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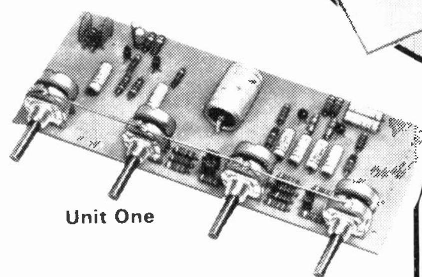

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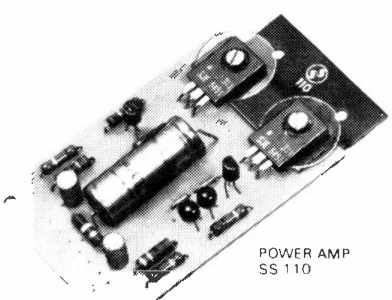

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SS 110

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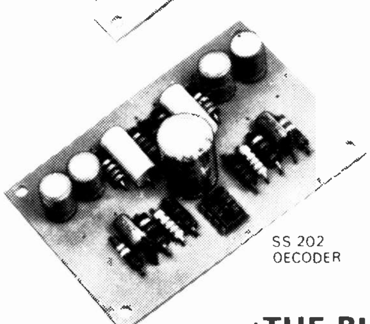

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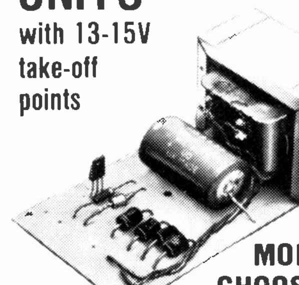

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MARCH 1977 VOL 6 No 3

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SEMICONDUCTORS - COMPONENTS

SUPER UNTESTED PAKS

PAK	No.	Order No.	Price
U50	100 Germ. Gold bonded OA47 diode	16130	£0.60
U51	150 Germ. OA70/81 diode	16131	£0.60
U52	100 Silicon Diodes 200mA OA200	16132	£0.60
U53	150 diodes 75mA 1N4148	16133	£0.60
U54	50 Sil Rect Top Hat 750mA	16134	£0.60
U55	20 Sil Rect Stud Type 3 Amp	16135	£0.60
U56	50 400mW Zeners DO7 Case	16136	£0.60
U57	30 NPN Trans BC107/8 Plastic	16137	£0.60*
U58	30 PNP Trans BC177/178 Plastic	16138	£0.60*
U59	25 NPN TO39 2N697/2N1711 sil.	16139	£0.60
U60	25 PNP TO59 2N2905 silicon	16140	£0.60
U61	30 NPN TO18 2N706 silicon	16141	£0.60
U62	25 NPN BFY50/51	16142	£0.60
U63	30 NPN Plastic 2N3906 silicon	16143	£0.60*
U64	30 PNP Plastic 2N3905 silicon	16144	£0.60*
U65	30 Germ. 0071 PNP	16145	£0.60
U66	15 Plastic Power 2N3055 NPN	16146	£1.20
U67	10 TO3 Metal 2N3055 NPN	16147	£1.20
U68	20 Unijunction trans IIS43	16148	£0.60
U69	10 1 amp SCR TO39	16149	£1.20
U70	8 3 amp SCR TO66 case	16150	£1.20

Code No's mentioned above are given as a guide to the type of device in the pak. The devices themselves are normally unmarked

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Pack No.	Qty.		Order No.	Price
C1	200	Resistor mixed value approx. (Count by weight)	16164	*£0.60
C2	150	Capacitors mixed value approx. (Count by weight)	16165	*£0.60
C3	50	Precision resistors. Mixed values	16166	*£0.60
C4	80	⅛th W Resistors mixed preferred values	16167	*£0.60
C5	5	Pieces assorted ferrite rods	16168	*£0.60
C6	2	Tuning gangs. MW/LW VHF	16169	*£0.60
C7	1	Pack wire 50 metres assorted colours single strand	16170	£0.60
C8	10	Reed switches	16171	*£0.60
C9	3	Micro switches	16172	*£0.60
C10	15	Assorted pots	16173	*£0.60
C11	5	Metal jack sockets 3 x 3.5mm. 2 x standard switch types	16174	*£0.60
C12	30	Paper condensers preferred types mixed values	16175	*£0.60
C13	20	Electrolytics trans. types	16176	*£0.60
C14	1	Pack assorted hardware — Nuts / bolts, grommets, etc.	16177	*£0.60
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C16	20	Assorted tag strips and panels	16179	£0.60
C17	15	Assorted control knobs	16180	*£0.60
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C19	2	Relays 6 — 24V operating	16182	*£0.60
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C22	50	Metres PVC sleeving assorted size and colour	16185	£0.60
C23	60	½ watt resistors mixed preferred values	16188	*£0.60
C24	25	Presets assorted type and value	16186	*£0.60
C25	30	Metres stranded wire assorted colours	16187	£0.60

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Pack No.	Qty.		Order No.	Price
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S2	6	Slider potentiometers, all 470 ohms	16191	*£0.60
S3	6	Slider potentiometers, all 10k lin.	16192	*£0.60
S4	6	Slider potentiometers, all 22k lin.	16193	*£0.60
S5	6	Slider potentiometers, all 47k lin.	16194	*£0.60
S6	6	Slider potentiometers, all 47k log.	16195	*£0.60

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Size 4¼"×3¼"×1¾"

Value	No	Price
0-50UA	1302	£4.50
0-100UA	1303	£4.50
0-500UA	1304	£4.50
0-1MA	1305	£6.00
0-50V	1306	£6.00

2" RANGE

Size 2¾"×1¾"×1½"

Value	No	Price
0-50UA	1307	£3.50
0-100UA	1308	£3.50
0-500UA	1309	£3.50
0-1MA	1310	£3.50
0-50V	1311	£3.50

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0-1MA	1315	£3.20

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Value	No.	Price
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4K7	1833	*£0.22
10K	1834	*£0.22
22K	1835	*£0.22
47K	1836	*£0.22
100K	1837	*£0.22
220K	1838	*£0.22
470K	1839	*£0.22
1M	1840	*£0.22
2M2	1841	*£0.22

LOG TRACK

Value	No.	Price
4K7	1842	*£0.22
10K	1843	*£0.22
22K	1844	*£0.22
47K	1845	*£0.22
100K	1846	*£0.22
220K	1847	*£0.22
470K	1848	*£0.22
1M	1849	*£0.22
2M2	1850	*£0.22

DUAL GANG

LINEAR TRACK

Value	No.	Price
4K7	1851	*£0.68
10K	1852	*£0.68
22K	1853	*£0.68
47K	1854	*£0.68
100K	1855	*£0.68
220K	1856	*£0.68
470K	1857	*£0.68
1M	1858	*£0.68
2M2	1859	*£0.68

LOG TRACK

Value	No.	Price
4K7	1860	*£0.68
10K	1861	*£0.68
22K	1862	*£0.68
47K	1863	*£0.68
100K	1864	*£0.68
220K	1865	*£0.68
470K	1866	*£0.68
1M	1867	*£0.68
2M2	1868	*£0.68

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LINEAR TRACK

Value	No.	Price
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10K	1871	*£0.48
22K	1872	*£0.48
47K	1873	*£0.48
100K	1874	*£0.48
220K	1875	*£0.48
470K	1876	*£0.48
1M	1877	*£0.48
2M2	1878	*£0.48

LOG TRACK

Value	No.	Price
4K7	1879	*£0.48
10K	1880	*£0.48
22K	1881	*£0.48
47K	1882	*£0.48
100K	1883	*£0.48
220K	1884	*£0.48
470K	1885	*£0.48
1M	1886	*£0.48
2M2	1887	*£0.48

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.1 Pitch

Size	No.	Price
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2.5" x 17"	2203	£1.42
3.75" x 5"	2204	£0.52
3.75" x 3.75"	2205	£0.46
3.75" x 17"	2206	£1.82
4.75" x 17.9"	2207	£2.34
2.5" x 1" (pack of five)	2208	£0.57

.15 Pitch

Size	No.	Price
2.5" x 17"	2209	£1.13
2.5" x 5"	2210	£0.42
2.5" x 3.75"	2211	£0.31
3.75" x 17"	2212	£1.51
3.75" x 5"	2213	£0.57
3.75" x 3.75"	2214	£0.42
2.5" x 1" (pack of five)	2216	£0.52

DRILLED PLAIN P.C.B.

.1 Pitch

Size	No.	Price
3.75" x 17"	2217	£1.18
3.75" x 2.5"	2218	£0.26
5" x 3.75"	2219	£0.42

.15 Pitch

Size	No.	Price
2.5" x 17"	2221	£0.78
3.75" x 17"	2222	£1.00
2.5" x 5"	2223	£0.26
2.5" x 3.75"	2224	£0.21
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IS11	Phono screened	1682	*£0.12
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CS6	Jack 3.5mm	1657	*£0.06
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CP6	Single Microphone H/Duty	3131	£0.12
CP7	3-core mains (5 amp)	3132	£0.09
CP8	2-core Oval (2.5 amp)	3133	£0.08
CP9	2-core Speaker	3134	£0.07
CP10	Low-Loss UHF	3135	£0.14
CP11	Multicore 8-way	3146	£0.25
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CP12	Standard VHF Coax	3232	£0.10

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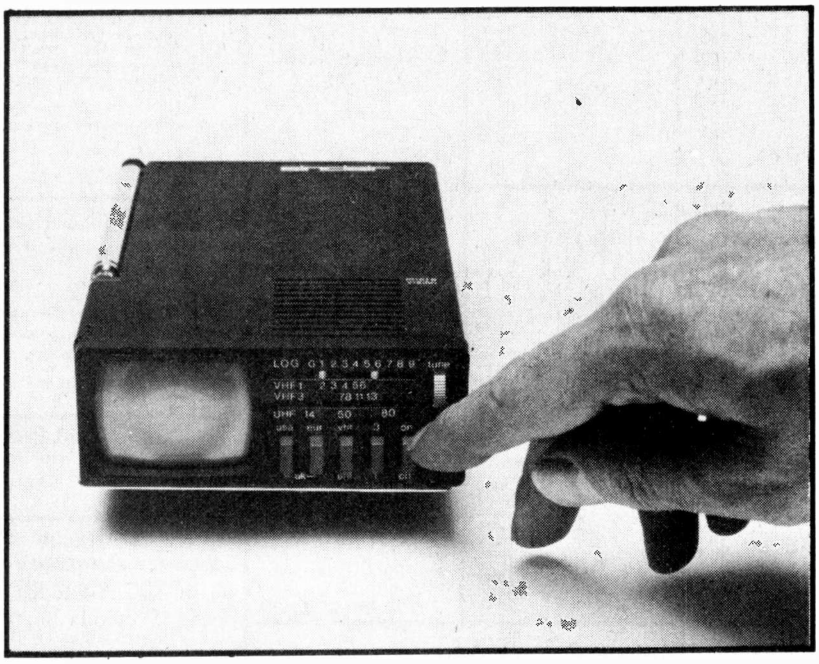
news digest

AT LAST! THE ULTIMATE 'EXECUTIVE' TOY



After several false starts - the first of them over ten years ago, Sinclair have got their miniature television into production. Entrepreneur Clive Sinclair has invested a staggering £500,000 into the research on this project and for years we have heard unofficially that it's 'about to be launched'. Well, he finally made it.

The TV is B&W of course but there its resemblance to other sets ends. The Microvision, as it is called, measures 152 x 102 x 38mm. and sports a 2-inch (diagonal) screen.

The tube employs electrostatic deflection using an EHT of only 2kV. The tube is supplied by AEG/Telefunken of Germany who are believed to have spent another £200,000 in development.

A major feature of the receiver is its multi-standard capability. Unlike radio, there are several world standards for TV: Britain is about the only country to rely primarily on UHF for example, and we use a 6MHz sound-to-vision spacing, whereas most of Europe uses 5.5MHz. The receiver can accomodate either and also the North American 525 line, 60Hz signals with a 4.5MHz sound-to-vision spacing.

