrical) Ltd.,

34 America Lane, Haywards Heath, Sussex RH16 3QU. Tel: (0444) 454563. Shop at this address.

"We sell virtually anything electrical."

Cambridge Kits,

45 (H) Old School Lane, Milton, Cambridge CB4 4BS. Tel. Cambridge 860150.

"All kits complete to last nut and bolt, including case, all kits normally sent by return, money back assurance, drilled PCBs." Giro account no. 21 923 4000.

Cambridge Learning Ltd.,

Unit 99, Rivermill Site, St. Ives, Huntingdon, Cambs PE17 4BA. Tel: (0480) 67446.

"Self-instruction books on computing and electronics." Catalogue prices include overseas surface postage; customers who want airmail should write and enquire. Diners and Trustcard accepted as well as Barclaycard and Access and American Express. Payment should be by bank draft in sterling drawn on a London bank, or quote a credit card number.

Clef Products Ltd.,

44A Bramhall Lane, South, Bramhall, Stockport, Cheshire SK7 1AH. Tel: 061 439 3297.

"We deal direct with the public who therefore save about 35% off the price."

Cricklewood Electronics,

40 Cricklewood Broadway, London NW2 3ET. Tel: 01 452 0161. Shop at this address. Overseas buyers write for proforma invoice with requirements. American Express also accepted.

Crimson Elektrik,

9 Claymill Rd., Leicester LE4 7JJ. Tel: (0533) 761920. Distributors: Badger Sound Services, 46 Wood St., Lytham St. Annes, Lancs FY8 1QE; Bradley Marshall Ltd., 325 Edgeware Rd., London W12 1BN.

"Our kits consist of built, tested and guaranteed PCBs and the metalwork is pre-punched and printed. We aim for quality and reliability."

Cybertronic,

7 Station Rd., Off North Rd., Darlington, Co. Durham DL3 3GA. Tel: (0325) 59988.

"Design and manufacture of any circuitry from artwork to complete equipment. Training aids made to your spec."

Dataplus Developments,
81 Cholmely Rd., Reading, Berks RG1 3LY. Tel: (0734) 67027.

"Our one kit is the Zephion negative ioniser, a device for putting negative charge in the air in order to relieve stuffy atmosphere, headache, lethargy etc. Kit £21.50, ready built £29.80."

Decon Laboratories,

Comway St., Hove, Sussex BN3 3LY.

"Seno Kits available from retailers nationwide."

Dicon Electronic Ltd.,

Bond St., Bury, Lancs BL1 7DU. Dicon's speciality is their digital thermostat.

Digisound Ltd.,

14/16 Queen St., Blackpool, Lancs FY1 1PQ. Tel: 01 689 4138.

"Re magazine projects category: this is limited to kits of our own design plus, occasionally, kits where we assist in the design. We do supply components with particular emphasis on those used for electronic music."

Electrolube Ltd.,

Blaker Rd., Wargrave, Berks RG10 8AW. Tel: (073) 522 3014. Electrolube's kit speciality is the CM100 Circuit Maker, reviewed recently in HE. They also supply all kinds of cleaners and service aids for television, radio and electrical engineers.

Electronic Hobbies,

17 Roxwell Rd., Chelmsford, Essex CM1 2LY. Tel: (0245) 62149. Credit: Access only.

Electroni-Kit Ltd.,

388 St. John St., London EC1V 4NN. Tel: 01 278 0109.

"We supply interesting and educational practical kits entirely for the beginner — complete kits only (spares available). We were the first company to market "Hobby Electronics Kits" into the general hobby trade in the UK."

Electroni-kit's speciality is their Chip Shop Kits, straightforward projects needing only a soldering iron and a PP3 battery to complete them. They are also about to introduce an FX-Microcomputer kit with complete instructions for building and programming techniques.

Electronize Design,

Magnus Rd., Wilnecote, Tamworth B77 5BY. Tel: (0827) 281000.

"Electronic ignition kits for the Total Energy Discharge system. Available by mail order or personal collection."

Emos Ltd.,

High March Rd., Daventry, Northants NN11 4HQ. Tel: (03272) 5523.

"Basically a mail-order components suppliers, we will be opening an electronics supermarket here in 1983 and will also be doing a wider range of kits. We hope also to be able to accept credit cards in the future. We have vast

stocks of components and our prices are very competitive."

Enfield Electronics,

208 Baker St., Enfield, Middx. Tel: 01 366 1873.

Experimental Electronics,

335 Battersea Park Rd., London SW11. Tel: 01 720 2683. Shop at this address.

"Main products: 'Experimenter's Printed Circuit Kit', an inexpensive kit for the amateur who wants to learn how to make printed circuit boards (price £2.50, p&P 50p). Contents: four small boards, chemicals, instruction booklet; 'Printed Circuits for the Home Constructor' and '50 Suggested Circuits' booklet with circuit diagrams, chassis plans and part layouts for 50 interesting projects the amateur can build with salvaged or surplus components on PC chassis made with this kit. Circuits range from crystal sets to hifi amplifiers, scientific equipment, testers, alarms etc."

Global Specialities Corporation (UK) Ltd. (GSC),

Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ. Tel: (0799) 21682. Shops in Clacton, Cork, Blackpool, London. American Express also accepted.

Goddards Components,

110 London Rd., At. Albans, AL1 1NX. Tel: St. Albans 64162. Shop at this address.

"We hope also to open a microcomputer department early in 1983."

Greenbank Electronics,

92 New Chester Rd., New Ferry, Wirral, Merseyside L62 5AG. Tel: 051 645 3391.

"We have been trading for 12 years, and offer a range of computers of our own make, that anybody can put together"

Overseas carriage: £1.00 Europe, £3.50 elsewhere.

Greenweld Electronic,

443 Millbrook Rd., Southampton SO1 0HX. Tel: (0703) 772501. Shop at this address. "We stock a whole range of components, books, connectors, meters, boxes, etc."

Harris and Lockyer Associates,

33 Pedmore Close, Woodrow, South Redditch, Worcs. Tel: (0527) 24452. Overseas: surface mail: fixed charge of £2.00; air mail: write for quote. Credit: Access only

Hart Electronic Kits Ltd.,

Penylan Mill, Oswestry, Shropshire SY10 9AF. Tel: (0691) 2894.

Shop at this address. "Hart Electronic specialise in ultra high

quality hifi kits to designs of the foremost names in the field, eg John Linsley-Hood, E A Rule."

Heath Electronics (UK) Ltd.,
Bristol Rd., Gloucester GL2 6EE.
Tel: (0452) 29451.

"Everybody knows Heathkit. Part of Heath is Heathkit Continuing Education which does self-instruction courses in electronics, digital techniques and computers, etc." American Express also accepted.

Henry's Radio,
404 Edgware Rd., London W2 1ED.
Tel: 01 402 6822.
Shop at this address. Mail order to 11-12 Paddington Green, London W2.
"We do a lot of electronics junk and salvage, hifi cases, second hand monitors, etc. as well as electronic components." Accept Visa and Access for computing and components, American Express for test equipment and audio.

Hunter Electronics,
PO Box 5, Axminster, Devon EX13 5AS.

ILP Electronics Ltd.,
Graham Bell House, Roper Close, Canterbury CT2 7EP, Kent. Tel: (0222) 54778.

"Please keep an eye on use — we are expanding our range of amplifiers in kit form."
Sell through Technomatic, Maplin, Electrovalue among others. Overseas mail order charges: 15% added to total. ILP also have agents overseas.

Input Design,
Victoria House, Short Mead St., Biggleswade, Beds. Tel: (0767) 65767.

Jayen Developments,
12B Milton Rd., Highgate, London N6 5QD. Tel: 01 348 3538.
Overseas buyers send cash plus £1.00 extra postage.

Kelan Engineering, Ltd.,
Hookstone Park, Harrogate, N. Yorks.
"Kelan has been established for 13 years as a manufacturer of high quality PCBs and supply to all areas of electronics from the hobby engineer to aerospace and telecommunications. We aim to induce quality into all areas of industry by education at the correct starting point — the hobbyist. We aim for same day delivery and apologise if we are more than a week late."

L & B Electronic Modules,
34 Oakwood Place, Mitcham, Surrey.
"L&B take special pride in providing value for money in terms of high quality and performance backed up with an efficient dispatch service. We also have

a French and Scandinavian distribution network." Credit: Access only.

Lectro-lines,
101 Hainault Rd., Romford, Essex RM5 3HF. Tel: (70) 22018.
"We do a radio tuner module only."

Lightning Electronic Components,
18 Victoria Rd., Tamworth, Staffs BR9 7HR. Tel: (0827) 65767. Shop at this address.
"Lightning Electronic Components specialise in quick turn around of mail order, and a personal service to callers at our new showroom in Tamworth. Our catalogue is currently out of print but we are now accepting orders for our 1983 copy due in February/March 1983. Some items listed in the survey will not be available until the early months of 1983. You are advised to check first. Apart from the items listed we also supply a wide range of components, including some of the hard-to-obtain semiconductors. For this service we require an SAE with your requirements. Remember, for striking service, turn to Lightning!"

Magenta Electronics Ltd.,
135 Hunter St., Burton on Trent, Staffs DE14 2ST. Tel: (0283) 65435.

"We are specialist suppliers of components and kits of parts for magazine projects in this and other electronics publications. Our kits include all parts specified, nuts, screws, IC sockets, PCBs and miscellaneous hardware. As well as kits, we also supply a wide range of electronic components, tools, hardware and accessories for the hobbyist. See our catalogue and price list for the full range." Overseas buyers please send three IRCs, with a list of your requirements, for quotation.

Maplin Electronics,
PO Box 3, Rayleigh, Essex SS6 8LR. Tel: (0702) 554155. Shops in Hammersmith, London W6; Perry Bay, Birmingham; Westcliffe-on-Sea; Manchester (opening 1983). "All Maplin kits and modules are described in pages 205 to 209 of the Maplin catalogue."
Transcash and Mapcard (Maplin's own credit card) accepted, also American Express. Overseas buyers check prices in catalogue and newsletters.

Mercia Electronics,
Coronet House, Upper Well St., Coventry, West Midlands CV1 4AF. Tel: (0203) 58541.
"Complete PCB manufacturing kit suitable for hobbyist and R&D departments."

Midwich Computer Co. Ltd.,
Rickinghall House, Rickinghall, Suffolk IP22 1HH. Tel: (0379) 898751.
"Midwich specialises in microcomputer and digital components and offers a complete range with discounts for quantity. All orders, subject to availability, are dispatched same day."

Overseas orders add 10% for postage, etc. and pay in sterling.

Phonosonics,
22 High St., Sidcup, Kent. Tel: 01 302 6184.

"Friendly helpful suppliers with a breakdown service for our own kits. Over ten years of design and delivery!" Overseas buyers send £1.00 for export list and catalogue. American Express also accepted.

Photoetch Services,
8 Tufnell Gardens, Mackworth, Derby DE3 4DY.

"A specialist company dealing only with the in-depth requirements of DIY PCB making. As well as marketing established products we are currently engaged in developing a range of entirely new small scale PCB making aids. The company policy is to bring professional PCB making equipment to the small scale user. We offer free technical advice to our customers."

Pimac Systems,
20 Bloomfield Rd., Moseley, Birmingham B13 9BY. Tel: 021 449 0384. Shop: Birmingham (Tomorrows World Discount Centres).

Pops Electronical,
38-40 Lower Addiscombe Rd., Croydon, Surrey CR0 6AA. Tel: 01 688 2950. Shop at this address. "Kits! We supply by post and retail a range of kits for producing PCBs, ie ferric, drills, copper clad, etching pins, transfers, etc. We are the sole UK stockist of French Sub-Sub min. 12V, 10W soldering iron."

Portative Instruments,
23 Blenheim Rd., St. Albans, Herts AL1 4NS.
"HE organ and pedal kits are still available." Overseas buyers write for quote.

T. Powell,
311 Edgware Rd., London W2.
"Mainly specialise in ioniser kits."

Powertran Electronics,
Portway Industrial Estate, Andover, Hants SP10 3WN. Tel: (0264) 64455.

Radio Component Specialists,
337 Whitehorse Rd., Croydon, Surrey. Tel: 01 684 1665. Shop at this address.

"Established 1952, same ownership and management for 30 years. Same day mail order, showroom open every day except Wednesday and Saturdays." For overseas orders, send deposit and a detailed export invoice will be sent in return.

Rheinberg Science Ltd.,
Sovereign Way, Tonbridge, Kent TN9 1RN.

J W Rimmer,
367 Green Lanes, London N4 1DY.
Tel: 01 800 6667.

"We sell mainly to manufacturers, scientific and technical users, with some items of interest to the general public. We have a full audio and PA range and our speciality is very high powered amplifiers, with ranges starting from 100 watts up to about two and a half kilowatts."

Overseas buyers write with instructions for proforma invoice.

Riscomp Ltd.,
21 Duke St., Princes Risborough,
Bucks. Tel: (08444) 6326. Shop at this address.

"A range of security modules and accessories stocked, in addition to individual components. Also full range of VIC-20 computers and add-on units and software. Appointed Commodore dealer."

Roadrunner Electronic Products Ltd.,
Unit 3, The Haslemere Industrial Estate,
Weydown Rd., Haslemere, Surrey
GU30 1BT.

"Our kits are used for making up prototype printed circuit boards. Assuming the hobbyist has the components and a circuit we can provide the wiring system and boards on which to build the said circuit in kit form." Overseas mail order charges: 15% on catalogue prices.

RTVC,
323 Edgware Rd., London W2.
Tel: 01 723 8432.

"We are one of the oldest kit makers in the business, established since 1954." No overseas orders. Credit: Access only.

Sparkrite,
82 Bath St., Walsall, West Midlands
WS1 3DE. Tel: (0922) 614791.
"Sparkrite 'brand leading' range of auto electronic kits: we have been manufacturing kits for the DIY mail order market for ten years." Overseas customers send payment in sterling.