A major aspect of the design has been to reduce current consumption to reasonable proportions. The set will work from its own mains supply while the batteries are recharged. Four hours viewing can be obtained from one recharge, which can also be done from a car battery.

Price of the Microvision will be £175 + VAT in Britain and $300 plus sales taxes in the U.S., the area where sales are expected to be highest.

The first potential customers are seen by Sinclair as being the international executives but they also consider that the demand by value for truly portable TV is likely to exceed that for pocket calculators. Sinclair consider that they will have the market to themselves for at least 1½ years.

At the world launch to the media, held at the Savoy, London, in January, several models were shown. Certainly those sets seen by ETI *worked* and we wish Sinclair well in this new venture.

AMATEURS!

Aren't we all? Anyway there's a club for you if you're an electronics amateur in Britain. Not surprisingly, it's called the British Amateur Electronics Club, and is a thriving institution these days. A monthly newsletter is issued to members, and discounts on components, cases, etc can be arranged (for members). At present they're deep into a computer project (aren't we all...), but no aspect of our subject is ignored. Details from: *Mr. C. Bogod, 'Dickens', 26 Forrest Road, Penarth, Glam.*

REDUCTION IN TIME

It is always a pleasant surprise to be able to announce a price reduction in our age of ever upward costs. Electronic watch prices are perhaps where one might best expect to hear the thud of bottoming margins, but even so, CBM have done nicely with these:

CBM 5000 – 5 func., black polystyrene case and strap: from £17.50 to £11.95.

CBM 5001 – 5 func., chrome with black leather strap: from £18.95 to £17.50.

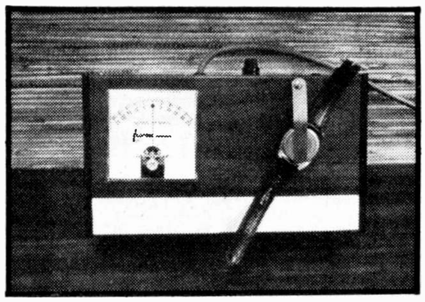
CBM 5002 – 5 func., gilt with black leather strap: from £19.95 to £17.50.

CBM 5003 – 5 func., chrome with metal bracelet: from £21.00 to £19.95.

CBM, Industrial Estate, Eaglescliffe, Stockton-on-Tees, Cleveland.

DIGITAL WATCH TUNE-UP BOX!

The digital watch industry is expanding fast and so, naturally, is the watch *repair* business. Intertime Corporation have come up with a machine to make calibration and testing of quartz crystal watches as simple as pushing the button - in other words at all times when you're not using both hands!



The basic unit has a self-contained voltage source for powering modules while testing, and an analogue meter for easy visual monitoring. This gives a precise setting of a wide variety of digital watches and quartz analogue watches using 32,768Hz crystals, which accounts for 99% of the market.

The tester picks up the quartz crystal radiation, processes it, determines error as a function of frequency shift and displays any such error on a meter.

The basic unit without any of the options is offered at about £200, after importation levies. *Intertime Corp., 17782 Sky Park Boulevard, Irvine, California 92714, U.S.A.*

MPUs WEARING A MINI?

There is a micro-exhibition of MPUs being staged by Bywood Electronics this month at the Berners Hotel, Berners St., London W1. It runs on Saturday February 26th from 12-7pm. On show will be Bywood's Scrumpi, a brand new VDU system, and quite a few peripherals.Worth a walk is it not?

ETI - CANADA

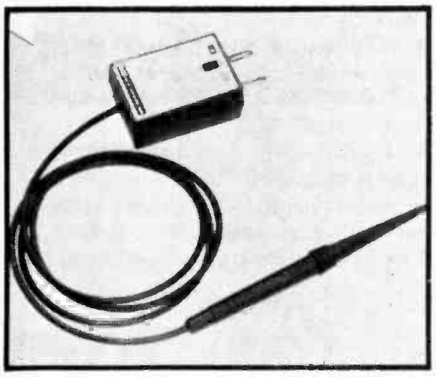
As some readers may have seen in the December issue, we have launched a Canadian edition of ETI.

Les Bell, who has been on the editorial staff in Britain for about a year, is working in Canada on the magazine: finding that curling (his favorite sport) and North American Hamburgers (believed to be his sole source of sustinance) in plentiful supply, he has settled happily. (If you're interested in replacing him, see our job advert elsewhere in this issue).

ETI is now published in Australia, France and Holland as well as in Britain and Canada. The combined circulations now total just under 200,000, making us the second largest electronics magazine in the world (Popular Electronics in the U.S. is the biggest).

ANY DMMs FOR DEGREES

Designated the Series 80T, these new probes have been designed as a universal accessory to the DMM and are available in both Celcius and Fahrenheit versions. 80T-150C has an operational range from −50°C to +150°C, and the 80T-150F has a temperature range of −58°F to 302°F.



Both versions provide an output in mV per degree, and feature a basic accuracy of ±2°C or F. Each model can be changed to the other simply by fitting or removing two jumper leads, and re-adjusting the calibration.
Fluke International Corp., Garnett Close, Watford WD2 4TT.

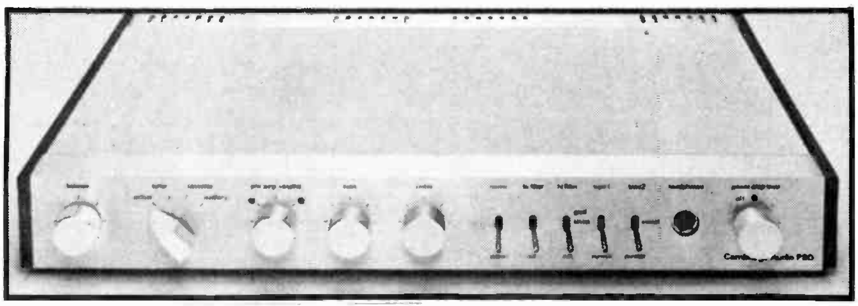
SPACE SHUTTLE ON THE TILES

Extremely pure silica glass has been manufactured for at least 40 years - longer than jet aircraft have been around. Now it is to aid and abet the ultimate aircraft - the U.S. Space Shuttle. Made into tiles (composed of 96% silica glass) of which 34,000 are used, the material covers well over 70% of the surface of the Shuttle.

These tiles are incredible heat 'shedding' devices (see photo) and will be expected to withstand temperatures of up to 1260°C for 100 re-entries into the atmosphere. Previous heat shields were destroyed on re-entry.

Each tile is precisely milled to fit exactly against the curvature of the Shuttle body, thus making the composite craft as light as possible, and as aerodynamic as is feasible. This does however mean that no two of those 34,000 tiles are alike! Imagine the little man in a white coat with the job of fitting them to the aircraft - a huge 3-D jigsaw puzzle with only one solution out of 34,000 (i.e. 34,000 x 33,999 x 33,998...x 1) possibilities! Rather him than me.

THE P80 INTEGRATED STEREO AMPLIFIER



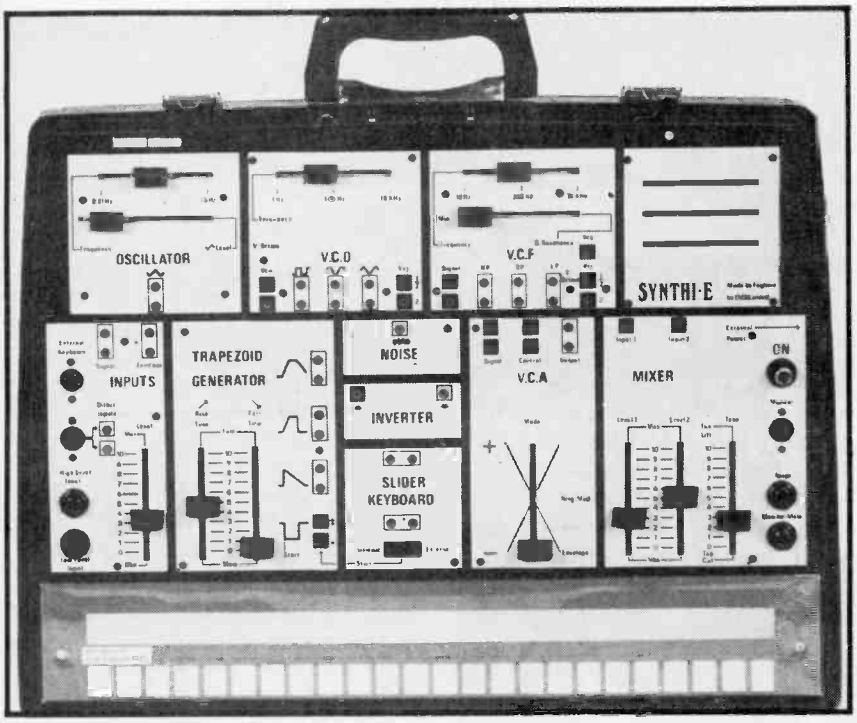
The new Cambridge Audio P80 Integrated Amplifier (which supercedes the P60) offers increased power output (40 watts per channel) and incorporates a number of modifications.

Cambridge Audio employ a buffer stage to eliminate cartridge inductance problems which can plague other amplifiers. The R.I.A.A. standard is more accurate than virtually all their competitors.

A new and onobtrusive form of amplifier protection is incorporated. Musical peaks will often cause amplifiers to limit and clip. This phenomenon is now recognised as a major source of signal degradation in high fidelity power amplifiers. A substantial 'power margin' is built into the P80, such that the protection system allows them to pass unchecked, while still protecting the amplifier against improper load conditions.

The P80 incorporates very flexible tape facilities; the simultaneous use of three tape-recorders, or dubbing one source whilst monitoring another.
Cambridge Audio Ltd., 105-109 Oyster Lane, Byfleet, Surrey, KT14 7LA.

A SOUND EDUCATION



EMS have produced a small-scale synthesizer especially for school usage. It arrives with a comprehensive teaching course, and is of modular construction, such that patchcords are required for linkage.

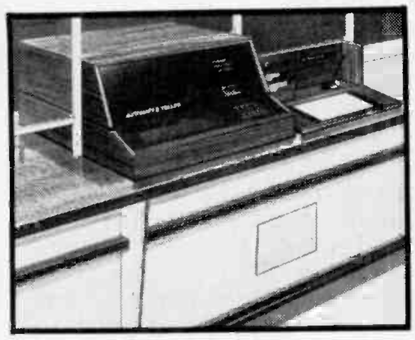
External options include mechanical keyboard (3 octave). oscilloscope, and a mains power unit to supplement the internal batteries.
EMS Ltd., 277 Putney Bridge Road, London SW15 2PT.

A DASHING DISPLAY

This mock-up has been put together by Bowmar Instruments to show one very possible future of the car dashboard. It includes both circular and linear bargraphs along with digital and alpha-numeric displays. All the displays are naturally made by Bowmar. I hope they've developed a gold LED to go into a Rolls-Royce!
Bowmar Instruments Ltd., 41-45 High Street, Weybridge, KT13 8BB.

TELLER TALE

This rather ugly box bodes well for a steady bank balance. It simply doesn't give overdrafts! Selected (how?) branches of the Midland and Clydesdale banks are installing the autotellers in an effort to speed up bank procedures. The terminal carries out such simple actions as balance enquiries, chequebook requests, and cash withdrawals.



They will be linked to the Midlands B6700 computer systems at Bootle (Lancs.) and Brent. A built-in VDU provides the information to the customer. One of our staff wandered into such an establishment, paid in his salary (all 50p of it), and attempted to draw his beer money for the forthcoming weekend.

The result was not the supply of crisp blue sheets of paper he eagerly awaited to finance his two-day debauch. Instead the box hummed and clicked and printed out those heartless words that spoke so eloquently of dry bread and water in the immediate future - No Funds.

Ah well - such is progress.

FOUR THOUSAND PLUS 17

RCA Solid State-Europe has launched 17 new COS/MOS digital integrated circuits in the standard CD4000 range. All the devices have quiescent current specified to 20V, a maximum input leakage current of 1uA at 20V.

Among the new circuits are several unique types, CD40100B 32-bit left/right shift register; CD40102B 8-stage pre-settable 2-decade binary-coded-decimal synchronous down-counter.

TALE OF A NEW CAT

Arrow Electronics have issued a new catalogue to the waiting world. It is their ninth, and a very worthy presentation. It contains many unusual (and useful) semiconductors, and a good range of hardware etc. It is worth the 40p, which will also entitle you to ring 'em up and pester the technical staff for further info on the contents.
Arrow Electronics, Coptfold Road, Brentwood, Essex.

BURGLAR PROOF YOUR HOME!

A layman's guide to protecting the home; or how to keep what you've got for longer!

THERE ARE TWO rising things in modern society, inflation and crime. We can't help you beat inflation but can help to slow down the crime rate! It seems anything that isn't bolted down tends to disappear rapidly, the more expensive the item the faster it goes. When it comes to the home not only is the financial burden enormous, the trauma of a burglary is great as well.

Burglars fall into three general categories; the walk-in thief who does just that, and walks out with any small valuables and cash. The small time burglar, who will break in usually in the late afternoon, and take considerably more than a casual walk-in thief. Professional gangs who will literally clean out a house — carpets, furniture, hi-fi, everything!

PHYSICAL SECURITY

So how do you go about stopping them? The first step is physical security, locks and bolts, moats, bars, trained crocodiles etc. The reason physical security is mentioned first, is that burglars usually don't like making much noise, if they have to use a sledge-hammer to open a door, they'll pick another house.

All exterior doors should have mortice deadlocks fitted. The advantage of these, over the normally used front door lock, is that without a key you can't open them. Even if the door is solid wood, there are ways of opening the common front door lock — from the outside! A point to watch is that if the door is less than 1½ inches thick, a mortice may weaken the door — in cases like this consult a local locksmith. Also if you have a garage — with connecting door — make sure it's as secure as the front and back doors. Further door security is provided by hinge bolts; these are fitted on the hinge side, and automatically engage when the door is closed.

An important thing to remember is to use a professional locksmith, if you have not fitted locks before. If you do fit them yourself follow the instructions carefully. A badly fitted lock can give a false sense of security. Don't fall for door to door lock salesman — they may offer to fit locks — but chances are they could keep extra keys!

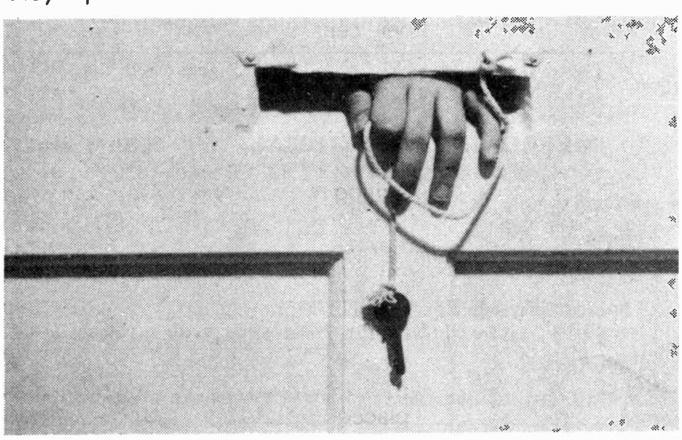
WINDOWS

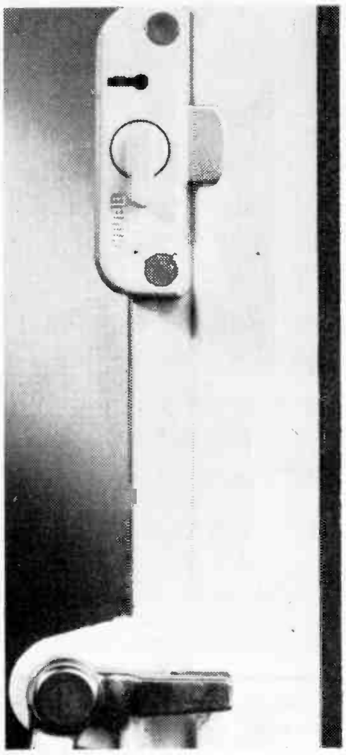
Next the accessible windows should be secured. Several types of locks are available for windows, the best type for each type of window needs to be worked out. Metal framed, wood framed and sash windows all need different locks which secure the frame or the handle depending on the particular model used. They rely on the principle that burglars don't like climbing through a window, with broken glass still int it. In general windows are the weakest point of any house; all ground floor and accessible higher ones must be locked.

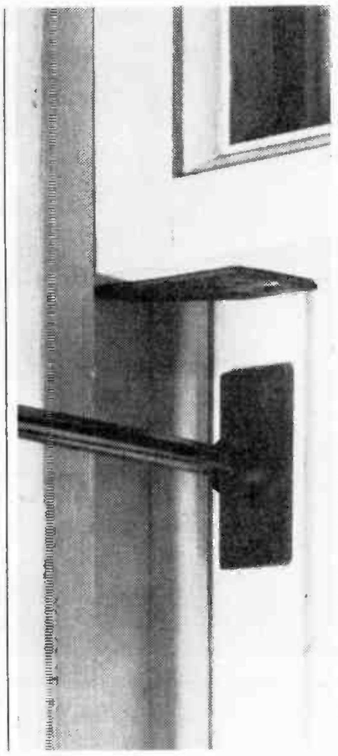
WET PAINT

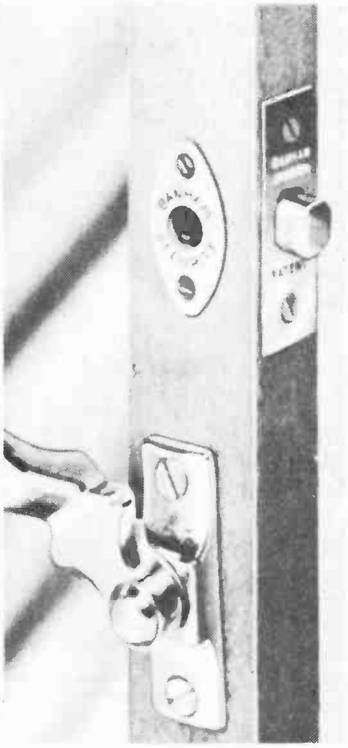
Other physical security measures are locks on internal doors, or security bolts, so that if a room is entered the burglar is contained in one room. Non drying paint can be used on drainpipes: this wonderfully messy stuff is a good measure. It looks like normal paint, but is like jelly when the surface is broken, any cat burglar grasping the drainpipe gets a very nasty surprise, and will tend to beat a hasty retreat covered in wet paint! Don't use it less than 7 feet from the ground.

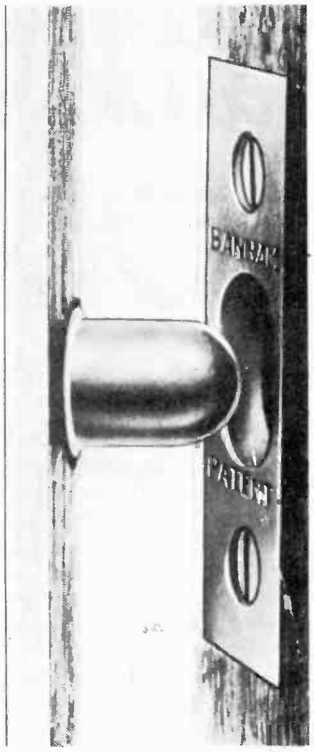
Leaving lights on at night, with a radio playing is another simple deterrent method. Of course, all of











Top, left to right: Chubb 8K100/W, Chubb WS1 window locks. Banham W/104 Mortice bolt, H/103 hinge bolt.

Centre; Chubb Castle mortice deadlock.

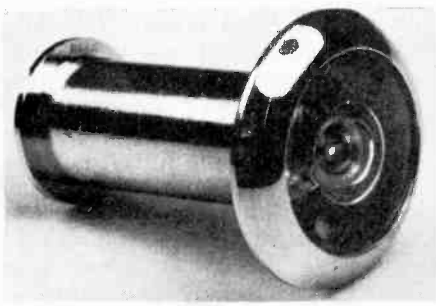
Bottom; Three ways your house can be 'done', and typical door spy hole.

these precautions are only effective if you use them — close windows and lock doors, even if you go out for ten minutes. A fact to bear in mind is that a good housebreaker, can "do" a house in six minutes, and get a lot of small valuables.

If in any doubt about any part of your security, contact your local Crime Prevention Officer (via any police station) who will visit you and give free sensible advice.

ELECTRONIC SECURITY

If the precautions discussed have been taken, you will have cut by about 75 per cent the chances of being done. For most people this would enable them to sleep at night, but the remaining 25 per cent risk can be cut to virtually no risk, with a well installed electronic alarm system. As with physical security an alarm system is only effective if it is used. The variety of electronic systems possible makes selection and installation a very important part of the system.



A badly thought-out system can be worse than no system at all. For example if the wrong sort of devices are used, the alarm may go off erratically or not at all. In the Greater London area alone, out of 150,000 automatic calls to police stations and security centres, 99 per cent were false alarms! This tends to create a "crying wolf" reaction from the police and neighbours. In fact some police authorities maintain a black list of erratic installations, also a 110dB siren wailing on your roof at 4am tends to annoy the neighbours — especially if caused by a passing car vibration!

SENSORS

All alarm systems need sensors, to detect (hopefully) an intruder. In order to be of any use they must be placed in the way of potential entry

BURGLARPROOF YOUR HOME!

points. Also the optimum type must be used at each point. For example a loop of foil on the back of a window, is not much use, without a sensor to detect if the window is open!

PASS SWITCHES

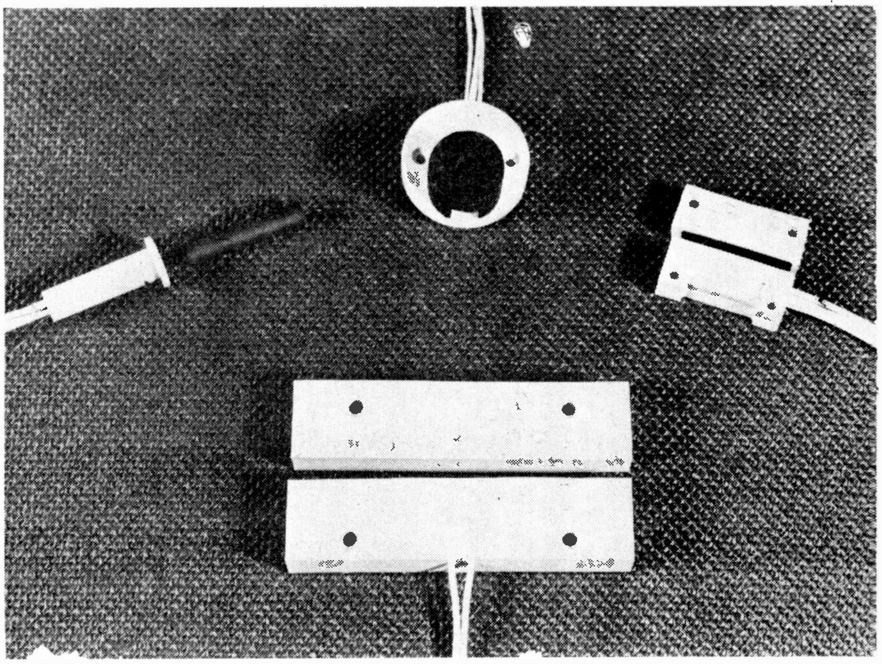
Alarm systems also need a control box to house any electronics, power supply, batteries, bell and main on/off switch. An external bell is also needed, with possibly an autodial unit, to alert the police. Usually a key operated pass switch is used, so that silent entry and exit can be made. This can either be integral with the mortice deadlock, or a separate switch mounted in the door frame. The advantage of being in the mortice deadlock, is that only one key is required. This is not good practice in industrial systems, where two keys is an added security measure. But for the home it is much simpler to have one key, as it can control a virtually automatic system, when you lock the door the alarm is on. Most security mortice deadlocks can be obtained with an integral microswitch, for a few pounds extra.