Swift-Sasco Ltd.,
PO Box 2000, Gatwick Rd., Crawley,
West Sussex RH10 2RV. Tel: (0293)
287000.

DR & JG Taylor,
24 Beckenshaw Gardens,
Woodmansterne, Banstead, Surrey SM7
3NB. Tel: (07373) 54474.

"We supply kits or parts kits at present for 'Elektor' projects and will be supplying CB and accessories and possibly test equipment. We can also supply some components not readily available to the general public."

Technomatic Ltd.,
17 Burnley Rd., London NW10 1ED.
Tel: 01 452 1500. Shops in North
West London and the West End. "We

hold large stocks of prime grade electronic components and a wide range of connectors. Same day return service is offered on all stock items. We also accept telephone orders if they are in excess of £5 on VISA/Access. Orders before 2.30 pm go out the same day." Overseas orders in sterling only; write for quote.

Thurnall Electronics,
95 Liverpool Rd., Caddishead,
Manchester. Tel: 061 775 4461.
"Latest releases: A/D board, RS232 interface and sound board. Software for joystick games available soon."

T K Electronics,
11 Boston Rd., London W7 3SJ. Tel:
01 579 9794. Shop: Hanwell, London
W7.

"TK Electronics specialise in kits which are useful in a large variety of applications. Examples of these are programmable digital timers for use in off-air recording, central heating control, etc., and general purpose remote control transmitters/receivers for controlling anything from room lighting, audio amplifiers, TVs, model control and motorised garage doors. The range also includes a low-cost system for switching any electrical appliance in the house from a central location by means of digital signals injected into the mains wiring. Other kits include digital thermometers, disco lighting units, digital lock and a range of light dimmers. A catalogue is available free of charge on receipt of an SAE of minimum size 6" x 9"."

Unilab/Rainbow Ltd.,
Clarendon Rd., Blackburn, Lancs.
Tel: (0254) 57643.

"We sell primarily for use in schools and colleges."

Unitech (Midlands),
Freeport, Sutton Coldfield, West
Midlands B74 2BR.
"Unitech (Midlands) offers a unique range of telephone equipment kits. Products include a telephone monitor kit and a remote control bell kit. The kits are easy to build and are ideal beginner's kits. We will be extending our range to include remote control devices and a unique slide/tape synchroniser." Overseas buyers pay by sterling bank draft.

Velleman (UK) Ltd.,
PO Box 30, St. Leonards on Sea, East
Sussex. Tel: (0424) 753246. Kits
available direct or from: Marshalls
Electronics, 85 W. Regent St.,
Glasgow; S & R Brewster, 86-88 Union
St., Plymouth; Bradley Marshall,
Edgware Rd., London; Baxol Tele
Exports Ltd., Ballinacash, Post
Rathdrum, Co. Wicklow, Eire.
"Kits are well packaged in clear plastic containers suitable for component storage. Any kit which is assembled and

fails to operate can be returned and will be repaired and returned to the customer with engineer's note on where error occurred. Nominal charge made, where only little damage is done no charge at all is made. Our engineers happy to supply advice for applications." Credit: Barclaycard only.

Watford Electronics,
35 Cardiff Rd., Watford, Herts.
Tel: Watford 40588.

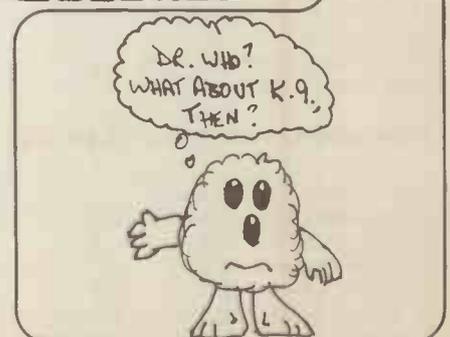
"Terms of business: cash/cheque/POs or banker's draft with order. Government and educational institutions' official orders accepted. Trade and export enquiry welcome. Overseas orders postage at cost, air or surface. Access orders welcome. Please add 15% VAT to total costs including p&p. We stock thousands of items. It pays to visit us. We are situated behind Watford Football Ground. Nearest station: Watford High St. Open Monday to Saturday: 9am to 6pm." Watford add that overseas postage charges can only be estimated.

Wavebands,
103 Coventry St., Kidderminster,
DY10 2BH.
Overseas buyers add 6% currency surcharge.

Wersi Organs and Pianos Ltd.,
14-15 Royal Oak Centre, Purley,
Surrey. Shops in Purley, Birmingham,
Barnsley; agents in Whitstable, Ipswich,
Rickmansworth, Nottingham, Preston,
Newquay, Edinburgh. "We market WERSI kits: up to the minute designs in kits, intended for the technical and non-technical constructor. Organs, pianos and associated equipment are included in the range." Credit: Access only.

Wilmslow Audio,
35/39 Church St., Wilmslow,
Cheshire SK9 1AS. Tel: (0625)
529599. Shop at this address.
"Specialise in hifi and PA
loudspeakers. We are the largest firm in the country dealing specifically with loudspeakers. We have two demonstration rooms. We have the largest selection of kits and drive units in the country." Overseas buyers write for export price list. American Express, Hifi Markets and Photomarket Budget Card also accepted.

Beasties



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Learn the wonders of digital electronics!

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All prices include worldwide postage (airmail is extra - please ask for prepayment invoice). Giro A/c No 2789159. Please allow 28 days for delivery in UK.

-SUPERKIT(S) @ £19.90
-DIGITAL COMPUTER DESIGN(S) @ £8.50
-DIGITAL COMPUTER LOGIC AND ELECTRONICS @ £6.00

I enclose a *cheque/PO payable to Cambridge Learning Ltd for £..... (*delete where applicable)

Please charge my:

*Access / American Express / Barclaycard / Diners Club Eurocard / Visa / Mastercharge / Trustcard

Expiry Date..... Credit Card No

Signature.....

Telephone orders from card holders accepted on 0480 67446 Overseas customers (including Eire) should send a bank draft in sterling drawn on a London bank, or quote credit card number.

Name.....

Address.....

Cambridge Learning Limited, Unit 93 Rivermill Site, FREEPOST, St Ives, Huntingdon, Cambs, PE17 4BR, England. (Registered in England No 1328762).

Greenbank
Greenbank Electronics.

Dept E2H, 92 New Chester Road,
New Ferry, Wirral, Merseyside L62 5AG
Tel. 051-645 3391

READ THIS IF YOU VALUE YOUR JOB

I am writing to a worried man (or woman). I am writing to you. Are you scared of computers? Well not scared of the computers themselves, but scared of what they can do. Pretty well everywhere at work, on TV, these micro-things are being seen more and more all the time and you seem more and more to be getting left behind.

Do you have colleagues who are always spouting on and on about computers? Do you understand a word of what they're saying? Be honest, do you? Do you understand a word of what they're saying really, or are they just speaking words they've read out of a magazine or heard on T.V?

What you need is a friend, an honest friend, who will try to help you. I will be your friend, I am your friend. My name is David Parkins, why not write to me or phone me? (my number is 051-645 3391).

I said I would be an honest friend so I'll begin now — I work for a firm which sells a computer in kit form, and I would like to sell you one. The name of the computer system is 'Interak 1'. I know you are going to buy a computer kit of some sort very soon, because you just can't let things go on as they are. 'Computing' is a club, and you're not a member yet. Worse still you may have bought a computer and found you still haven't a clue what goes on inside. Miracle chips they may be but it will be a miracle if you can understand what they do by just looking at them.

What I want to sell you is not just the pieces, I want to sell you 'the knowledge'. Then you'll know as much as I do, and you won't need me anymore. All I ask from you is that when you know what computing is really all about, that you treat others in the same way that you would like to be treated. Don't sneer at them because they don't know the difference between PASCAL and BASIC, they don't know what an RS232C interface is, or how a UART works, remember we all had to start somewhere.

Computers are not made to make our lives easier and happier (and richer) if they are used wisely, so it is vital that everyone be introduced to the 'Computer Club' as quickly as possible. Once everyone knows about computers we will be free to continue to make an honest living — at the moment there are all sorts of people who are unscrupulously taking money from innocent people by taking advantage of their ignorance, and I for one just don't want to be a part of a business like that. Just read through a few advertisements, and think to yourself how can they all be the best?

When I said I am writing to sell you 'the knowledge' please don't think I am offering a correspondence course. In my view that's not a suitable way to learn — a course has to proceed in simple logical steps — how an 'AND gate' works, and what is a 'flip-flop' and so on — microcomputers have left all that simple stuff behind long ago and you'll never catch up that way.

Learning computing is a bit like learning to swim, but you've got no time to waste. What I think you need is to be plunged in at the deep end — there's no time for splashing about in the paddling pool learning a bit at a time. But if you're going in at the deep end you'll need a friend to save you from drowning — that's what I'm here for.

Of course it's not like swimming in one important respect — you have to buy a computer first before you can enter the water. Down at the shallow end this will cost you about £50 with a further £50 for the necessary RAM (memory). — at the deep end, where you'll find me, the cost is at least double.

I bet you're saying 'some friend this — he's already wanting me to spend twice as much as I thought'. Well it's true, I think you have got to, and here's why: The cheap systems are built down to a price — the 'chip count' (number of integrated circuits used) has to be kept right down, preferably to four or five. There are two penalties to be paid. Firstly, no real expansion can be accommodated — the system will go so far then no further, secondly some special design 'tricks' have to be incorporated to make the chips do double duty and get the maximum performance out of the minimum resources. Don't get me wrong — some of the tricks are brilliant but the whole point in your buying a computer is so you can get an understanding yourself, not simply looking as a lump of silicon (integrated circuit) where all the skill is buried. Once the design is 'encapsulated' in a master integrated circuit there's no way you'll ever find out what's inside unless the designer chooses to tell you, and he's hardly likely to tell you — he might want to use the same idea in the Mk II model next year!

Some people go into this with their 'eyes open' — but I think computing has come to a pretty poor state of affairs if you have to be prepared to throw away a hundred pounds or so on a system which cannot expand with you, but has to be replaced by the next model annually. I would also say beware of committing the diametrically opposite mistake — a gimmick computer. This is one which is all things to all men. You name it, it's got it. This processor, that processor as an option. Level 1 expands to level 2 which has the optional what not interface which can easily be adapted for this or that.

Do you think the purchase of a computer is going to solve your problems? Of course not, learning is hard work. My computer (Interak 1) is ideal for your purposes. I assume that you don't really know much about computers, you've probably got an interest in electronics, and with all the publicity that these micro chips are getting in magazines, TV, radio and newspapers you know that you've got to know all about them. Well I'll let you into a secret and give you some valuable information. There's too much going on for you to learn everything and new information is being created every day at such a rate that the longer you leave it to get caught, the harder it will be to catch up.

Ask almost anyone what makes a good computer and they'll describe a monster. I'll show you the way to obtain sufficient knowledge to use computers for your pleasure, your work, and so that you can, if you want to, help others. It's all very well having a computer that has everything, but if you have too much hardware you'll be like the old woman who lived in the shoe — you won't know what to do.

I have a friend who has bought an Interak 1 System. (I say he's a friend but at the moment he thinks he's just a customer) and he's received a parcel, he's opened it and checked that he's got what we think we have sent him and I imagine he's ploughing his way through the manuals (yes one of the problems of being presented with a lot of information is having to read it all — carefully). He's got a lot of work ahead of him. Although he doesn't understand what it's all about, he'll learn from reading the manuals how to assemble the computer from its component parts, and then how to make it work.

I've put a lot of time and effort into this friendship, writing the words, and drawing what I think are helpful diagrams. I'm sure my friend will write to me with his problems and I'm also sure he will be delighted with his computer and any helpful remarks I may make.

I admit most of my answers to his problems may take the form of 'application notes', in fact most of them will, but that's just the way that I cope with helping lots of friends (when I get a letter with a problem or more often a list of something I've put in the manual, I write my answer in the form of an application note, then if I'm presented with the same problem again I can quickly give a well thought out answer in an application note with maybe just a covering letter.)

You've got a problem at the moment, you've either got a computer and not been able to learn all you need to know, or you haven't got one yet. Don't just go out and buy the first computer you see, or the biggest or the cheapest, but the one that will help you to solve your problems. Remember that I'm here to help you, I've got a leaflet/data sheet set, that will probably tell you everything you need to know about my Interak 1 System. Write to me at Greenbank Electronics, using the above address and ask me to send you my Interak 1 leaflet. Now I warn you, there's quite a lot that I'll send you (about 38 sides of A4-size paper). It's type-written, with some hand drawn illustrations of the various kits. Of course it costs quite a bit to send through the post so an A4 SAE would be appreciated but as you are my friend, if you don't enclose one I won't mind. By the way I'll probably enclose leaflets on some of the other things that my company sells but as I say to people I speak to, 'if I give you a leaflet you don't want please don't be offended'.

I'm being honest with you, I'm trying to make you into an Interak 1 user, because the more people who have this system, the more people I'll be able to exchange my programs with, and that's important.

You might not think that you are capable of building up a sophisticated computer system from component parts, but you need have no worries on that score. You do of course have to work carefully and patiently, but that's all you have to do. I haven't met anyone yet who was incapable of doing the job. Some people need a bit of help, some people need more help than others, but the way I look at it is that if you can't follow the instructions I have provided then it's my fault not yours. The same applies to testing the completed computer. If you make a board and you can't get it to work, I am here to help you — just pop the board into the post to me, and I'll plug it into my own system and will soon get it going for you.

Even if you don't buy the Interak 1 System then I do urge you to buy some sort of computer as soon as you can. If you have any children this is even more important. Children need computers almost as much as they need food and drink. There never was a more nutritious food for a young mind than a digital computer. Without a preconceived feeling that computers are somehow mystical, children are in a far better position to learn than we mere adults.