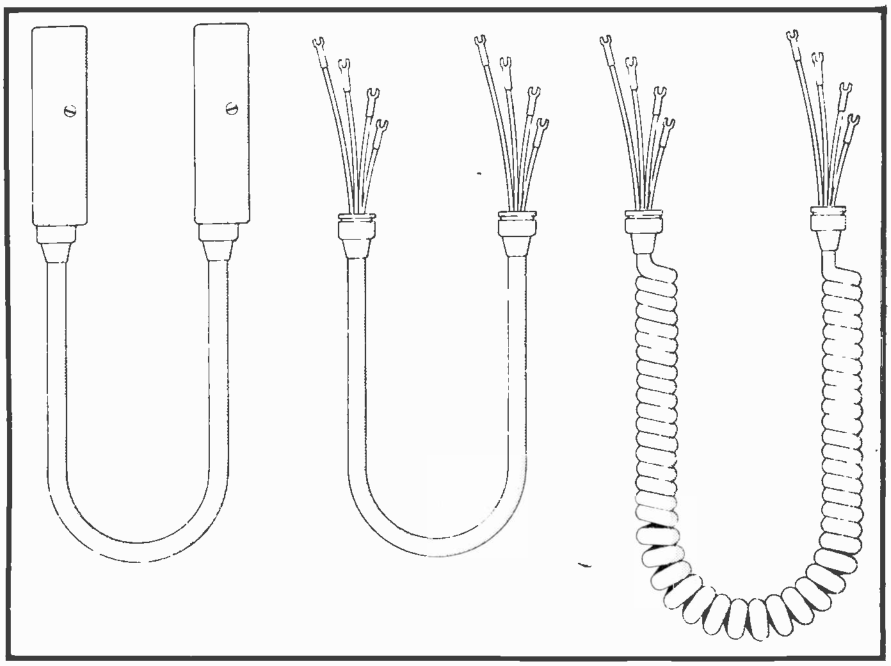
DOORS

External doors should be fitted with reed switches or microswitches. There are several types available, some are completely hidden when installed, others are mounted on the surface of the door and frame. Always fit the magnet or microswitch actuator to the door itself, not to the frame. This is to eliminate wires from the frame to the door. The only exception to this is when a pass switch is fitted, then fitting a reed switch to the door eliminates wiring over the top of the door.

WINDOWS

Windows are usually a large part of the sensor network. There are several ways of protecting them, giving different degrees of effectiveness, and various costs. Reed contacts are an obvious choice for opening windows, mounted in the frame, so that the magnet moves when the window opens. This will not prevent anyone climbing through a broken pane.



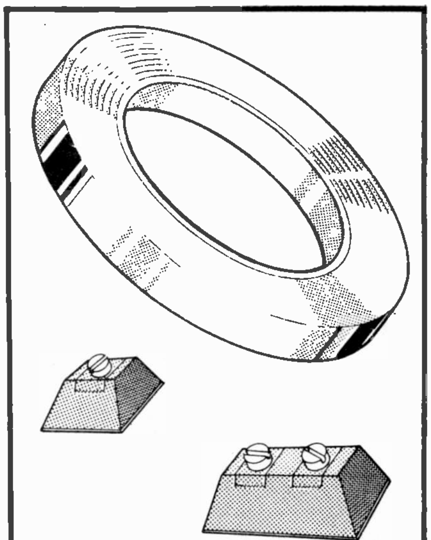


Top; Four types of reed switch, all available from Sesco.

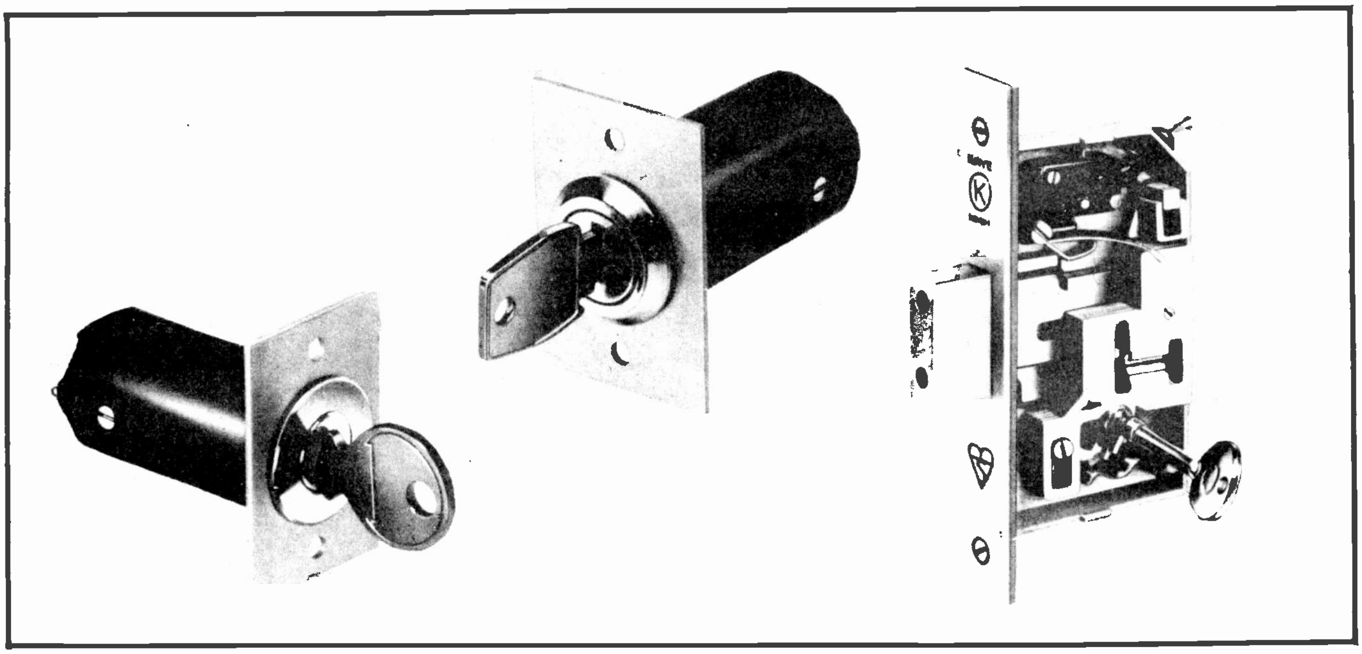
Centre; Door loops, used to make secure flexible contact, from frame to door.

Below; Roll of self adhesive aluminium foil, used to protect windows.

Aluminium foil applied to windows, acts as part of the alarm circuit, when broken sets the alarm off and is quite cheap. However installation is not quick for the inexperienced, and can look very amateurish, if not unsightly. If installed properly foil can act as a powerful deterrent, to all but the most determined burglar. After all why risk detection, when next door is not alarmed? This reasoning also applies to the mounting of your external bell unit, if it is visible.



Window foil termination blocks.



SHOCK TACTICS

Vibration sensors can be used on large windows. These rely on the physical shock, produced when a window is broken. They are quite expensive, compared to using foil, but much simpler to install. Careful adjustment is needed, to prevent spurious operation.

An interesting device for window protection, is the Guard-Glass Detector. This device is an acoustic sensor that listens for the sound of breaking glass! A self-contained unit it has an on axis range of 15 feet (4.5m). Electronic circuitry filters out unwanted low and high frequencies. This device along with most other alarm sensors, is available from Sesco.

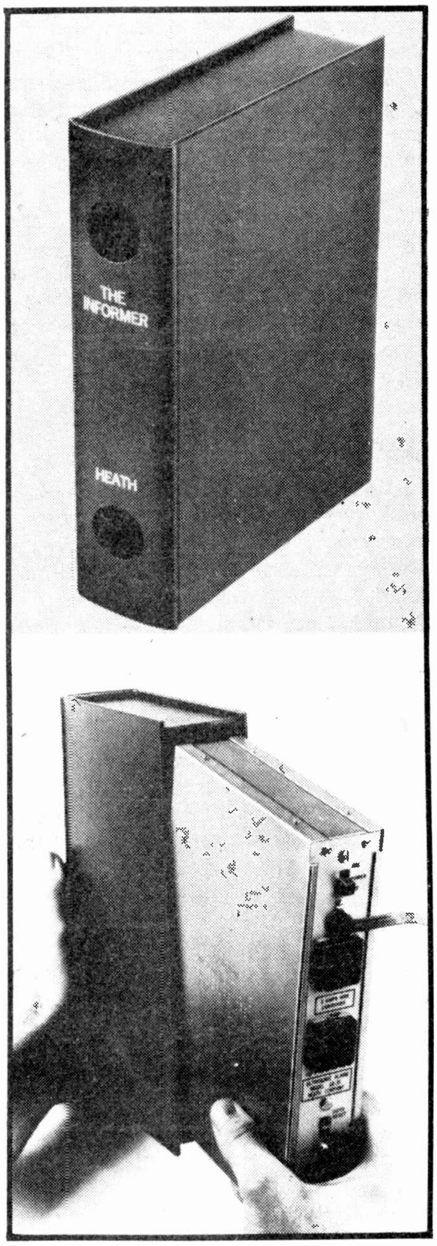
MATS & BEAMS

Another approach is to lock the windows, and defend the rooms. Rather than wire up every window only the most vulnerable are connected to the alarm. In this case the interior needs protection, to detect an intruder as soon as possible. The simplest method is to use pressure mats, placed in the positions most likely to be walked on. The obvious place is by door ways, and on the stairs. If pressure mats are used on stairs it is a good idea to use two — with one at the top, and one half way. They should be installed underneath the carpet, and the wiring hidden from view.

Invisible beams can be used, to cover the hallway. These operate the alarm when anything gets in the way of the beam. Simple beams can be bypassed easily with a torch, by shining it onto the light sensitive part. More sophisticated units use modulated beams, so that the constant light from a torch will operate the alarm.

SPACE ALARMS

The hardest sensor to get past, is the space alarm. These can be ultrasonic or microwave units. They operate by beaming out a signal and detecting the reflected signal, any change in the reflected signal (caused by an intruder) produces an alarm signal. Set up and calibration of these units is quite delicate, spurious signals can be produced by mice or even air currents. About 60 per cent of false alarms are produced by space alarms, that have been set too sensitively. The more expensive units have built-in delay electronics, to help eliminate spurious operation.

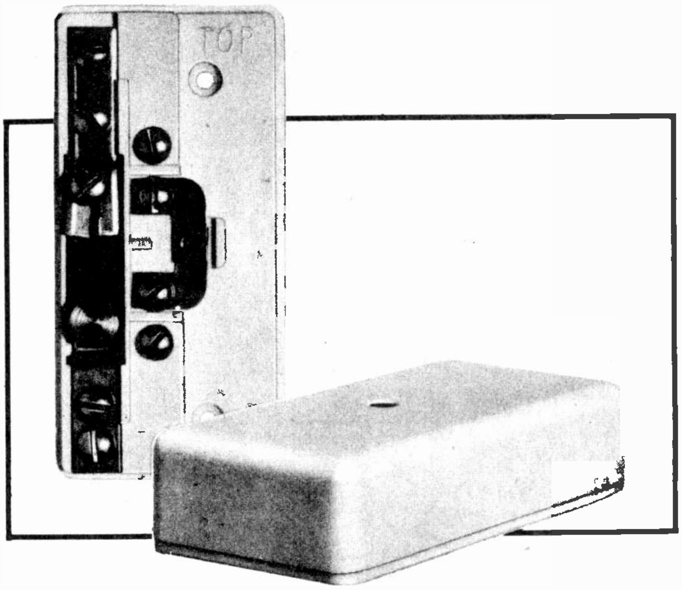


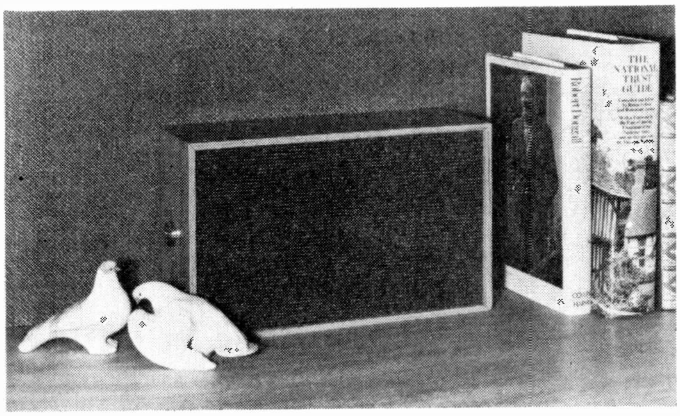
Top, left to right: K/B pass-switch (50 million keys, L/B pairswitch (2 thousand keys), Kaye shunt mortice lock (2 thousand keys).