So far I have only let you think that the Interak 1 System will cost you money, but there are plenty of ways it will bring money in. Obviously if you have your own business you will know how much time and money a computer will save. And if you have brought yourself up to a standard where you can write your own programs and fix the system yourself (not that it will go wrong, you built it — remember) there won't be any hidden overheads to be paid. Other ways you can make money are writing programs that you can sell, or even writing a book. Don't think that you have to be particularly clever to do this. There may be thousands of people less fortunate than you who will be dying to hear of another's experiences. The last thing they will want will be some high faluting tome written by some lab-dicta-computer buff.

I look forward to hearing from you so I can tell you about my Interak 1 Computer. Write soon, David.

POP-AMPS

Owen Bishop

Simple measuring circuits based on operational amplifiers

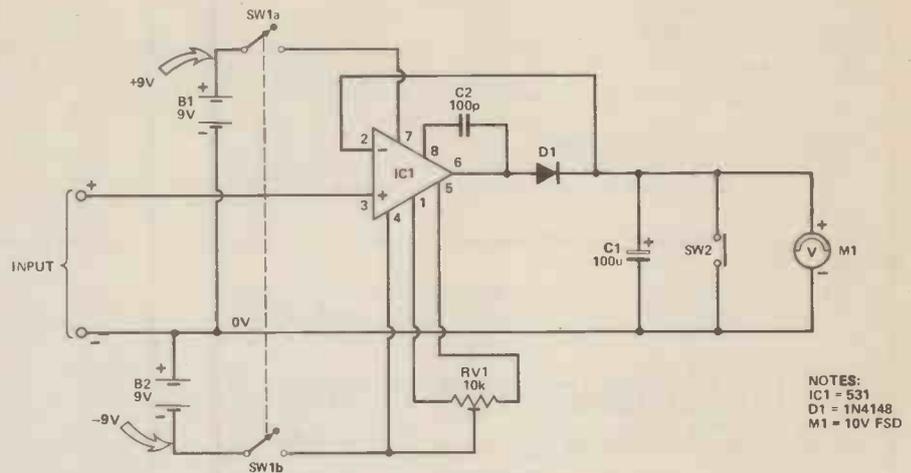
No. 5: Peak Voltage Detector

SOMETIMES we want to be able to measure a voltage that is rapidly changing, but it may be changing so fast that we cannot take the reading quickly enough, or the needle may not follow the changes. Again, a brief surge of voltage may be over before the needle has had time to respond! The Follow-and-Hold circuit described in the December 1982 issue could be helpful here, but if you want to measure the *highest* voltage reached, you will need to act quickly to press the button at just the right moment! In these circumstances a Peak Voltage Detector can be of great help. As its name implies, it detects the maximum (or peak) voltage fed to its input during a period of time, and shows this value on the meter as a steady reading. The circuit is shown in Figure 1.

Essentially it consists of the unity-gain voltage follower described in No. 4, with the addition of a diode (D1) and capacitor (C1). This circuit uses a 531 op-amp which has a very high 'slew rate'; this is the maximum rate at which output can change. For the 531, the slew rate is 12V/us compared with 1V/us for the 741 op-amp. When a rising voltage is applied to the non-inverting input (pin 3) the output at pin 6 rises rapidly. It continues rising so as to bring the voltage at the inverting input (pin 2) to the same value as that at the non-inverting input. The feedback to the inverting input is by way of the diode D1, so the voltage actually fed to the inverting input is approximately 0V6 lower than output voltage at pin 6.

The positive swing of the output continues until the output is 0V6 less than the input voltage, at which time the voltage at point 'A', and at pin 2, is exactly equal to the input voltage. Now, as the input voltage continues to rise, the output rises correspondingly and the capacitor becomes charged to that voltage, but the voltage is indicated on the meter only if the rate of rise is slow enough for the needle to follow it.

If the input voltage now falls, the output from pin 6 also falls, but because of the diode this can have no effect on the voltage at point 'A'. The capacitor retains its charge more-or-less without loss for a period of several tens of seconds and, during this time, the meter needle has a chance to catch up with voltage changes,



NOTES:
IC1 = 531
D1 = 1N4148
M1 = 10V FSD

Figure 1. Another simple circuit; Peak Voltage Detector.

displaying the peak voltage that was reached. If the input voltage then increases and exceeds the previous maximum, the needle will show the increased peak reading.

Following a peak input, the charge slowly leaks away from the capacitor and the meter reading slowly falls. The rate at which this happens depends mainly on the current taken by the meter itself. If the meter has a 20kR/V coil and is on its 10V range, and if the peak voltage reading is +5V, the leakage current through the meter is 25uA. To this must be added a leakage of about 8uA through the capacitor, if it is an aluminium electrolytic type. Reverse leakage through the diode is less than 0.01uA and so can be ignored; a further 0.25uA leaks away to the inverting input. At this rate of leakage, a reading of +5V will have dropped by approximately 0V33 at 1 second after the peak. This sounds rather rapid, but it is quite easy to see the value to which the meter needle rises before it begins to fall, and a usefully accurate reading can be obtained — after all, the pulse that initiated the reading may have lasted for only a few milliseconds. However, ways of reducing leakage will be discussed later.

Resetting

The rate of fall of the needle becomes reduced with time, and may take several tens of seconds to return to zero. It is convenient, therefore, to fit a Reset button, SW2. When this is pressed the capacitor is immediately discharged and the meter reading returns to zero. Capacitor C2 is the

frequency-compensating capacitor, needed with this op-amp to maintain constant gain over a wide range of frequencies.

Using The Circuit

Switch on the power and select the voltage range required on the meter. Join the input terminals together; the output should read 0V — if not, adjust RV1. Now the input terminals should be connected to the appropriate points of the circuit to be monitored. The meter indicates the maximum voltage attained during the period of monitoring. To begin a new period, press the Reset button briefly.

Reducing Leakage

Although the circuit is perfectly adequate for most purposes there may be occasions when you want to have plenty of time in which to carefully read the peak value. As the discussion above showed, the greatest leakage is through the meter coil. The obvious way to eliminate this is to replace the meter with the complete Very-High-Impedance Voltmeter circuit described in Pop Amps No. 4. At a 5V peak, the leakage to this circuit will be only 5uA, assuming you are using a CA3140 operational amplifier in the very-high-impedance circuit. With 531 as peak voltage detector followed by a CA3140 as high-impedance voltmeter, the rate of fall from a 5V peak is only 0.08V/s, giving you plenty of time in which to take your reading. The only serious leakage is through the capacitor, especially if it is old. If you find that the rate of fall is still too great, try replacing the

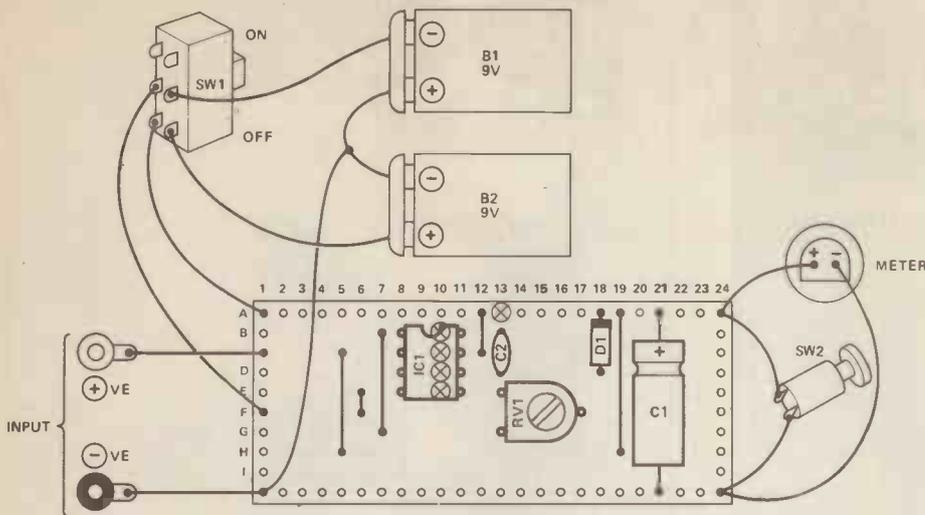


Figure 2. The component layout, viewed from the top; track cuts are marked by a circled "X".

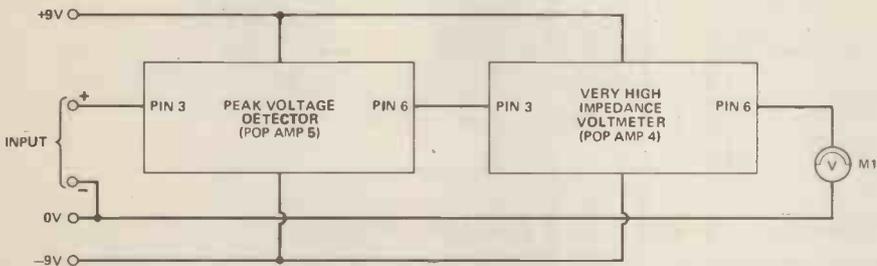


Figure 3. Better performance is obtained by using the Peak Voltage Detector together with the High Impedance Voltmeter.

capacitor with a new one or, better still, replace it with a tantalum bead capacitor (100uF, 10V). When using two amplifier ICs they can share the +9V and -9V power supply; the complete inter-board wiring is shown in Figure 3.

HE

Parts List

POTENTIOMETERS

RV1 10k
min. horizontal preset

CAPACITORS

C1 100u
10V electrolytic
C2 100p
polystyrene

SEMICONDUCTORS

IC1 531
op-amp
D1 1N4148

MISCELLANEOUS

M1 10V FSD
SW1 DPST
toggle or slide
SW2 SPST
push-to-make

Stripboard, 63 x 25 mm (24 holes x 10 strips); 2 x 9V batteries + clips; 4 x 4 mm sockets; terminal pins, wire, solder etc.

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Hardware Kit HW 4012 £4.25 + VAT

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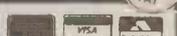
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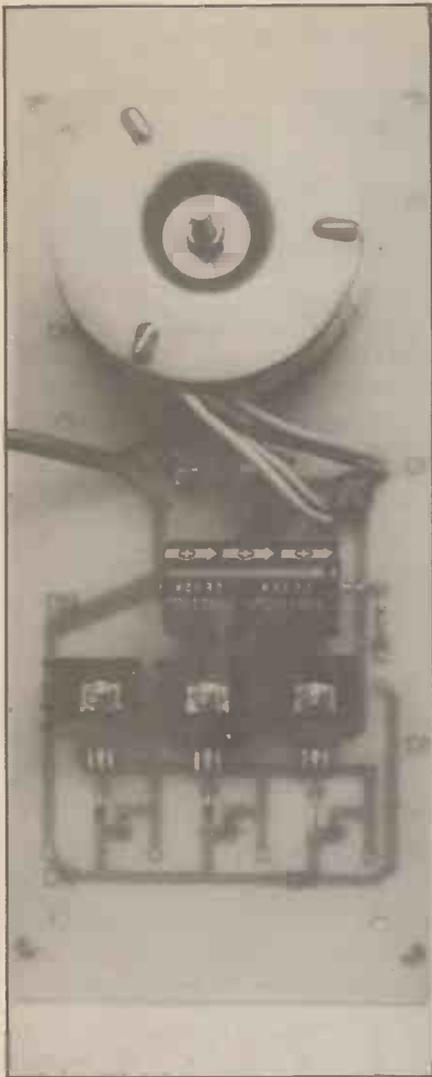
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<p>3005-00 Instrument Cabinet H 54mm, W 82mm, L 145mm £5.27 inc VAT All Aluminium</p>	<p>3006-70 Instrument Cabinet, H 68mm, W 263mm, D 216mm £11.58 inc VAT All aluminium</p>	<p>3003-00 Heat Sink Box, H 78mm, W 72mm, L 143mm £5.00 inc VAT</p>



DigiTester

Paul Kelly

Part 2: PSU

A simple but versatile power supply for the DigiTester or other digital circuitry.

THE DIGITESTER is intended to work with external circuits based on either TTL or CMOS technology. TTL devices operate on +5V supplies, whereas CMOS devices may be powered by any supply between 3V & 18V with 5, 10, or 15V being the most common. Now, in order for the interface between the circuit under test and the DigiTester to work correctly, both must operate from comparable voltage supplies. Accordingly, the power supply for the DigiTester has been designed to switch between +5, +10 and +15V. In the event that you find yourself needing to test CMOS circuitry operating on some other voltage, it is possible to change one or more of the standard voltages provided by the DigiTester supply; small differences in voltages can usually be tolerated, eg the circuit under test supplied from +9V with the DigiTester switched to 10V (it should always be higher).

The first stage of the PSU of Figure 1, comprising T1, BR1 and C1, produces

from the mains an unregulated DC supply of about 20V. T1 is a toroidal transformer, chosen for its convenient size and mounting requirements, and has other advantages of low 'hum' and low stray magnetic fields. If you find yourself unable to afford the slightly higher cost of such a transformer then a conventional laminated transformer of a similar specification may be substituted. Resistor R1 and the LED are present purely to indicate whether the supply is on or off.

The three voltage supplies are provided by three low cost regulator ICs, type 7805 5V regulators. IC1 has a 10V Zener diode in series with its common or Ground lead so that the output of the regulator is maintained at 15V (5 + 10). In a similar way, IC2 is made to provide a 10V regulated supply. Note that the input voltage to IC2 is the output of IC1, and that the input of IC3 is the output of IC2. This ensures that the voltage differential from input to output, for any of the

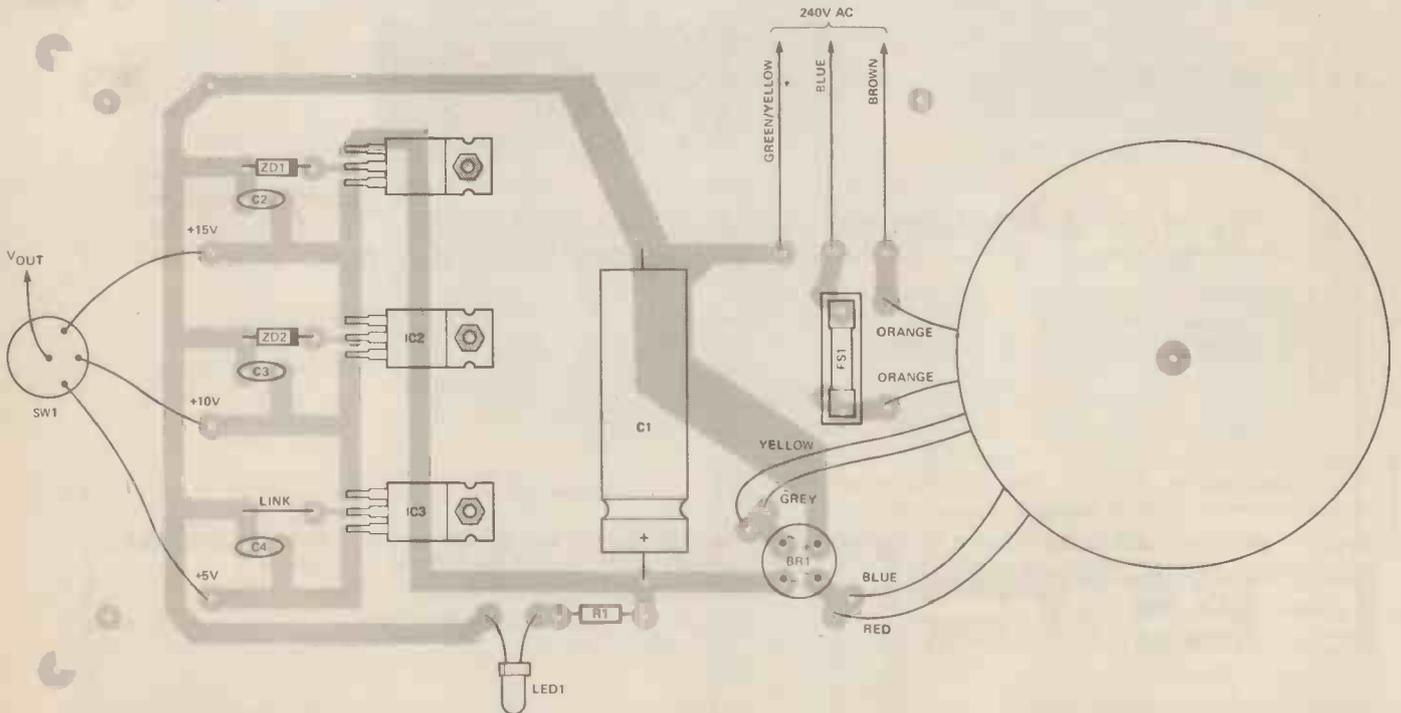


Figure 2. The PCB component overlay. In use, the board should be mounted in a simple case, using the four mounting holes. A third Zener can be substituted for the link in common lead of IC3 to provide a voltage other than 5V, if required.

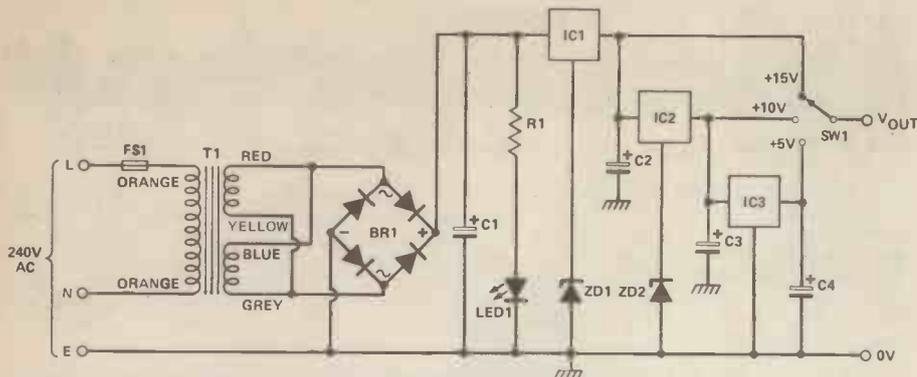


Figure 1. The PSU circuit; component values are given in the Parts List.

regulators, is limited to a maximum of about 5V. When, for example, current is consumed from the +5V line it passes from the unregulated supply through IC1, IC2 and IC3, so that the three ICs dissipate similar amounts of heat due to the comparable voltage drops. In this way the ICs may operate with only a small heatsink each – if a single regulator were to be switched by Zeners in its common lead over the required range, its dissipation at 5V output would be considerable; or else it would be necessary to switch a multi-tapped transformer. It is recommended that, with the heatsinks as shown, the total output current be limited to about 500mA, which is more than adequate for the CMOS circuitry of the DigiTester.

The output voltages may be changed if required by changing the value of ZD1 or

ZD2 (O/P = V(ZD) + 5V). The switch, SW1, is used to select the required operating voltage for the DigiTester.

Last month we introduced the DigiTester project, describing it as a series of modules that could be connected together to form a highly flexible and useful piece of test equipment. This is still our intention but, unfortunately, severe problems have been encountered in devising a cheap, effective method of connecting the modules together; our first method ("so simple it has to work!"... ha!) turned out to be extremely awkward. Therefore, the remaining parts of the DigiTester project are being temporarily postponed until the larger problem has been solved.

HE

Parts List

RESISTORS

(All ½ watt carbon)

R1 1k2

CAPACITORS

C1 2200u

35V electrolytic

C2,3,4 1u

25V tantalum

SEMICONDUCTORS

IC1,2,3 7805

5V regulator

BR1 W005

50V/1A bridge

ZD1 10V/400mW

Zener diode

ZD2 5V/1/400mW

Zener diode

LED1 any LED

20 mA max.

MISCELLANEOUS

T1 0-15V, 0-15V

toroidal transformer, 30VA

SW1 rotary switch

single pole, three-way

2A anti-surge fuse; 20mm PCB

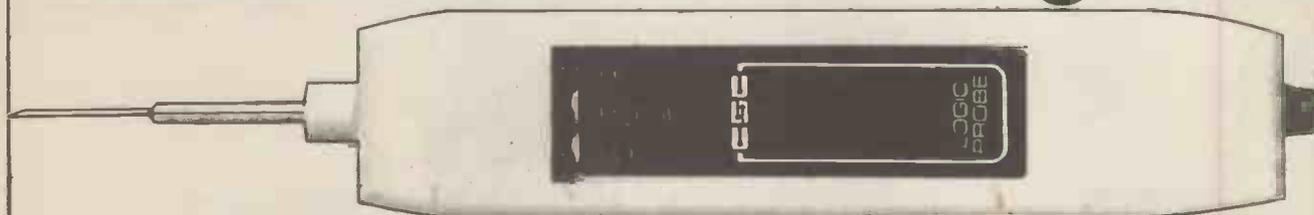
mount cartridge fuse holder; PCB

mount cable clamp; heatsinks; PCB,

wire, solder etc.

BUYLINES page 34

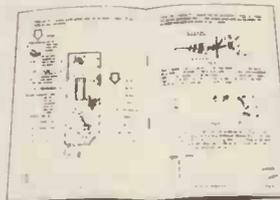
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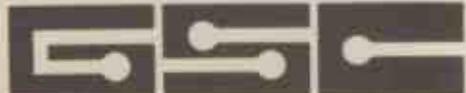
With this easy-to-build Logic Probe Kit from GSC and just a few hours of easy assembly – thanks to our very descriptive step-by-step manual – you have a full performance logic probe.

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Peter Rony

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Prices are correct at the time of going to press but may be subject to change.

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Look in the Book

A guide to the people who produce books about electronics.

WAS IT NOT ISAAC AZIMOV, best known as a prophet of the technological future, who once decided to look closely at the most effective way of storing and absorbing information for everyday use, and came to the conclusion that the ideal 'information module' very much resembled a book?

Well, Azimov may have had a vested interest in his support for books, but their appeal is unlikely to be outstripped by information technology for a while yet. Portable, compact, with all the information instantly and simultaneously available, even (if you are not one of those people who regard writing in margins as a form of

depravity second only to carving your name on ancient monuments) user-updatable! As if to prove a point, one boom area in books is variations on the theme of 'teach yourself to program a microcomputer'.

Which brings us to the subject of books written specially for the hobby engineer or programmer. Up till now, it has often been hard for hobbyists, especially in remote corners of the country, to find out just what books are available, and where. There are very few specialist publishers or bookshops for electronics, amateur radio and microcomputing. We've done our best to round them up

here and give them a chance to introduce their wares.

To get more news of contents, prices, titles etc., you can write to the publisher for a catalogue. Having got the information and made your choice, you could order straight from the publisher, but it's normally better to order through a local bookshop, as publishers are geared to supplying bookshops, and you will probably find it quicker, and even cheaper. Otherwise, you may end up having to pay quite heavy postage charges.

Let's let the book people speak for themselves.

1982/83

BABANI BOOKS



Babani

Bernard Babani (publishing) Ltd. has had over 40 years of experience in publishing radio, electronics and computer books, having evolved from the original Bernards Publishers Ltd., which was founded by the late Mr. Bernard Babani in 1942. We offer one of the largest ranges of titles available, which covers practically every aspect of radio, electronics and computing. If you send us your name and address we will send you our latest catalogue completely free of charge.

Our philosophy is to offer the best value possible in technical books and the majority of our titles are no more expensive than ordinary fiction paperbacks, averaging about £1.95 in price. We are able to achieve this remarkable value by printing enormous quantities and by using the latest editorial and paperback production techniques.

We feel that the following books will be of special interest to beginners and young electronics hobbyists:

227: *Beginners Guide to Building Electronic Projects* by R A Penfold (£1.95). The purpose of this book is to enable the complete beginner to tackle the practical side of electronics, so that he or she can confidently build the electronic projects that are regularly featured in the popular magazines and books. Subjects such as component identification, tools, soldering, various constructional methods (Matrixboard, Veroboard, PCB), cases, legends, etc., are covered in detail and practical examples in the form of simple projects are given.

BP48: *Electronic Projects for Beginners* by F G Rayer (£1.95). Contains a wide range of easily made projects with a considerable number of actual component and wiring layouts to aid the beginner. A number of the projects have been arranged so that they can be constructed without any need for soldering.

BP92: *Electronics Simplified - Crystal Set Construction* by F A Wilson (£1.75). This is a book especially written for those who wish to participate in the intricacies of electronics more through practical construction than by theoretical study. It is designed for all ages upwards from the day one can read intelligently and handle simple tools.

BP97: *IC Projects for Beginners* by F G Rayer (£1.95). This book offers a range of fairly simple projects based around a number of popular inexpensive linear and digital integrated circuits. With most of the projects, complete layout and/or point-to-point wiring diagrams are included to help simplify construction.

BP107: *30 Solderless Breadboard Projects - Book 1* by R A Penfold (£2.25). A solderless breadboard is simply a special board on which electronic circuits can be built and tested.

The components used are just plugged in and unplugged as desired. The 30 projects featured in this book have been specially designed to be built on a Verobloc breadboard. Wherever possible the components used are common to several projects, hence with only a modest number of reasonably inexpensive components, it is possible to build, in turn, every project shown.

BP115: *The Pre-Computer Book* by F A Wilson (£1.95) (To be published in 1983). Aimed at the absolute beginner with no knowledge of computing, this entirely non-technical discussion of computer bits and pieces and programming is written mainly for those who do not possess a microcomputer but either intend to one day own one or simply wish to know something about them.

Write to Bernard Babani (publishing) Ltd., The Grampians, Shepherds Bush Road, London W6 7NF.

Cambridge Learning

Cambridge Learning was formed in 1974. Current 'teach yourself' and 'made simple' books were neither simple nor interesting, so CL was dedicated to providing self-instruction courses for beginners in computing and electronics. All these courses use the 'programmed learning' technique, where the student is tested throughout the text with short questions whose answers are given immediately, at the top of the next page. This form of testing provides much more interest for the reader, because the questions are so frequent (at least one per page) and everyone enjoys answering correctly.

CL's list now contains some 20 titles which are thoroughly tested on a likely selection of people before being published. A true beginner can pick up a CL book knowing that all chance of becoming stuck has been minimised — there is

nothing more frustrating than trying to grasp a subject from a text which assumes some arbitrary amount of prior knowledge. For this reason, every CL course covers all aspects of its subject, even those which are considered too simple for most 'teach yourself' books.

Digital Computer Logic is a theory course for absolute beginners. It has this year been completely revised, and now provides instruction in the following subjects: number systems, gate logic, boolean algebra, de Morgan's laws, flipflops, counters, shift registers. No prior knowledge is assumed other than arithmetic.

Superkit is a practical course which covers the same ground as DCL, but lets students see the results for themselves by building each circuit (around 50 experiments) on a breadboard. The kit was designed to be cheap, safe, and reliable. There is no soldering involved so components may be re-used, and all mistakes made good. Power supply is from a dry battery so children may use the kit and learn as they enjoy themselves. The kit contains: instruction manual, breadboard, seven TTL integrated circuits, and many other components, all in a pocket-sized wallet.

Digital Computer Design is a more advanced theory course in digital electronics, but that should not be taken to mean 'more difficult'. All the theory covered in the beginner's course is repeated here at a faster pace, after which the more leisurely style is adopted to describe the new material. This course teaches how a processor can be made from the basic building blocks of logic gates. Topics covered include: Karnaugh mapping, full adders and subtractors, Schmitt triggers, number processor, microprogram controller, memory, microcomputers, programming.

Superkit II is being introduced to run parallel with the theory in Digital Computer Design. It is a supplement to the beginners' Superkit and utilises the same breadboard.