Centre and Bottom; Two views of the Heath kit ultrasonic intruder unit, type DD39.


VANDALS
ENTRANCE
10,000
VOLTS
BEWARE
MINES AND
CARNIVOROUS
PLANTS
CROMWELL
VILLA
STOP
IN

BURGLARPROOF YOUR HOME!





Above; Homeguard 71Mk11 kit and type 600/m vibration contact.

Bottom; Maxi Guard ultrasonic unit.

All available from Sesco.

CONTROL UNITS

The control unit itself can be made up, or purchased complete. Various kits are available with assembled control unit, and a selection of sensors, usually with a bell for external use. Examples are the Chloride Gent 61 system, Radiovisor 600/S and Homeguard 71Mk II. These are all basic alarm systems extra sensors can be added to those supplied. All these units are supplied with a bell, however it is a good idea to use a siren. The reason is that in general sirens are louder, and more penetrating. How many times have you heard an alarm bell ringing and walked past? Most people ignore bells because they are so common.

INSTALLATION

Actual installation is probably the key to all alarm systems. A badly installed system can be tampered with and made ineffective. A true story about installations concerns a major alarm company and a large record store. The managing director of the record store decided to have the security system checked. He contacted a firm of consultants who agreed to check out the security. The first day the record store opened, the consultants visited it — but one stayed behind in the loft space above a toilet. Later on when the store was shut, he climbed down and disabled the alarm system, with a screwdriver and a pair of side cutters. The hardest part was reconnecting the system — to stop anyone really stealing anything! The next day the company received 300 albums by taxi, with a note saying how they were taken. If the system had been installed correctly this could not have happened.

All wiring must be neat and concealed if possible. Colour codes should be changed in different parts of the system. Cutting or shorting any wires exposed should set off the alarm.

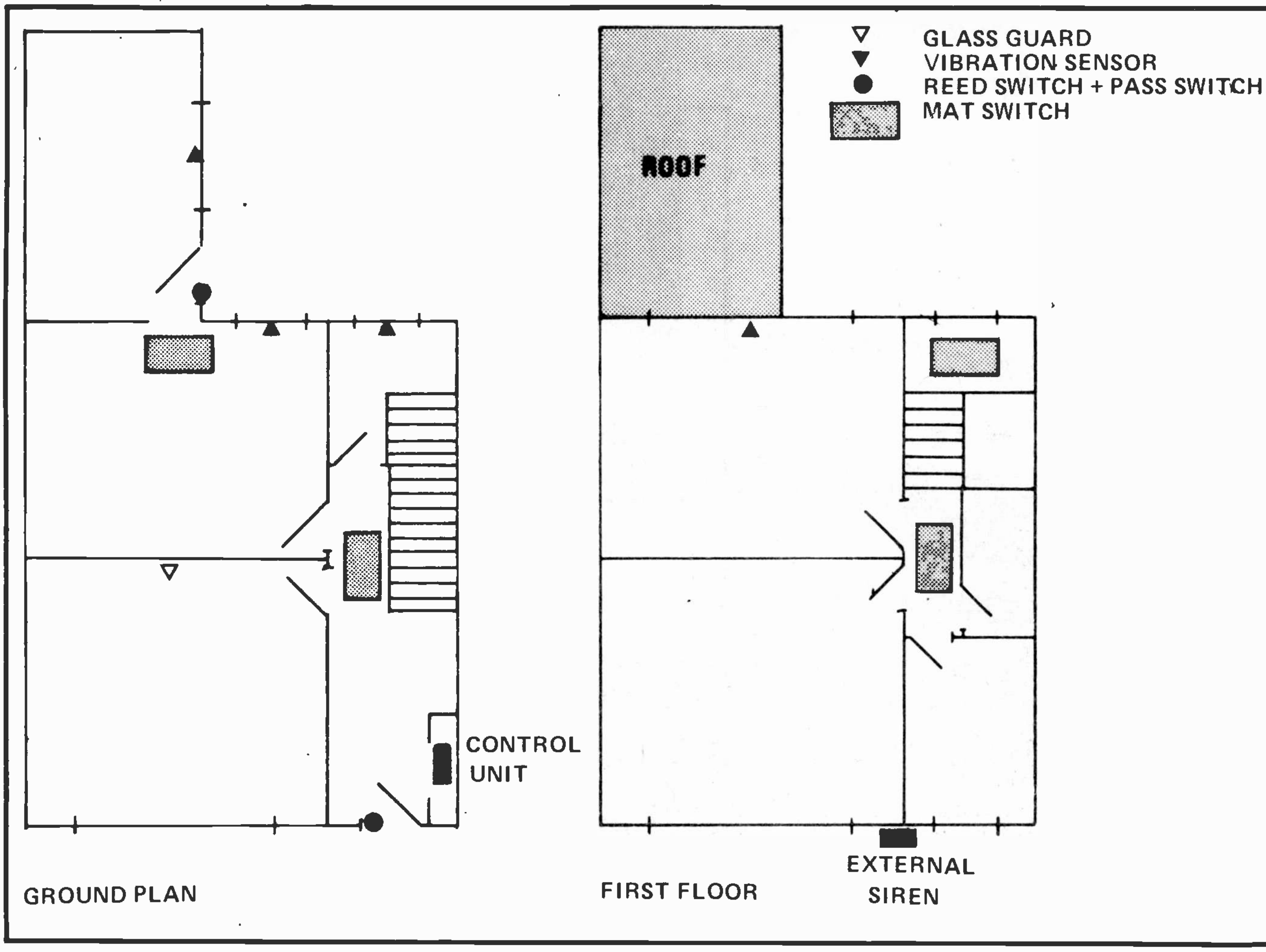
FOILED AGAIN

Window foil should only be applied to prepared glass. First clean the glass with ammonia and water (commercial cleaners tend to leave deposits), dry with a lint free cloth. Mark the line of the foil with chinagraph on the outside of the window. Right angles are made by bending in the opposite direction first, and then in the direction you want to go. This produces a small triangular tab, which should be glued down with varnish. Although, for most home installations the foil can be used from side to side without any angles, practice on a sheet of glass first. If in doubt use another form of sensor.

UPSTAIRS/DOWNSTAIRS

It is good practice to arrange two separate circuits. One for downstairs and one for upstairs. In this way you can have the downstairs protected while you sleep without the chance of late night visits to the bathroom setting off the alarm.

Make sure everyone in the house knows how to use the system, and does use it. If you have pets, it is possible to use window vibration sensors on locked internal doors. This is instead of mats or space protectors, force used on the doors will set off the alarm. Beams should



be above the height of any dogs, liable to walk through them.

Virtually any combination of the various sensors can be used. Degrees of security can range from slight to Fort Knox. A typical system is illustrated, along with a drawing of the author's cottage system . . . .

FINALLY

Don't forget the burgler is generally an opportunist, and will always take the easiest way in. Also if it is worth installing a system, it may be worth increasing your insurance cover to present values.

This article was made possible by help and advice from: Metropolitan Police (Crime Prevention Department), Banham's Patent Locks Ltd., Chloride-Gent Ltd, Chubb & Son's Lock and Safe Co Ltd., Radiovisor Parent Ltd and Sesco (Security) Ltd.

Further details on devices illustrated and mentioned are available from:

Banhams Patent Locks Ltd, 233-235 Kensington High Street, London W8 6SF.

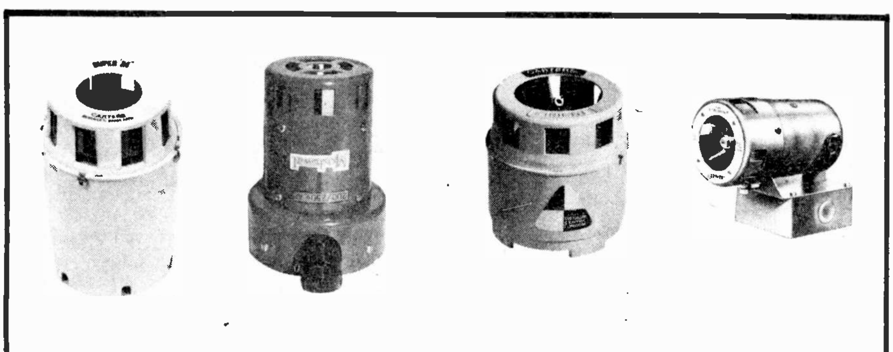
Camrex Special Coating Services Ltd, P.O. Box 34, Sunderland SR12QA.

Chloride Gent Ltd, Faraday Works, Leicester LE5 4JF.

Chubb & Son's Lock and Safe Co Ltd., 14 Tottenham Street, London W1P 0AA.

Radiovisor Parent Ltd, Stanhope Works, High Path, London SW19 2JX.

Sesco (Security) Ltd. Jubilee Works Chapel Road, Hounslow, Middlesex TW3 1TX.



Left to right; Carter 'M' siren (100dB), Madewell 'Mini Siren' (100dB), Carter 'Mini-mitre' (93dB), Gent Siren (110dB). All dB ratings measured at 3 metres.

—ETI project 480

50/100W AMP

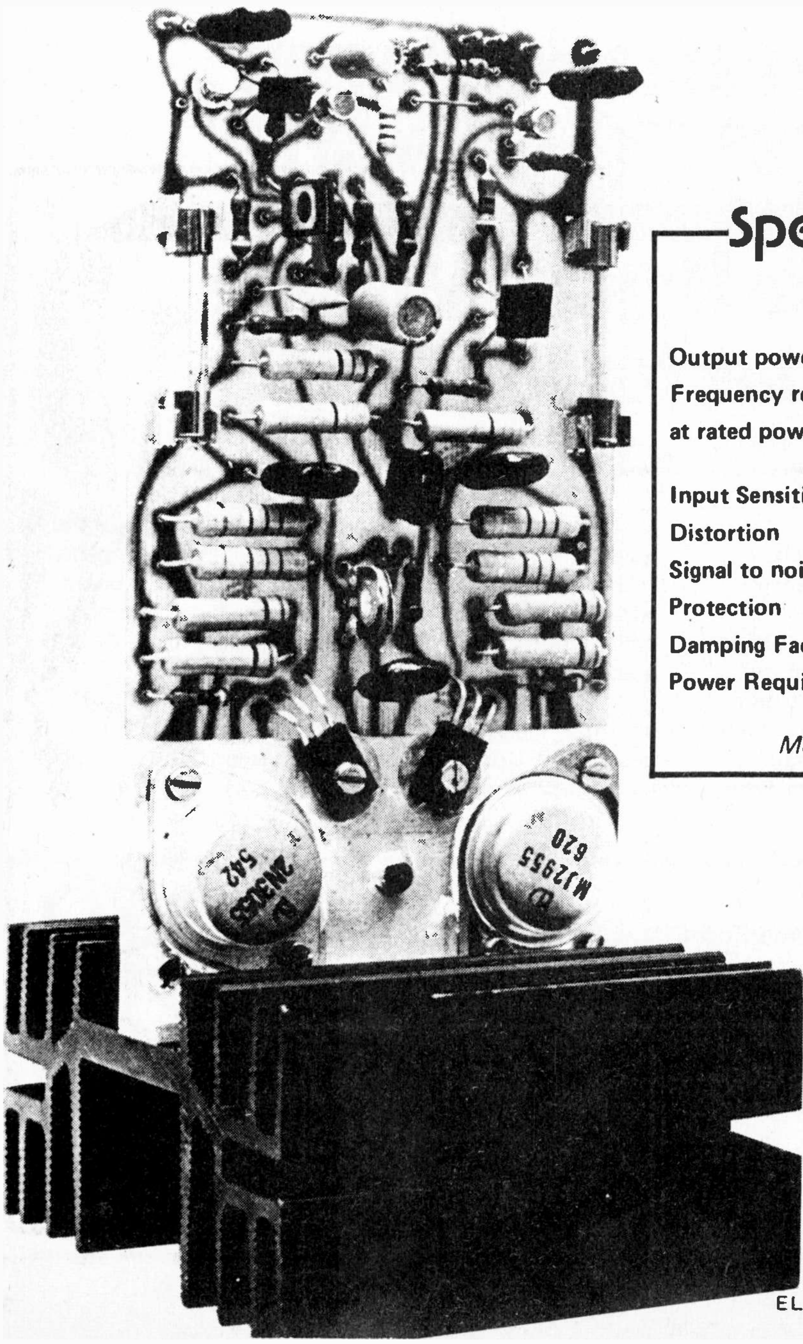
MAKING HIGH POWERS EASY TO OBTAIN — 50W OR 100W THE CHOICE IS YOURS — THE ONLY DIFFERENCE IS TWO TRANSISTORS!