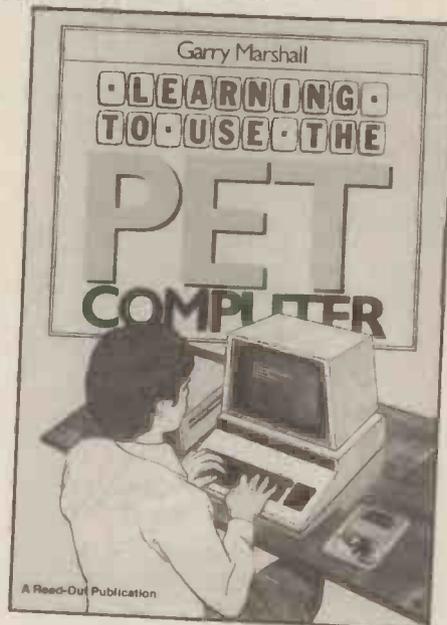
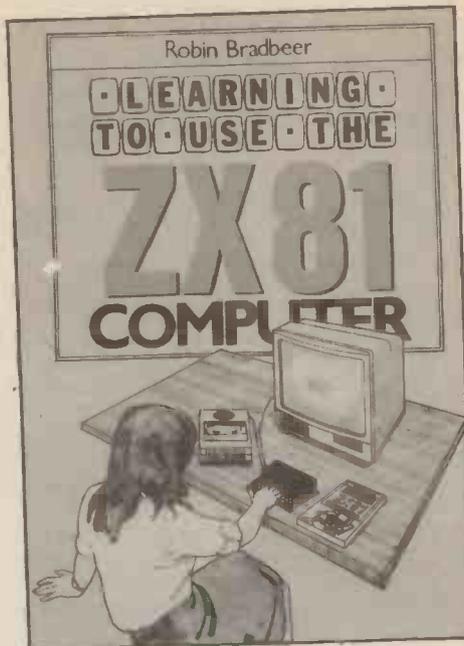
Computer Programming in BASIC is CL's popular course in four volumes which gives the beginner a working knowledge of the BASIC language, with or without a computer.

Microprocessors CL's latest course describes the logic behind microprocessors, their method of construction, and how they may be programmed.

Please send for a booklist to Cambridge Learning Ltd., FREEPOST Unit 93, Rivermill Site, St. Ives, Cambs PE17 4BR.

Gower Publishing

Gower Publishing has recently brought out a new series of paperbacks for novice micro owners, aptly titled the "Learning to Use" series. Costing around £4.95 each, the books are simply written and take the user through the stages of controlling the machine, programming it and creating graphics, with appendices on where to obtain add-ons, and a glossary. The aim is to allow the



user to become acquainted with the machine quickly and without confusion. Titles already in the series are *Learning to Use the BBC Microcomputer*, *Learning to Use the PET Computer*, *Learning to Use the VIC-20 Computer*, *Learning to Use the ZX81 Computer*, and *Learning to Use the ZX Spectrum*, with others in the pipeline.

Another title of interest to some Hobby readers is *The Personal Computer Book* by Robin Bradbeer (£9.50 hardback, £5.95 paperback), which explains the possibilities and pitfalls of the personal computer, and is a useful reference book before and after buying a system. The updated edition (1982) includes a survey of over 60 micros currently on the market.

Gower's main line is books for computer professionals, including books on computers in the office and computers and the law. They also publish essays, and a bibliography, on microcomputers, and a bibliography specifically for the PET, which covers 290 issues of 17 different magazines.

For a catalogue and information contact Colette Manning, Gower Publishing Co. Ltd., Gower House, Croft Rd., Aldershot, Hants GU11 3HR.

Keith Dickson

Keith Dickson Publishing was founded three years ago as a specialist publisher of electronics books for the amateur enthusiast and the technician, and last year acquired the Norman Price list of electronics textbooks for the radio and television technician.

Of our recent publications, *Introducing Amateur Electronics*, by I R Sinclair (£3.50), has proved extremely popular with those who have just taken up electronics as a hobby. For those who are studying a City and Guilds or a TEC course on electronics our three volumes *Electronics Servicing 1, 2, and 3*, published under the Norman Price imprint, have been very successful.

We will gladly send anyone who is interested a copy of our free catalogue listing the 40 or so books currently in print and add their names to our mailing list for information on new titles as published.

Write to: Keith Dickson Publishing Ltd., 17 Hendon Lane, London N3 1RT.



Melbourne House

Melbourne House Publishing, a well established publishing company which in recent years has been concentrating on software for microcomputers, is now the largest international micro software company. In an ever changing, fast moving market, Melbourne House has always been amongst the first with computer software in the popular micro market and the company is committed to providing software for the ZX80, ZX81, Spectrum, VIC20, TRS80 and Dragon Computers. MH are very proud of their reputation for software excellence and have a large team of professional in-house programmers as



well as seeking out the most creative of individual sources. MH has always encouraged software submissions from computer users, some of whom have gone on to write excellent books and games.

Recent publications for the Spectrum computer range from titles for beginners to titles of interest to more experienced users. *Over The Spectrum* (£6.95) contains over 30 programs using the Spectrum's complete facilities to the maximum, by providing the full listing of many exciting arcade favourites and utilities, business programs and educational programs with many programming tips and hints on extending the graphic capabilities of the Spectrum.

Dr Ian Logan, winner of the 1981 Rosetta Stone award for the best independent product for the Sinclair ZX80/81, has written three books for the Sinclair ZX81 and is now involved in Spectrum research. In Dr Logan's latest book, *Understanding Your Spectrum* (£7.95), he gives a complete overview of the way the Spectrum operates, both BASIC and machine language, including many demonstration programs. This book has three main aims: to explain in simple terms how the Spectrum works; to teach Z80 machine code from first principles; and to give details of 'Monitor Entry Points' so that efficient programs can be written.

Spectrum Machine Language For The Absolute Beginner (£6.95) is a book for the novice who wants to write faster, more powerful, space saving programs or subroutines. Even with no previous experience of computer language, discovering the ease and power of the Spectrum's own language is made accessible. Each chapter includes specific examples of machine language application which can be demonstrated and used on the Spectrum. The Spectrum software range is still not complete and MH continues to spend many hours of research into providing even more outstanding publications and games.

MH is also committed to providing literature and software for the VIC20 computer and their latest publication called *VIC Innovative Computing* has proved to be a very popular forerunner in the VIC20 market. The author, Clifford Ramshaw, who is recognised as one of the most creative programmers for computer games, brings with great skill and imagination some of the most popular arcade games, as well as new and fascinating programs. The book contains the complete listing of these games in a specially designed, easy to read, format as well as programming structures to open a new dimension in using the standard VIC20.

For information write to: Melbourne House Publishers Ltd., Glebe Cottage, Glebe House, Station Road, Cheddington, Beds LU7 7NA.



Texas Instruments

Texas Instruments has been producing data books and text books for more than a decade, but first came to prominence as publishers in the early 1970s, when the first volume of *Semiconductor Circuit Design* appeared. This was a classic marketing move, since it filled a huge information gap for electronics designers. The book went to five volumes, each of which was a sell-out.

Whilst the later volumes of this work were appearing, TI was already 'popularising' its approach with the first publication in its 'Understanding' series. *Understanding Solid-State Electronics* was published in 1972, since when a further nine titles in the series have appeared. They promise to be even more successful than the original Circuit Design series. Titles cover digital electronics, microprocessors, communication systems, automotive electronics and virtually all other aspects of component and computer system learning. Each book begins with simple analogies of the technologies involved, and moves steadily on — by end-of-chapter evaluation quizzes — to a middle level of learning in each discipline.

Understanding Solid-State Elec-

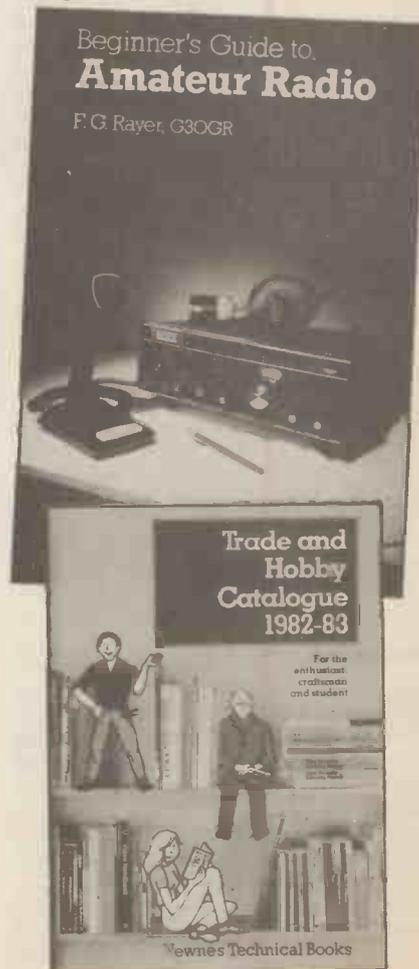
tronics, for instance, must be one of the most popular beginners' textbooks ever published. Like all other books in the series, it is available from electronics distributors and retail component dealers at £3.95 (plus £1.50 p&p), with the exception of the latest volume in the series, *Electronic Security Systems*, just published at £1.95 (plus £1.50 p&p). TI now publishes nearly 30 titles, almost half of which are purpose-written for complete beginners or those with only limited technical knowledge.

All books are also available from Texas Instruments Ltd., Book Department, PO Box 50, Market Harborough, Leics.

Newnes Technical Books/Butterworth

Newnes is a long established and well respected name in technical book publishing harking back to the halcyon days of the thirties and embracing such legendary characters as F J Camm. The Newnes Technical Books imprint covers a wide range of technical subjects, including electronics, computing, video, radio, TV, automobiles, boating, building and DIY subjects — even extending as far as horology and gemmology.

Electronics is a specially strong area and Newnes has the privilege of being the publisher of Scroggie's *Foundations of Wireless and Electronics* — a book which first appeared in 1936, has gone through nine editions and has sold over a



quarter of a million copies. Two series of electronics construction projects are available with such titles as *Electronic Test Equipment Projects*, *Electronic Projects for Home Security*, *Projects in Amateur Radio and Short Wave Listening*. Ian Sinclair's *Practical Electronics Handbook* is a particularly popular book.

In the personal computing area — Robin Norman's *ZX81 BASIC Book* tops the Newnes best-seller list, with many other close favourites, such as *Computing is Easy*, a first-time book for younger readers wanting to get into personal computing, *ZX81 User's Handbook*, *Programming the BBC Micro* and *ZX Spectrum User's Handbook*.

There are two major series *Questions and Answers* (at £2.50) and *Beginner's Guides* (at £4.35) in each of which appear many books on electronics and computing.

For catalogue or information write to: Newnes Technical Books, Butterworth & Co., (Publishers) Ltd., Borough Green, Sevenoaks, Kent TN15 8PH.

Prentice-Hall International

Prentice-Hall International is the UK division of the American publishing company Prentice-Hall Inc. of New Jersey, which publishes a wide range of technical, academic and professional books. Over 200 electronics and computing books are published each year by Prentice-Hall and its associated imprints, Reston, Reward, Spectrum and Brady in America, and by Prentice-Hall International in the UK. The electronics and computing publications include numerous books for hobbyists and home use. Prentice-Hall International also acts as exclusive distributor in the UK, Europe and Middle East for the popular books published by Howard W. Sams & Co., Inc.

Among the many electronics topics covered by Prentice-Hall International are amateur radio, audio and television, video, FETs, ICs, OP AMPs, oscilloscopes, and electronic projects from energy to security systems. Recent titles include *Practical RF Design Manual*, *Electronic Music Circuits*, *Video User's Handbook* (2nd edition), *Power FETs and their Applications*, *Building and Installing Electronic Intrusion Alarms* (3rd edition), *Fiber Optics and Microcomputer Design and Construction*.

In addition to electronic titles, Prentice-Hall has numerous computing books, for hobbyists and users of personal computers. The subjects covered include introductions to computing and microcomputers, microcomputers in business, interfacing, operating systems, programming languages (BASIC, C, COMAL, FORTH, Pascal etc.), and popular computers such as the Apple, ATARI, BBC Micro, Commodore 64, PET, TRS-80, VIC and the IBM Personal Computer. There are also several books available on the Z-80 and Z8000, the 6502, 6800 and 68000, and the 8080 and 8085 microprocessors. Titles published in 1982 that have been particularly

popular are *The Apple Personal Computer for Beginners*, *ATARI Games and Recreations*, *BASIC Programming on the BBC Microcomputer*, *Computers and the Radio Amateur*, *Interface Projects for the TRS-80*, *Z8000 Handbook* and *MC68000 16-Bit Microprocessor User's Manual* (3rd edition).

For details on Prentice-Hall International's electronics and computing books please write to Jean Walmsley at Prentice-Hall International, 66 Wood Lane End, Hemel Hempstead, Herts HP2 4RG, indicating your areas of interest.



Watford Technical Books

Watford Technical Books is the only bookshop in Britain not to stock 'Not the F-Plan Diet of an Edwardian Country Parrot'. It was started in 1982 to prove a point: after years of trying to persuade booksellers to stock technical books, the owner, Jeremy Dicks, decided that the only way to provide a comprehensive service for the hobbyist and the professional was to do it himself.

So WTB caters exclusively for the specialist. The shop only stocks books on electronics and computing, aims to have the largest selection in the coun-

try. Books from all the well-known publishers are kept on display as well as many from less well-known foreign suppliers.

Standard stock includes everything from McGraw-Hill's *Compilation of Data Communications Standards* at £190.00 to Babani's *Transistor Radio Fault-finding Chart* at 50p. There are more than thirty different books on the ZX81 and just about everything published by Osborne, Tabs, Byte, Howard Sams, etc. The aim of the shop is to allow you to browse at leisure before making a choice and parting with cash. However for those unable to visit, WTB also provides a mail-order service, and a telephone-order service for credit card holders.

Some public libraries are quite well supplied with books in electronics and computing, but to assist those who are not, and also for company librarians, WTB operates a regular information service and supplies books to all parts of the country.

The only problem is that wives tend to shuffle their feet and tug at their husbands' sleeves after an hour or so's browsing. Perhaps we need a small stock of 'Not the F-Plan'...

For information, lists, etc. contact Jeremy Dicks on Watford (0923) 23324 or send an SAE to: Watford Technical Books, 105 St., Albans Rd., Watford, Herts WD1 1RD.

Others To Check Out

Penguin Books Ltd., Bath Rd., Harmondsworth, Middx. publish myriad books in nearly every field known to man. Penguins are essentially paperback, although there is a hardback imprint, Allen Lane. Two books likely to be useful to hobbyists are *A Dictionary of Electronics* by S Handel, and *The Penguin Dictionary of Physics* edited by Valerie H. Pitt.

Pitman Books Ltd., 128 Long Acre, London WC2E 9AN publish books on a variety of technical subjects. *Essential Electronics, An A to Z Guide* by George Loveday (£5.95, paperback), designed to give a clear, concise guide to electronics terms, components, and processes with technical diagrams, is one title to reach this office in recent months.

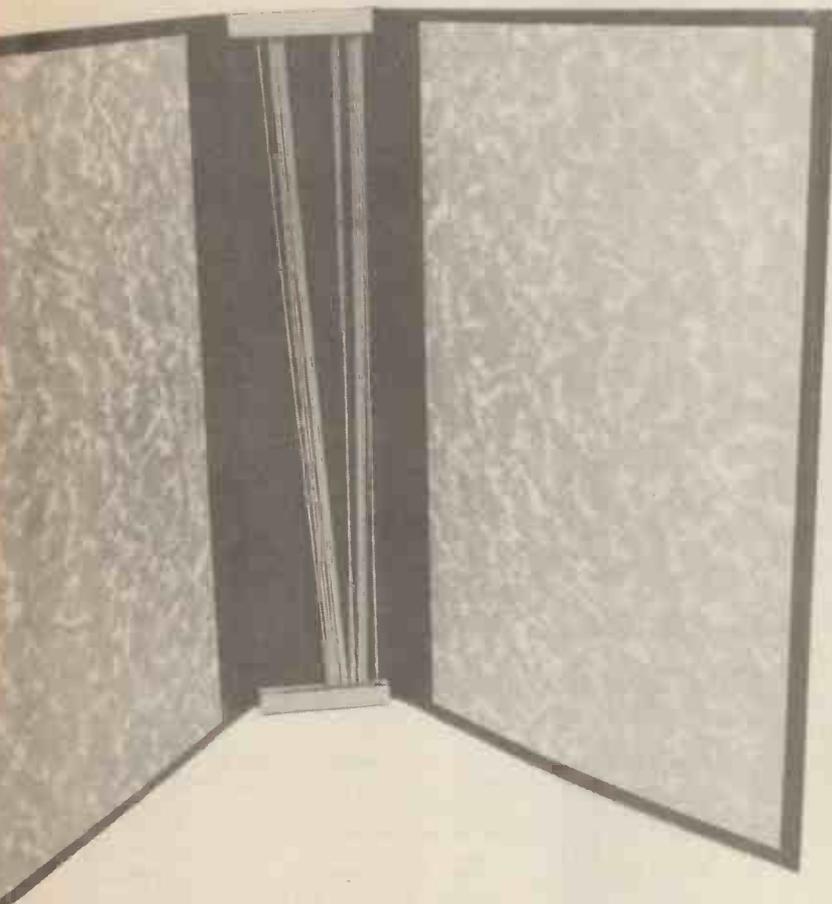
Pan Books Ltd., 18-21 Cavaye Place, London SW10 9PG have bought out a book of background information on computers, *Illustrating Computers (Without Much Jargon) — A Beginner's Guide to How Computers Work* by Colin Day and Donald Alcock, complete with cartoons.

And let us not forget the Radio Society of Great Britain, 35 Doughty St., London WC1N 2AE, who publish the *Radio Amateurs' Examination Manual* by G L Benbow, now in its 9th edition, as well as a number of other informative books such as the *Amateur Radio Operating Manual*, the *Television Interference Manual* and the radio amateurs' bible, the *Radio Communication Handbook*, first published in 1938 and regularly updated.

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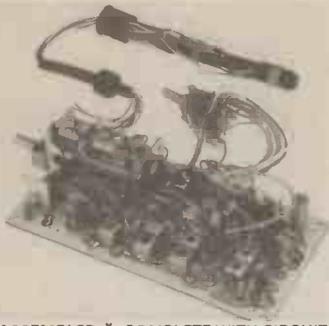
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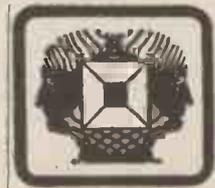
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POINTS OF VIEW

Feel like sounding off?
Then write to the Editor stating your Point Of View!

Seeing Red, Feeling Blue . . .

Dear Sir,
On 27th April I sent an order form with a cheque for £180.00 for the ZX Spectrum which I obtained from the Sinclair stand at the Computer Fair at Earl's Court, Saturday 24th April. On this order form it was stated that the ZX Spectrum would take up to 28 days for delivery.

On 11th June a letter arrived from Sinclair to say that the ZX Spectrum would arrive from Sinclair in two weeks. On 7th July the ZX Spectrum arrived. Within one hour of use it was not working properly: patterns came on the TV screen and would not go away.

On 8th July I sent the Spectrum and explained that it was not working correctly. The cost of postage was £2.07.

I have phoned to see if a new computer was being sent to me on the following dates: 9th July, 20th July, 29th July, 6th August, and 13th August. When I phoned it was stated that my computer would be dealt with as soon as possible. On 13th August I said that I must write to the Advertising Standards Authority and the following magazines: Hobby Electronics and Sinclair User, because in these magazines it states that the ZX Spectrum would take 28 days for delivery.

I believe I have a complaint, as in the first instance it took from 27th April till 7th July for the computer to arrive, and then from 8th July until I do not know when for a replacement with a new Spectrum.

I bought British because I thought it would be best, also for the after sales service. I now think this might have been the wrong decision in the case of the Spectrum.

S G Frith,
Clacton-on-Sea
Essex.

Dear Sir or Madam,
I am writing to you to complain about the Sinclair Research advert which you are currently printing. This advert says to allow 'up to' 28 days for delivery. On Saturday 14th August I received a letter from Sinclair apologising that I may have to wait 'up to' 12 weeks for my Spectrum. In fact I have already waited 13 weeks!

I therefore formally request you, as one of your readers, to refuse to repeat this until the copy is changed to show a more reasonable waiting period.

Leslie H. Alden,
East Dulwich,
London.

It does look as if Sinclair have found themselves snowed under with complaints as well as with orders. Here is Clive Sinclair's own reply which gives, we think, a fair choice.

Dear Customer,
As you will have heard, some delays are occurring in the delivery of our new ZX Spectrum computers, and I felt that I should explain the situation to you personally.

The delays have arisen thanks to an amazing response from you and many others which far exceeded our expectations. We have been swamped with orders and have also experienced some small initial production problems.

So sadly I must tell you that you may have to wait for up to 12 weeks, from the date of our original acknowledgement letter, before you receive your Spectrum, and I hope you will accept my sincere apologies for a situation which may cause you considerable inconvenience. I do, of course, understand if you wish to cancel your order, and a form is enclosed for you to obtain an immediate refund.

If you are happy to continue waiting we will send with your Spectrum in compensation for the delay a £10 voucher, which you can use in part-payment for a ZX Printer or to buy a complete pack of five rolls of printer paper.

You will also receive a demonstration tape containing:

1. A complete 'keyboard trainer' to introduce the Spectrum.
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I do hope that you will decide to accept this offer, and will enjoy your Spectrum for many years.

Yours sincerely,
Clive Sinclair.

Chosen at Random

Dear Sir,
I have recently purchased the March edition of HE which I picked up at random from my local newsagent and I would like to praise you on what I consider to be a very 'readable' magazine. I have recently become interested in electronics and I am currently taking TEC in Electrical and Electronic Engineering; the article Into Electronic Components (Part 8) was particularly interesting for me, as we

are currently covering transistors at Tech College. Could you inform me of the components you have covered previously and if I may purchase copies of them?

Now here's someone who appreciates a good author, and from the large and enthusiastic response we had to this series, he's not alone. The components covered before Part 8 were resistors, capacitors, diodes, inductors and transformers. The first two parts dealt with taking measurements and the basics of current and voltage. Photocopies (and back issues) are available from our reprints service (see the coupon in this or any other HE).

Globes For Glenwood

Dear Sir,
As a regular reader of HE I would gladly appreciate your help and advice. One project I am really interested in is an LED Chase Display. I would like to use approximately 48-60 globes at 1.5 watts each. If you have any information regarding the construction of the above I would appreciate your early reply.
Jeffrey Pletnick,
Glenwood,
Durban,
South Africa.

Over the past few years HE has produced several circuits for flashing LEDs in various patterns (September '79, November '79, January '81) and responding in different ways — sound to light is but one method. No doubt, if we published another LED chaser we would be deluged with letters complaining about running the same old projects. However, we will deliberate the possibility of designing the 'ultimate' in LED pattern displays. In the meantime, readers would do well to look through some back issues of ETI — they've come up with some real dazzlers!

Buzz Off

Dear Sir,
Being a foreign subscriber to your fine magazine for several months, may I venture to suggest that you publish plans for mosquito and fly repellents which, I am sure, would be welcomed by readers living in tropical countries where mosquitoes and flies are too numerous.

I hope my suggestion will be taken into consideration.

Y. P. Lin,
Hong Kong.

Going back a bit, we did an Insect Repellent in HE July '79, in our Short Circuits column. See the Backnumbers page, etc...

HE

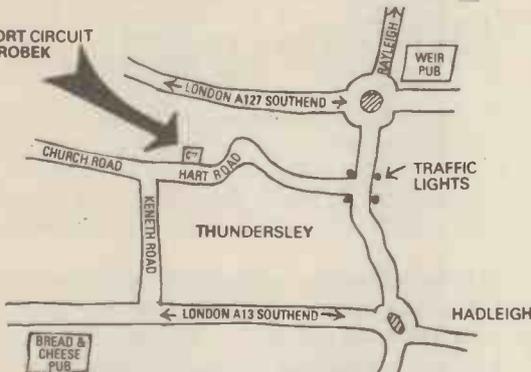
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ELECTRONICS

Don't blow a fuse dad; no need to go pots. I.C. in this month's magazine an advert for Robek; they don't let mos grow under their feet. They socket to you by return of post and have always LED the way in component supplies. So stop playing with your digitals; get on the phono and relay your requirements to them. They even take plastic money, providing it has Access or Barclaycard on it - or better still let's take a short circuit to their shop.

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- + lots more!

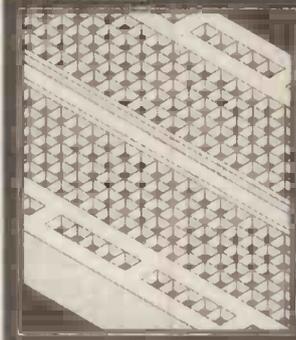
The introduction shows all the different components and explains how to use the breadboard. The Verobloc layout is shown for every project together with the circuit diagram and an explanation of how it works. Ideal for beginners in electronics, but also suitable for more advanced students.

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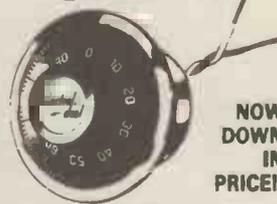
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one transistor; however, the saving, when compared to static cells, still allows larger capacity memory chips to be produced on a given area of silicon; the need to refresh these devices is a price that has to be paid.

A simplified diagram of the connection of many memory cells within a static RAM chip is shown in Figure 3. The cells are shown organised in an array of several rows, with common Enable inputs (rows X₀ to X_N) and having common data lines (columns Y₀ to Y_P). Access to a given cell is gained by selecting a complete row of cells, with the appropriate 'X' line, and selecting a pair of data lines with the appropriate 'Y' line switching on. The two sections of address decoding logic generate these 'X' and 'Y' signals from a minimum of external address lines, which is achieved by decoding each binary input address to a unique 'X' and 'Y' combination. The number of 'X' and 'Y' lines required in total is kept to a minimum by choosing a roughly 'square' dimension to the cell array.

RAM Chips

A list of the more common RAM chips is given in Table 1, for comparison; the Pin-outs are shown in Figure 4. In addition to wide variations in the size of the memories, there is a difference in the organisation of the devices, from one to the other. The device shown in Figure 3 most closely identifies with the 2102A chip, which has an organisation described as 1024 words by 1 bit. The signals R/W and CE used by the 2102A are a variation on the RD and WR signals of Figure 3, which are internally derived in the 2102A by gating the former two signals; when R/W is high AND CE is low, an RD (Read) signal is generated; when R/W is low AND CE is low a WR (Write) signal is generated. This system of control signals is common to most static RAMs since the Chip Enable (CE) — sometimes called chip select (CS) — pin allows for easy expansion of the memory system using many chips.

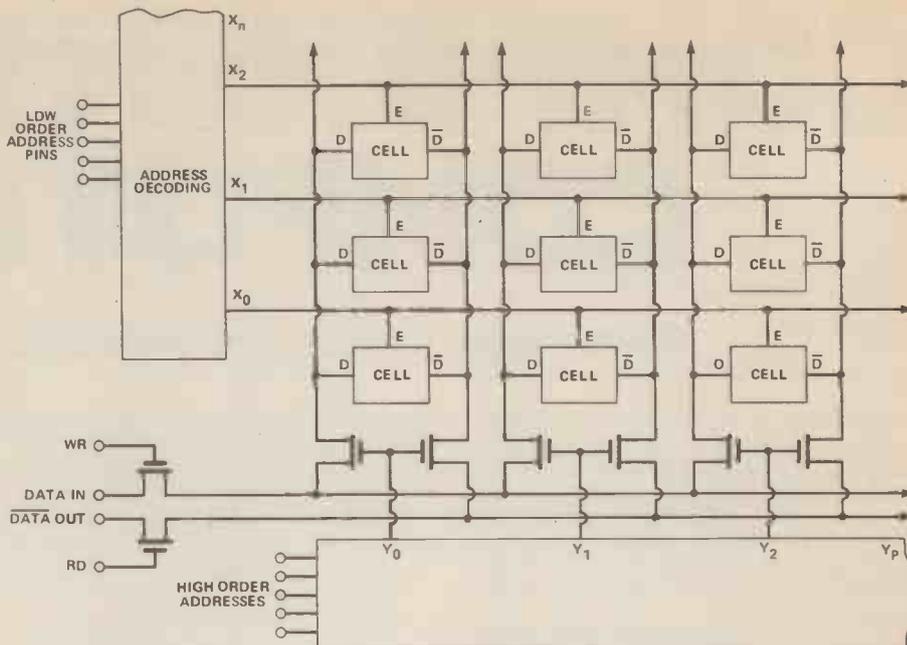


Figure 3. Address and Data Bus connections within a dynamic RAM chip.