THE MOST POPULAR AMPLIFIERS we have ever published are the 100W guitar amplifier (ETI 413) and the 50W stereo amplifier (ETI 422). These amplifiers have proved very reliable for the many thousands of readers who have built them.

Both of the amplifiers are, however, a bit fiddly to build (as are most power amplifiers) because the power transistors must be mounted on a heat sink which therefore needs wiring to the control board. Whilst this module has the same electrical design as the 422, the layout has been greatly simplified.

The new design was originally a replacement amplifier for the 422. We soon realised that by adding two transistors we had a replacement for the 100W amplifier as well.

Both versions are very easy to build and set up with all the components, including the power transistors, on the PC board (eliminating another source of possible errors).



Specification

	50 W version	100 W version
Output power	50 W into 8 ohms	100 W into 4 ohms
Frequency response at rated power	5 Hz – 50 kHz $^{+0}_{-3}$ dB	5 Hz – 50 kHz $^{+0}_{-3}$ dB
Input Sensitivity	500 mV	1 V
Distortion	see graph	
Signal to noise ratio	100 dB	100 dB
Protection	1.5 A fuses	3 A fuses
Damping Factor	25	20
Power Requirement	33 V @ 1.2 A	33 V @ 2.4 A

Measured performances of prototypes

CONSTRUCTION

Assemble the module, less the heatsink components, with the aid of the overlay in Fig.5. Now mount the heatsink bracket on the component side of the board with two 6 BA screws making sure the other holes line up with those in the PC board.

Mount the power transistors and the BD 139/140 using insulating washers and silicon grease. If the amplifier is to be run continuously at full power we recommend you use berylium oxide washers rather than mica ones. This will lower the junction temperature about 10°C.

The screws holding the 2N3055/MJ 2955 should also be insulated where they pass through the heatsink bracket. The BD 139 and BD 140 do not need any insulation other than the mica, provided 6 BA (or 3mm) screws are used. In the 100W version the additional transistors are mounted on the heatsink bracket outside the PC board area.

The heat sensing transistor Q6 should be inserted into the bracket using silicon grease, bend the lead flat against the PC board and solder to the pads provided. When installed, the transistor should be in the centre of the heatsink.

The recommended power supply is shown in Fig.3. This supply gives about 40V on no load, dropping to about 32V on full output. This allows reproduction of transients beyond 50W (or 100W) whilst providing a degree of protection for the output

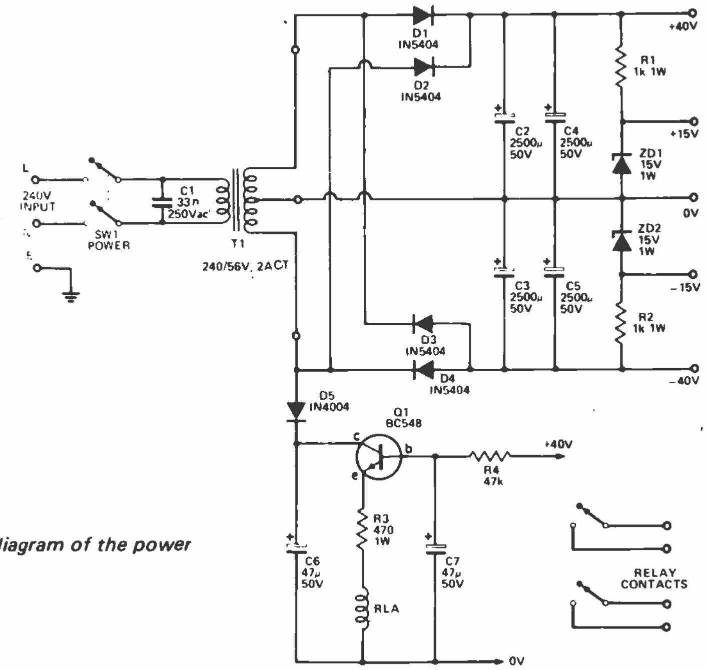


Fig. 3

Circuit diagram of the power supply

Parts List

POWER SUPPLY

Resistors			
R1, 2	1 k	1 W	5%
R3	470 R	1 W	5%
R4	47 k	½ W	5%

Capacitors	
C1	33 n 250 V ac
C2–C5	2500 µF 50 V electro lytic
C6,7	47 µF 50 V electro lytic

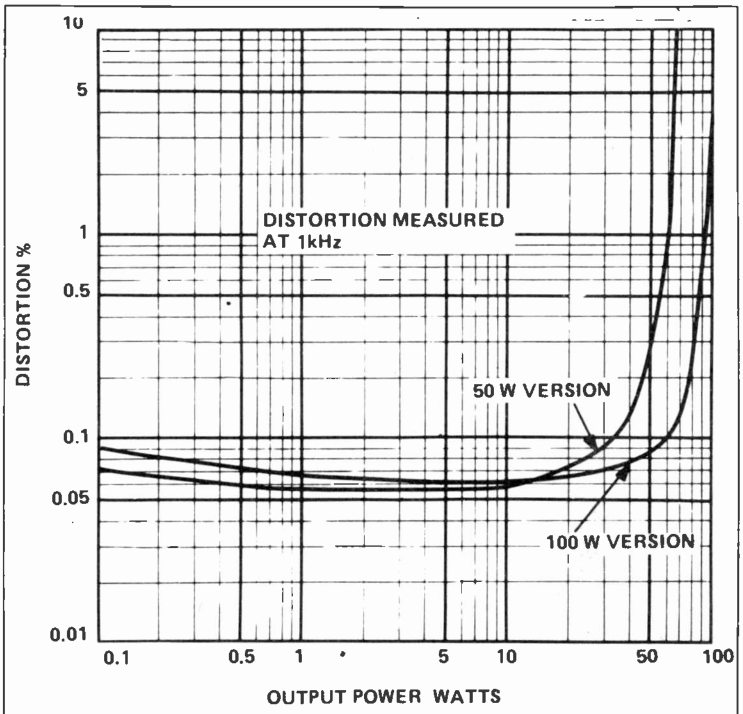
Diodes	
D1-D4	1N5404
D5	1N4004

Transistor	
Q1	BC 548 or BC 108

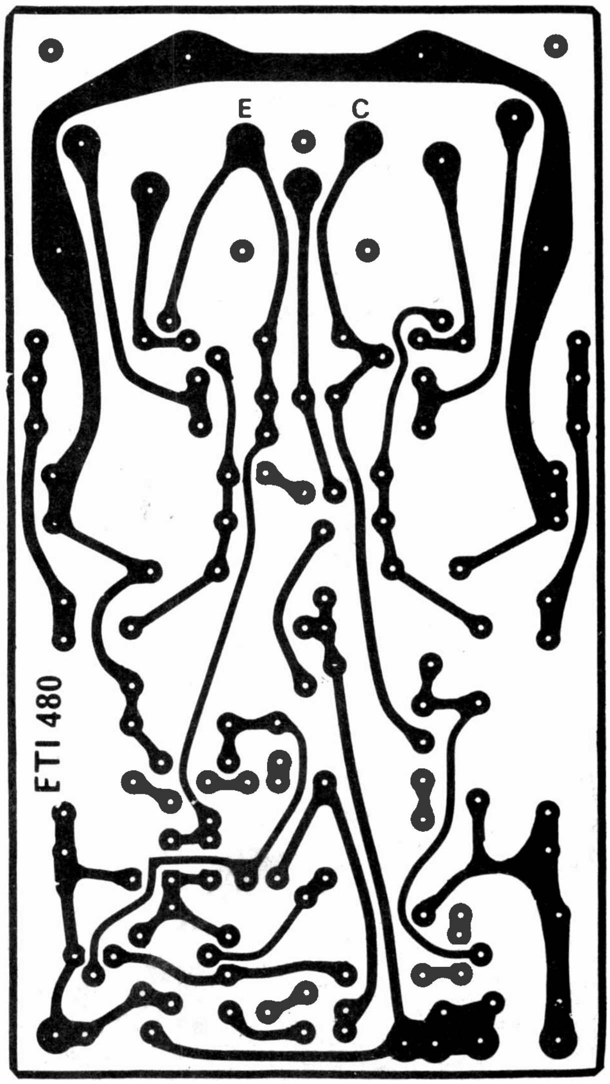
Zener diodes	
ZD1, 2	15 V 1 W

Miscellaneous

PC board – ETI 480 PS
Relay 2 pole 280 ohm coil
SW1 – on/off switch 240V 3AMP
T1 240V/56V2A C.T.



Graph showing relationship between output power and distortion.



Printed circuit layout of the amplifier. Full size 140mm x 76mm.

—50/100W AMP

transistors. If a regulated supply is used, it should not be higher than ±35V.

If no preamp is to be used, a couple of chassis-mounting capacitors

Parts List

Resistors *all ½ W 5% unless noted*

R1	1k5
R2	10k
R3	10R
R4	5k6
R5	2k7
R6	3k3
R7	220
R8*	10 k
R9	1k2
R10	470
R11	1k2
R12	560R
R13	470R
R14	47R
R15	33R 1 W
R16	10 R1 W
R17	33R 1 W
R18	47R
R19	1 R 1 W
R20–R23	220R 1 W
R24 R26	1R 1 W
R27 R30*	

Potentiometer

RV1	470R trim type

Capacitors

C1	4µ7 25 V electrolytic
C2	100 µ 16 V electrolytic
C3	100 p ceramic
C4	3n3 polyester
C5	330 p ceramic
C6	100 n polyester
C7	27 p ceramic
C8–C12	100 n polyester

Transistors

Q1–Q3	BC177 or BC557
Q4	BD140
Q5	BD139
Q6	BC109 or BC549
Q7	BD139
Q8	BD140
Q9	MJ2955
Q10	2N3055
Q11*	
Q12*	

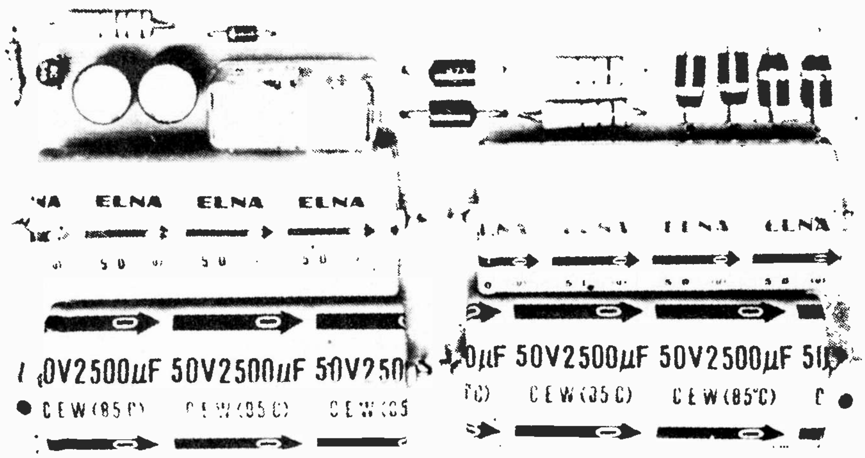
Zener diode

ZD1	5.6 V 400 mW

Miscellaneous

PC board ETI 480
Four PC mounting fuse clips (FC1)
Two fuses 1.5 A*
Heatsink
Insulation kits for Q7–Q12.