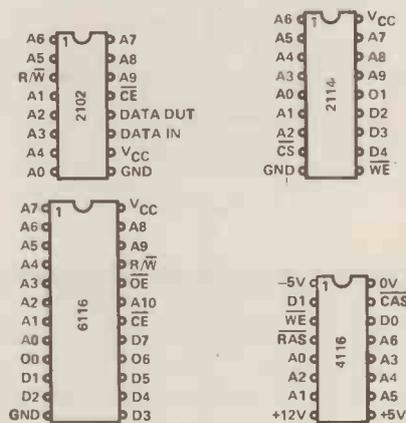


Figure 4. The pin-outs of some common RAM ICs.

Microcomputer systems generally require eight-bit (byte-wide) memory systems. Using memories that are only one bit wide, as with the 2102A, a byte-wide RAM may be produced simply by paralleling eight such devices; the address and control signals of each chip are commoned, leaving eight parallel data input lines and eight parallel data output lines. Conveniently, this paralleling of 1-bit memories can be done within the RAM chip itself as in the 2114 (four bits wide) and the 4118 (eight bits wide) and many other devices. The clear advantage of byte-wide RAMs is seen in small microprocessor systems which require a small memory size and a very low chip count. In the case of byte-wide RAMs, it is unusual for separate data input and output pins to be provided. Instead, just eight pins allow the output of data during Read operations

TYPE No.	ORGANISATION	TYPE	TECHNOLOGY	SUPPLY	PINS	CURRENT	COMMENTS
2102A	1024 x 1	Static	NMOS	+5V	16	50mA max.	Virtually obsolete
2114L	1024 x 4	Static	NMOS	+5V	18	70mA max.	Low cost static RAM
4118	1024 x 8	Static	NMOS	+5V	24	80mA max.	Byte-wide static RAM
6116	2048 x 8	Static	CMOS	+5V	24	35mA typ.	Very low current on standby
4116	16384 x 1	Dynamic	NMOS	±5V, ±12V	16	40mA max.	Low cost dynamic RAM
4816	16384 x 1	Dynamic	NMOS	+5V	16	35mA max.	Single rail version of the 4116
4164/4864	65536 x 1	Dynamic	NMOS	+5V	16	35mA max.	Largest capacity chip generally available

Table 1. The parameters of some common RAM ICs.

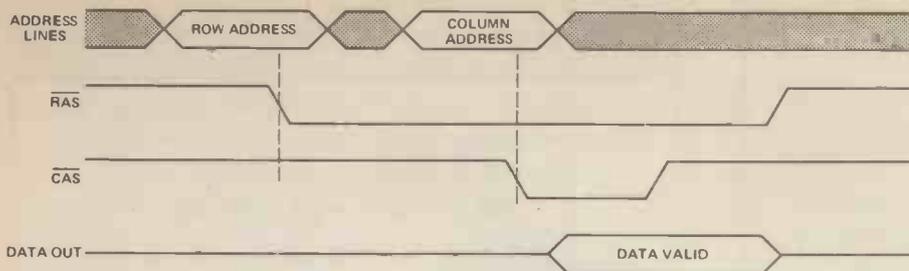
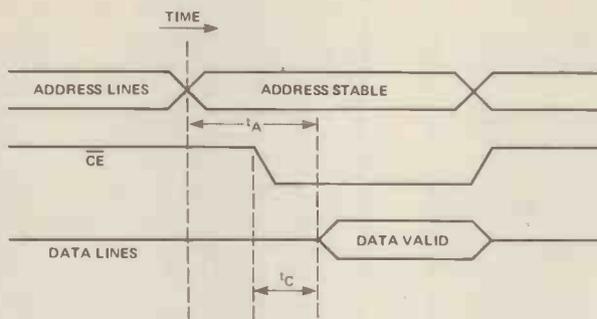


Figure 5 (above). A 16-bit address is presented to a dynamic RAM in two 8-bit bytes.

Figure 6 (right). A simplified timing diagram, illustrating the concept of access time.



and the input of data during Write operations; in this latter case, the RAMs internal output devices become tri-state or high impedance to avoid a conflict. This arrangement is entirely compatible with microprocessor systems where data transfer is bidirectional on a single eight-bit data bus.

In addition to the need for refresh accesses, dynamic RAM chips currently

available present an additional problem; in order to reduce pin count and package size an eight-bit address bus is used, so that the address needs to be multiplexed onto just eight input lines (for a 64k x 1bit RAM). This is illustrated in Figure 5; the low-order address byte is first presented to the chip's address lines and is clocked into an internal register by the falling edge of the RAS signal; then the high-order ad-

dress byte appears on the address pins, to be clocked into a separate register by the falling edge of the CAS signal; these two 'data' bytes form the row address and column address, respectively, of the memory cell array. The CAS signal is also used to turn on the output device of the chip during read cycles.

Several byte-wide RAM chips may be connected together to form a larger memory system. In this case, all but the CE pins of the chips must be commoned. Only one of the chips is selected at any time, as determined by higher order addresses. For example, eight 4118 chips (1k x eight) are connected to the micro-computer's data bus and to the first ten address lines (A0-A9). Now, three address lines (A10-A12) can be decoded to generate one-of-eight CE signals for the eight RAM chips with a simple three-to-eight line decoder (eg a 74LS138).

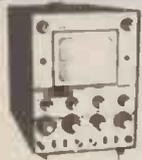
An important consideration when choosing a RAM device is the access time. This is the time between the appearance of the address signals (and/or control signals) and the moment when the output data becomes stable (illustrated in Figure 6). This effectively determines the maximum rate at which data can be transferred between the memory and processor. For example a 6800 micro-processor running at 1MHz requires an access time of 680ns maximum, but at 2MHz (6800 processor) this is 330ns.

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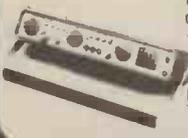
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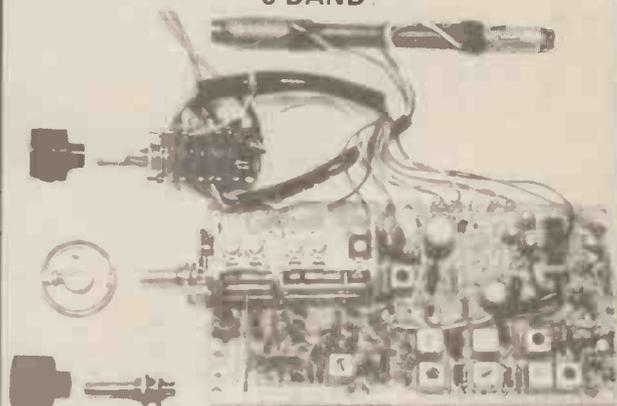
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"The trouble with holidays", someone once told me, "is that you need another week off to recover!" "Not much chance of that", quoth the editor. "Here, take this file and . . .". I won't repeat the rest. After all, this is a family magazine and colonial expressions are not really appropriate.

Despite the fact that I haven't given away a binder for months, now, I'm still receiving letters from readers who don't want one . . .

Dear CD,
I genuinely don't want a binder! But I would be a friend for life (ie, a reader) if only you could furnish me with the address of E.R.G. Components Ltd., who supplied the transformer for an oscilloscope I own.
R.J. Heap,
Gunnislake,
Cornwall.

I can furnish you with a three-piece suite, if you like. This bloke I know, Arthur, he gets them cheap from somewhere . . . the address is cheap, too. E.R.G. Components are at Luton Road, Dunstable, Bedfordshire LU5 4LJ.

This seems to be an appropriate point to remind you all that an immediate reply is only possible if an SAE is enclosed with your letter to me.

Dear CD,
Having built your 'Noiseless Fuzz Box', March '82 issue, I was somewhat thwarted when I found that BC650 transistors were required. I have been unable to find these in any catalogue or advertisement and I wonder if they are 'BC650s'. If so, could you recommend a supplier and a possible price. You claimed they were easily available components in the project. RSVP soon — good mag, keep up etc.
Binder?
W. Moms,
Bridgend.

You, the author and the article at least agree that the device in question is indeed a 'BC650'. The transistor is an ultra low noise, high gain type, from Motorola and I'm told that it is often used in the common base configuration as a direct-coupled microphone preamplifier. However, perhaps we overstated the case when we said 'easily available'. The only supplier I have been able to find, in fact, is Maplin Electronic Supplies Ltd., PO Box 3, Rayleigh, Essex SS6 8LR. Their order code is QB74R and their price is just 29p.

Incidentally, the Noiseless Fuzz Box was in the February '82 issue — not March. No?

One wonders, sometimes, whether anyone who reads this page can take a hint. It's refreshing then to find that at least one reader has got the message!

Dear Richard,
Thanks for an interesting page. I am glad you are keeping your binders. The grovelling joke is getting a bit thin (been good fun, though). Could I suggest you set the readers up to telling funny things that have happened to them, eg I put pencils etc behind my ear until I did the same with a soldering iron . . . or the time I made an oscillator out of a 555, and the chip itself started whistling. You know the sort of thing, something very short.

Cheers Richard (I called my son Richard). Keep up the good work.
C.B. Sewell,
Kirby-in-Ashfield,
Nottingham.

Yes, I know the sort of thing . . . but do you? If their sense of humour is anything like yours, I'm certainly not likely to lose many binders! Oh well, I may as well repeat myself: the CD Golden Binder Award of the Month is (and always was) for the most clever, witty letter to arrive through the post. I think I'm fairly safe.

In view of the current security scandals, I'm not sure that this letter should ever be answered. But perhaps someone in MI5 would like to know, too . . .

Dear CD,
Please could you help me! Recently I bought an air band (VHF) radio to listen to the Sea Harriers talking to the tower at nearby Yeovilton, and couldn't understand why I couldn't hear anything.

After asking a few questions I found that my radio only covered civil bands (108-136 MHz) and not the military bands (220-400 MHz). Yeovilton tower operates on 381.1 MHz AM SSB (I think!).

How about a project (UHF to VHF converter) before the start of next year's airshow season? If not, is it possible to adapt a UHF or old VHF TV tuner or alter your VHF radio of a few months back to obtain the necessary frequency?

Also why doesn't anyone use the vastly superior Z80 CPU for computer designs? I have never seen a design for

a home computer based on this CPU produced.

Hope you can help.
M. Robb,
Yeovil,
Somerset

From my somewhat limited experience in military communications, I do recall that there is actually no such thing as a 'military band', except for the Band of the Brigade Guards and so on. Rather, military communications are conducted on spot frequencies (which are often changed) right across the spectrum, and these are just slightly secret, which is why most governments operate a COMINT (Communications Intelligence) service.

However, if Yeovil is also used by civilian aircraft, the calling frequency will be published in the standard references. Even so, you will need a high quality SSB communications receiver before you can monitor those frequencies, if your information concerning the transmission mode is correct. Converters simply won't do the trick.

I totally agree with your comments concerning the Z80 CPU, but along with the extraordinary power, you also need a large number of support chips and complex circuitry to get the most out of it — which is why very few designs have ever been published.

It can be very disappointing when a project fails to work — but it's not always our fault, you know! In any case, there's simply no way anyone can advise 'what went wrong' without considerably more information.

Dear Clever Dick,
In your September '81 issue, I tried to make your Reaction Tester game. I spent a lot of time soldering it together, but it didn't seem to work. I am a beginner at electronics and do not know much about it. Please CD, could you tell me what went wrong?
M. Dawkins,
Croydon.

There're only two things to tell: the project contains no errors that we (or readers) have been able to find, and don't be too disappointed. First time is for finding out, as they say. As a beginner, you'll find that you'll make a lot of mistakes and that projects won't work for unknown reasons. All you can do is keep trying, keep learning and keep reading HE!