*** For 100 W version**
R8 is 4k7 ½ W
R27–R30 are 1 Ω 1 W
Q11 is MJ2955
Q12 is 2N3055
Fuses are 3A



The layout of the power supply PCB. Note the polarity of the diodes. The relay in the upper left centre is to 'dethump' any pre amp used.

How it works

The input signal is fed via C1 and R1 to the base of Q2 which, with Q3, forms a differential pair. Transistor Q1 is a constant-current source supplying about 2mA. This current is shared by Q2 and Q3. Transistor Q4 is also a constant-current source supplying about 10mA which, if no input signal exists, flows through Q5 and Q6. The differential pair controls Q5 and thus the voltage at its collector.

The resistors R11 and R12 together with potentiometer RV1 control the voltage across Q6 and maintains it at about 1.9V. But as Q6 is mounted on the heatsink, this voltage will vary with heatsink temperature. Assuming that the voltages on the bases of Q7 and Q8 is equally spaced about zero volts (i.e. 0.95 volts) the current will be set at about 12mA through Q7 and Q8. The voltage drop across the 47 ohm resistors (R14, R18) will be enough to bias the output transistors Q9 and Q10 sufficiently to give about 10mA quiescent current in these transistors. This quiescent current is adjustable by means of potentiometer RV1.

Local feedback is applied to the output stage by the network R20-R23, giving the output stage a voltage gain of about four. The overall feedback resistor, R8, gives the required gain control.

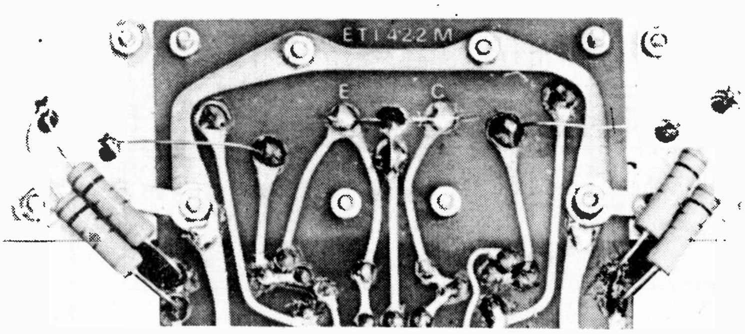
Protection to the amplifier (against shorted output leads) is provided by fuses in the positive and negative supply rails to both amplifiers.

Temperature stability is attained by mounting Q6 on the heatsink and this transistor automatically adjusts the bias voltage.

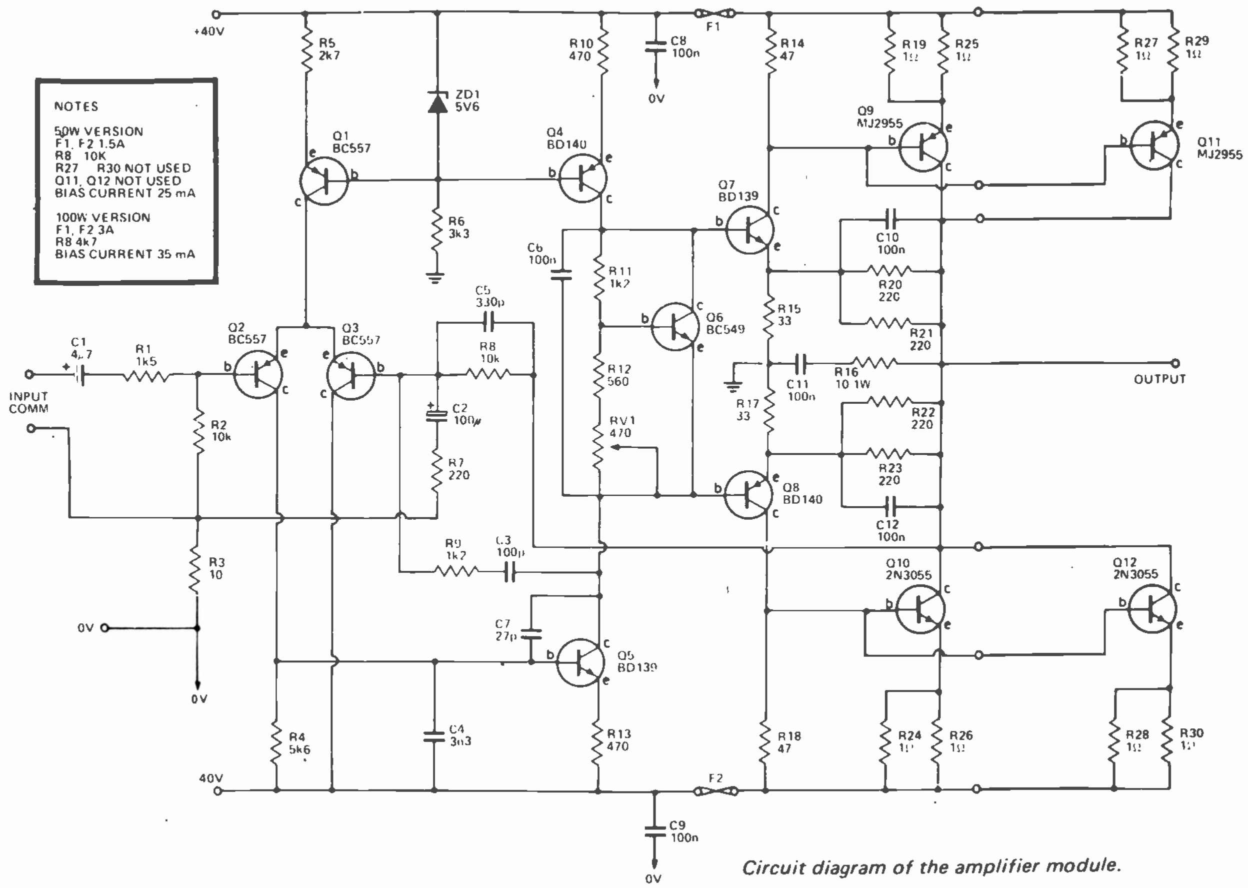
The power supply uses a full wave rectifier and a centre tap to derive ±40V dc. Dropping resistors and zener diodes are also provided for a preamplifier (if required).

As some preamplifiers cause the main amplifier to give a thump on switch-on, a relay is provided to overcome this. R4 and C7 cause a delay of about 3 seconds on switch-on. The relay can be used to switch the output leads from the main amplifier.

IMPORTANT: Q9, Q11 are specified as MJ2955, these must be TO3 cased. If not available in TO3 under this type number — use 2N2955 which are commonly available in TO3 cases.



Rear view of the 100 W module showing the links and resistor which are external to the pc board.



Circuit diagram of the amplifier module.

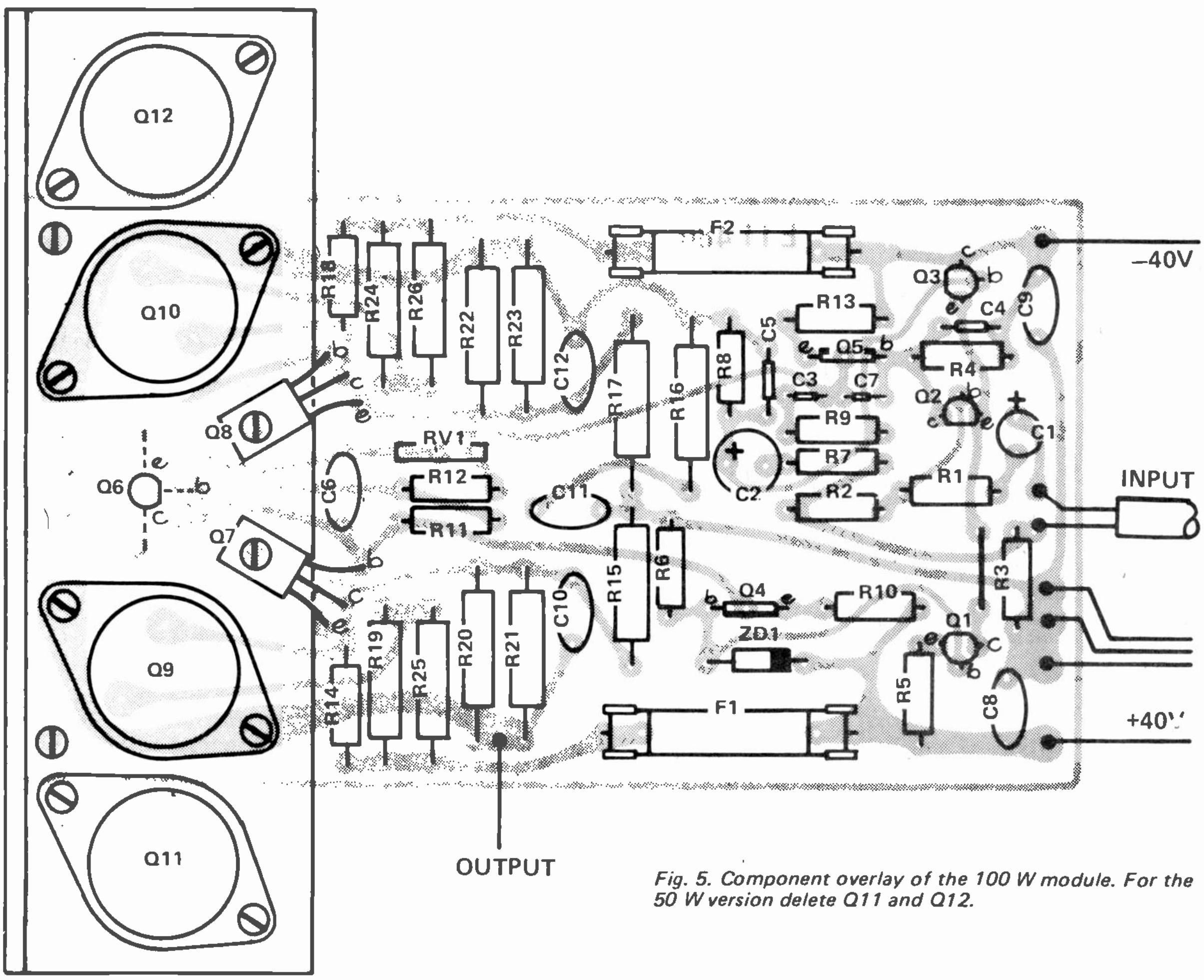


Fig. 5. Component overlay of the 100 W module. For the 50 W version delete Q11 and Q12.