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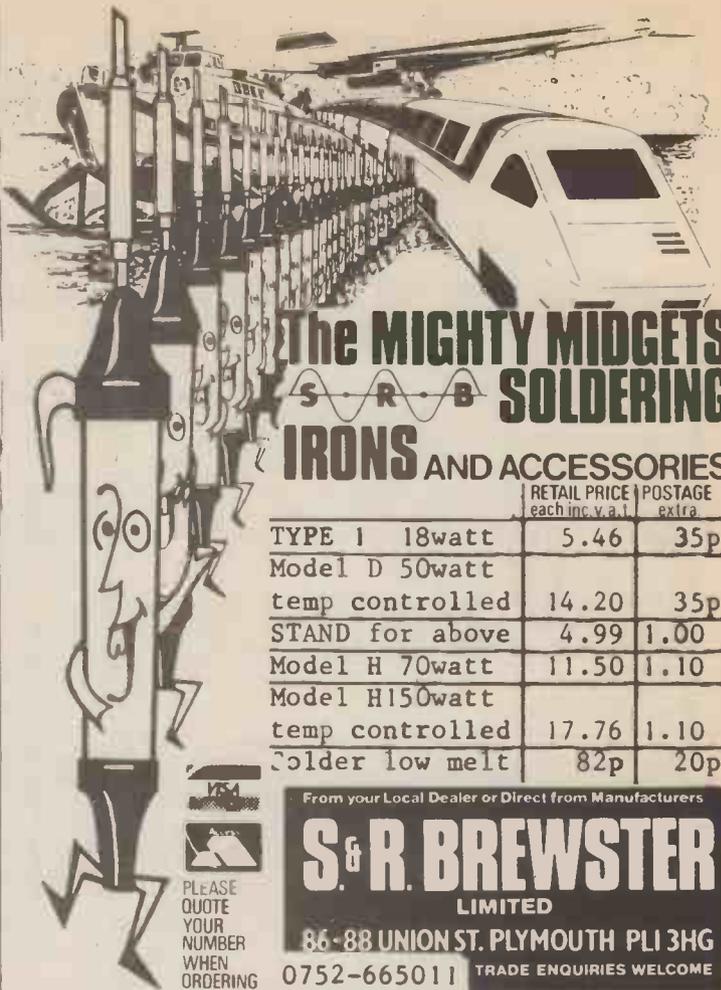
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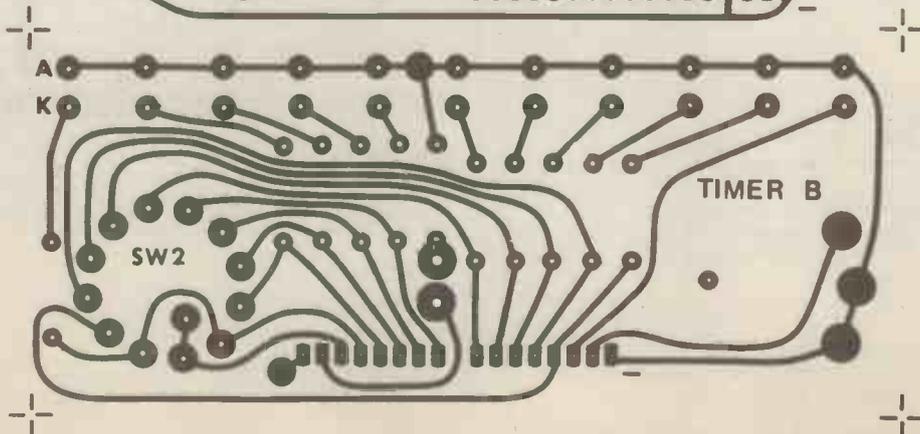
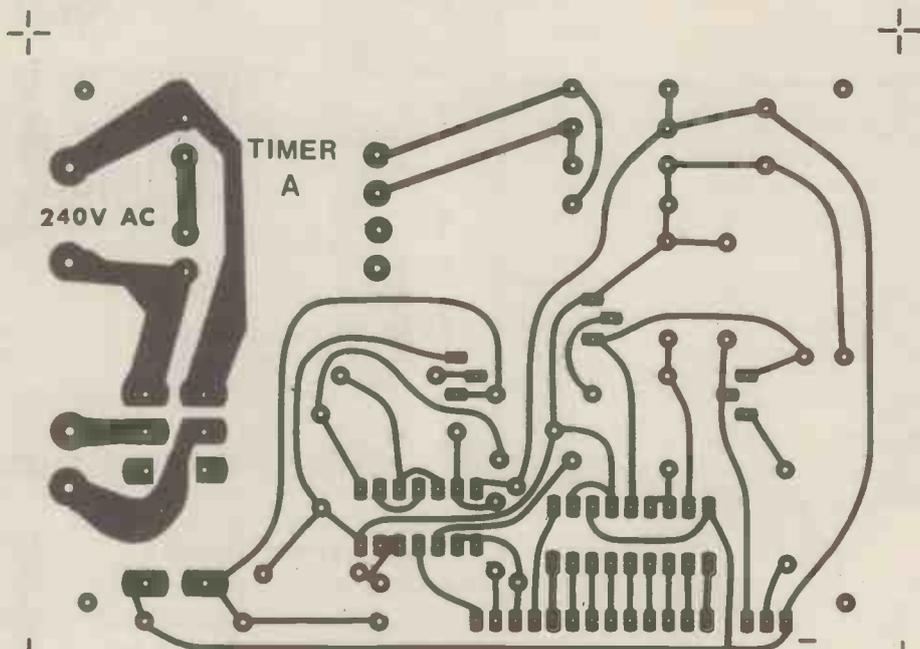
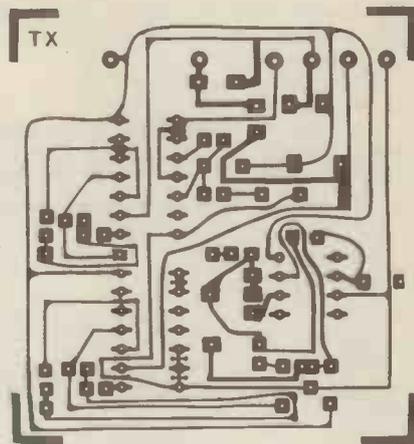
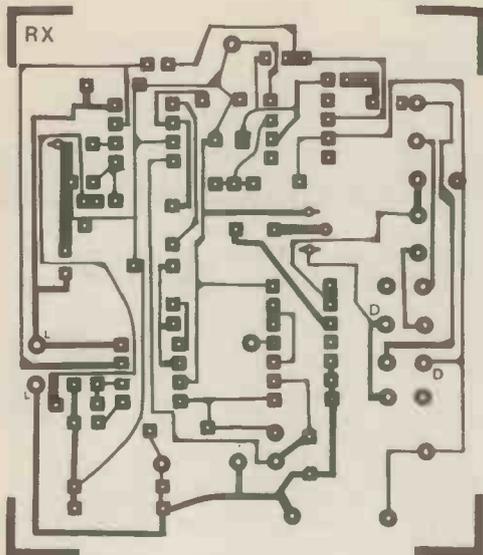
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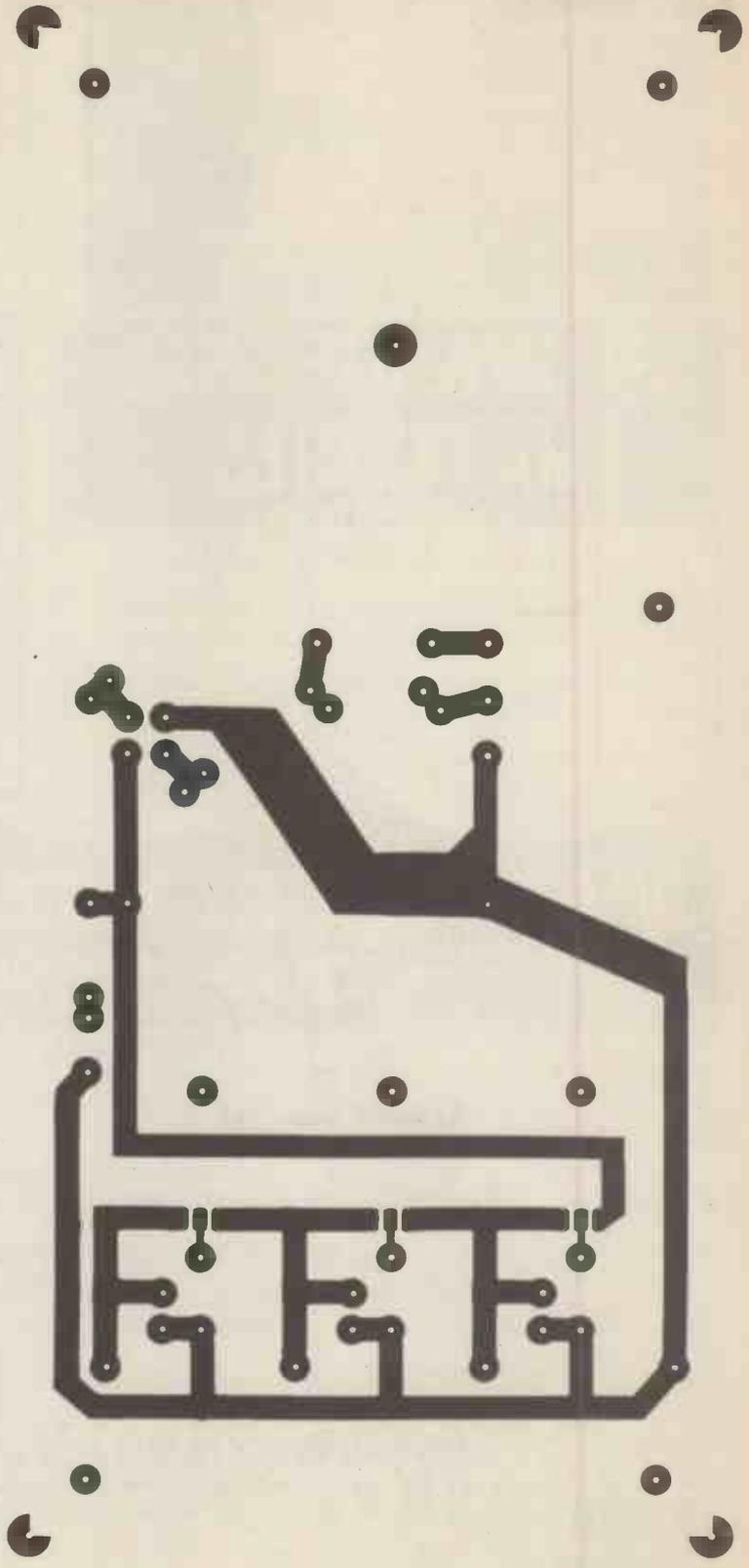
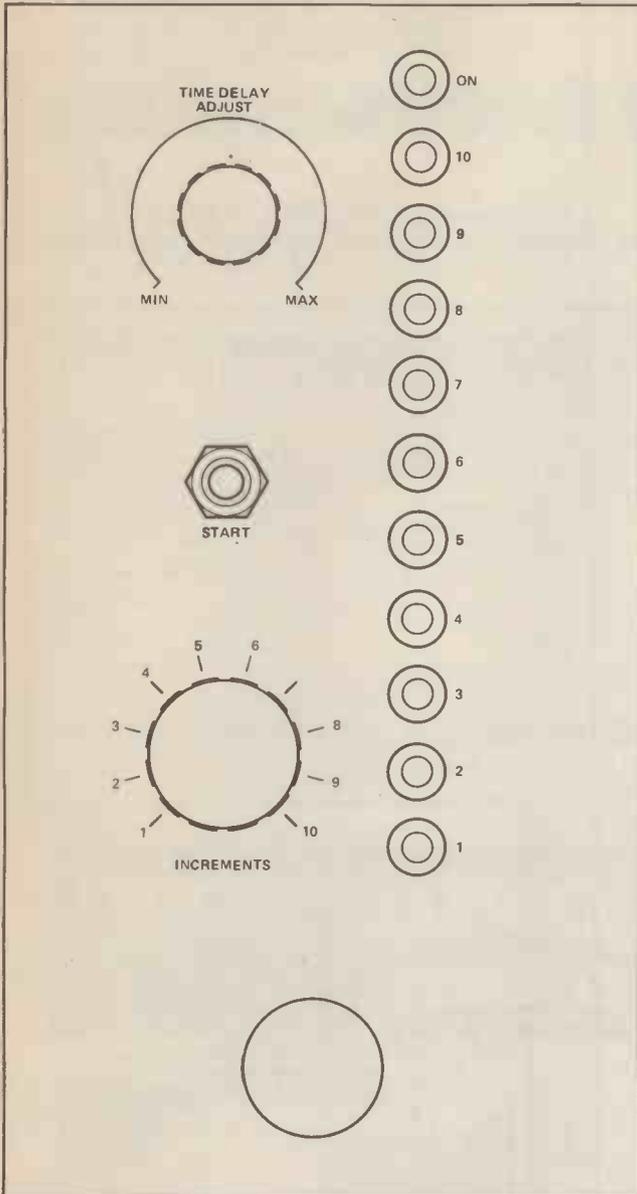
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HE PCBs





Top Left, the PCB foil patterns for last month's CB Selective Call Unit project. Note the links (L-L) on the foil side of the Receiver (Rx) board, and the diode (D-D) which is wired across the relay coil pins.

Bottom Left, the PCB patterns for the Incremental Timer; the Timer board is larger of the two. The Display board is mounted to the front panel by the potentiometer and switch fixings. The front panel artwork is reproduced at full size, above.

Right, the Digitester PSU board. The toroidal transformer is screw-mounted through its centre. The corner pads indicate the positions for fixing the board into a box.



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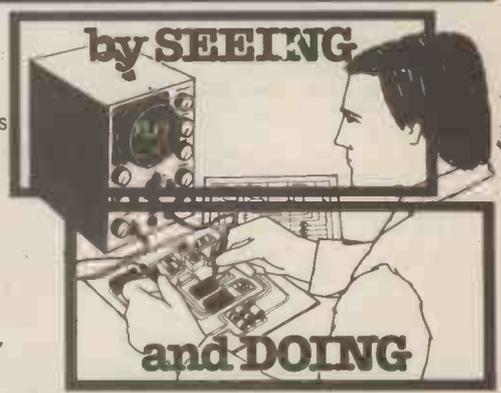
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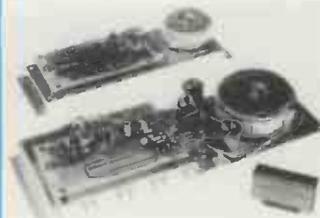


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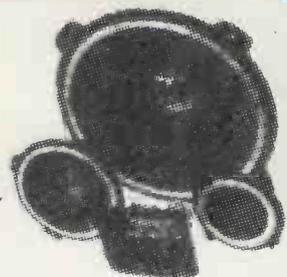
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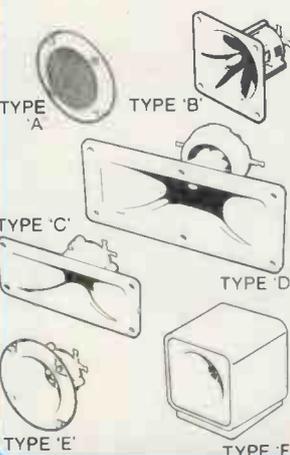
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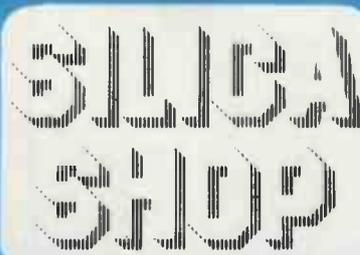
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