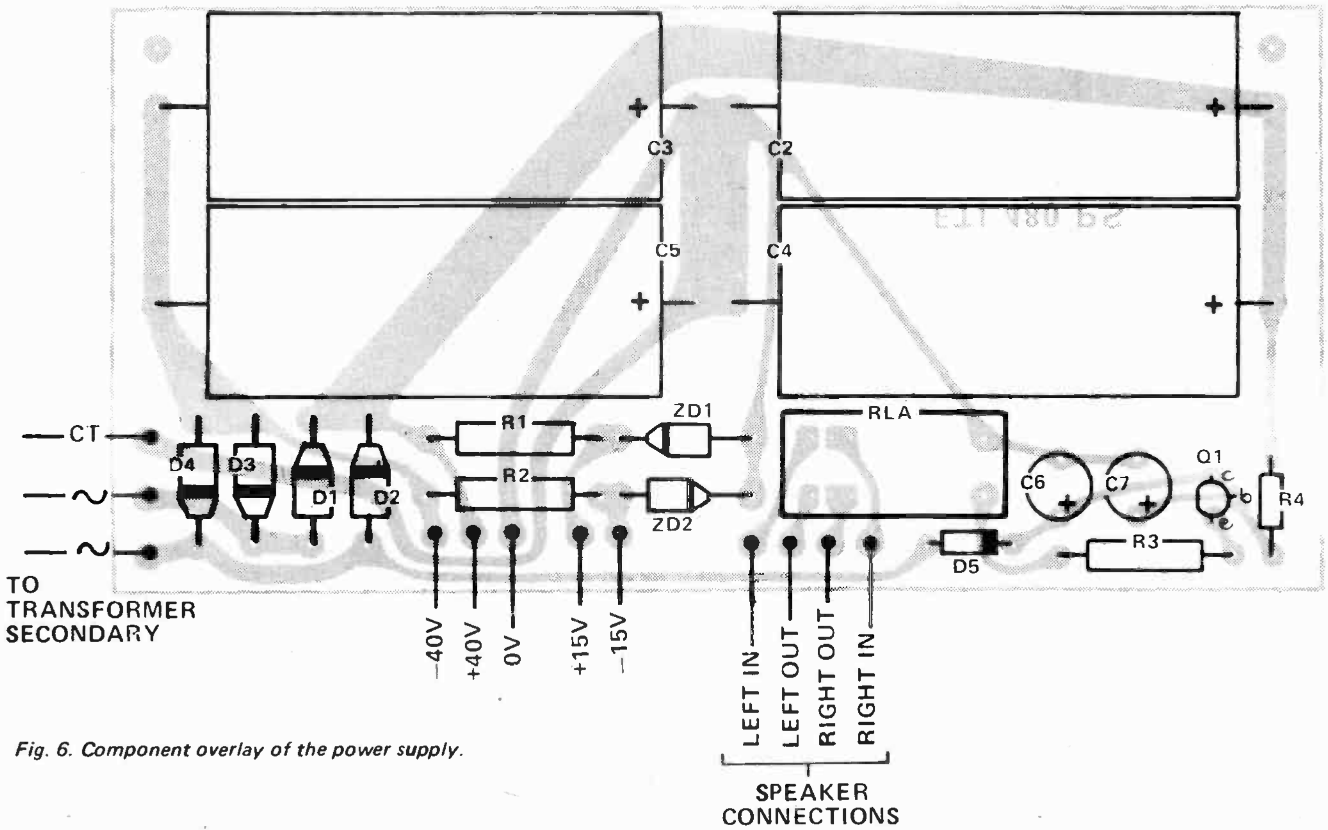
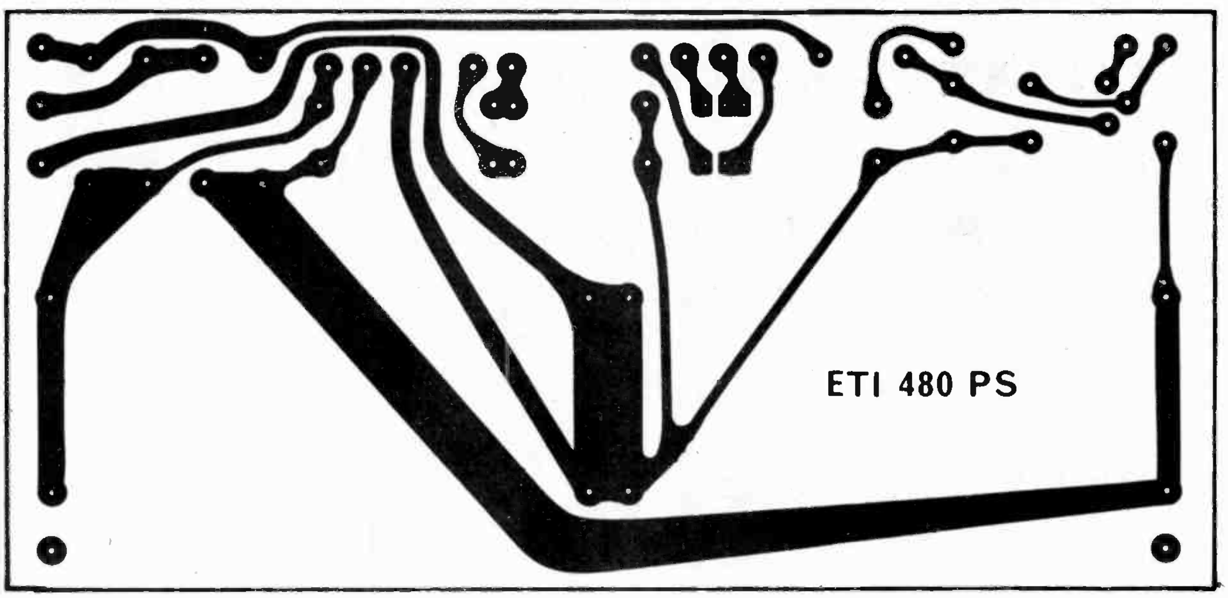


Fig. 6. Component overlay of the power supply.



Printed circuit layout of the power supply. Full size 160mm x 76mm.

(4700uF) with the diodes wired across the terminals will suffice. If the PC board is used, there is facility for building the preamp regulator and fitting a dethump relay (if required). The power amplifier itself does not produce any thump.

ALIGNMENT

The only adjustment you have to make is to set the current using RV1. The bias current for the 50W version should be 20-25mA and for the 100W version it should be 30-35mA. The figures are for the amplifier running cold. These currents increase about 50% when the amp gets hot.

To measure the current we recommend soldering a 100 ohm ½W resistor across each fuse-holder and removing the fuses. With no load connected and no input, adjust RV1 until there is about 2.5V (3.5V for 100W version) across the resistors. There may be a slight voltage difference between the two resistors, so just take an average. It's not that critical. This method of measuring current is much easier on your testmeter, should there be a fault in the amplifier. ●

TTLs by TEXAS					
7400	16p	7485	130p	74191	156p
7401	18p	7486	36p	74192	130p
7402	18p	7489	340p	74193	130p
7403	18p	7490	43p	74194	130p
7404	25p	7491	81p	74195	96p
7405	25p	7492	55p	74196	120p
7406	45p	7493	43p	74197	120p
7407	45p	7494	81p	74198	270p
7408	25p	7495	70p	74199	220p
7409	27p	7496	84p	**C-MOS ICs**	
7410	18p	7497	340p	4000	21p
7411	26p	74100	116p	4001	21p
7412	27p	74104	60p	4002	21p
7413	38p	74105	60p	4006	120p
7414	96p	74107	32p	4007	21p
7416	34p	74109	96p	4009	67p
7417	40p	74110	55p	4011	21p
7420	18p	74116	216p	4012	19p
7421	43p	74118	90p	4013	55p
7422	24p	74120	130p	4015	90p
7423	40p	74121	32p	4016	54p
7425	33p	74122	52p	4017	110p
7427	40p	74123	73p	4018	247p
7428	39p	74126	75p	4020	140p
7430	18p	74132	75p	4022	180p
7432	37p	74136	81p	4023	19p
7437	37p	74141	80p	4024	100p
7438	37p	74142	300p	4025	19p
7440	18p	74145	75p	4026	200p
7441	85p	74148	173p	4027	81p
7442	75p	74150	155p	4028	152p
7443	116p	74151	77p	4029	130p
7444	116p	74153	92p	4030	59p
7445	90p	74154	164p	4042	150p
7446	90p	74155	96p	4043	218p
7447	90p	74156	96p	4046	150p
7448	85p	74157	97p	4047	110p
7451	20p	74160	116p	4049	68p
7453	20p	74161	116p	4050	50p
7454	20p	74162	116p	4054	130p
7460	20p	74163	116p	4055	140p
7470	32p	74164	130p	4056	145p
7472	30p	74166	136p	4060	130p
7473	34p	74167	370p	4069	30p
7474	36p	74174	131p	4071	29p
7475	48p	74175	92p	4072	29p
7476	34p	74176	131p	4081	21p
7480	54p	74177	120p	4082	29p
7481	103p	74180	120p	4510	142p
7482	75p	74181	322p	4511	200p
7483	99p	74182	89p	4516	140p
7484	103p	74185	146p	4518	140p
		74190	155p	4528	130p

VOLTAGE REGULATORS
Fixed-Plastic 3 Terminals

1 Amp	+ve		-ve	
5V	7805	150p	7905	215p
12V	7812	150p	7912	215p
15V	7812	150p	7915	215p
18V	7818	150p	7918	215p
24V	7824	150p	7924	215p
LM309K	5V	1 Amp	TO3	150p
LM309H	5V	100mA	TO5	97p
TBA625B	12V	0 5A	TO5	106p

VARIABLE
723 14pin DIL 45p

LOW PROFILE DIL SKTS BY TEXAS

8 pin **12p**	16 pin **14p**	28 pin **60p**
14 pin **13p**	24 pin **54p**	40 pin **75p**

OP. AMPS			
301A	Ext Comp	8 pin DIL	40p
536T	FET Op Amp	TO 99	300p
709	Ext Comp	8/14 pin DIL	36p
741	Int Comp	8/14 pin DIL	25p
747	Dual 741	14 pin DIL	70p
748	Ext Comp	8/14 pin DIL	40p
776	Prog Op Amp	TO 99	160p
1458	Dual Op Amp	8 pin DIL	70p
3130	CMOS Op Amp	8 pin DIL	108p
3140	BIMOS/FET input	8 pin DIL	108p
3900	Quad Op Amp	14 pin DIL	70p

LINEAR I.C.s			
AY-1-0212	Tone Generator	16 pin DIL	650p
CA3028A	Diff Cascade Amp	TO99	112p
CA3046	5 Transistor Array	14 pin DIL	85p
CA3048	4 Lo Noise Amp	16 pin DIL	250p
CA3053	Diff Cascade Amp	TO5/DIL	70p
CA3080	Op Transcond Amp	8 DIL	97p
CA3089E	FM IF System	16 pin DIL	250p
CA3090AQ	FM Stereo Decoder	QIL	500p
ICL8038CC	VCO Fun Gen	16 pin DIL	370p
LM380N	2W Audio Amp	14 pin DIL	115p
LM381N	Stereo Pre Amp	14 pin DIL	190p
LM389N	Aud Amp +3 Trs Array	18 pin DIL	175p
M252	Rhythm Generator	16 pin DIL	850p
MC1310P	FM Stereo Decoder	14 pin DIL	190p
MC1351P	Lim/Det Aud. Pre amp	14 pin DIL	104p
MC3340P	Electronic Attenuator	8 pin DIL	180p
MFC4000B	¼W Audio Amp	PCB	90p
NE540L	Aud Pwr Driver	TO5	160p
NE555V	Timer	8 pin DIL	40p
NE556	Dual 555	14 pin DIL	96p
NE561B	PLL with AM Demod	16 pin DIL	425p
NE562B	PLL with VCO	16 pin DIL	425p
NE565	PLL	14 pin DIL	200p
NE566V	PLL Fun Gen	8 pin DIL	200p
NE567V	PLL Tone Decoder	8 pin DIL	200p
2567	Dual 567	16 pin DIL	400p
SG3402N	Ring Modulator	14 pin DIL	275p
SN72710	Diff Comparator	14 pin DIL	54p
SN72733	Video Amp	14 pin DIL	150p
SN76003N	Aud Pwr Amp with HS	16 pin DIL	275p
SN76008	10W Amp in 4 ohms	5 pin Plastic	280p
SN76013N	Aud Pwr Amp with HS	16 pin DIL	175p
SN76023N	Aud Pwr Amp with HS	16 pin DIL	175p
SN76033N	Aud Pwr Amp with HS	16 pin DIL	275p
TAA621A	Aud Amp for TV	QIL	270p
TAA661B	FM/IF Amp Lim/Det	QIL	150p
TBA641B	Audio Amp	QIL	300p
TBA800	5W Audio Amp	QIL	100p
TBA810	7W Audio Amp	QIL	125p
TBA820	2W Audio Amp	QIL	100p
TDA2020	20W Audio Amp	QIL	375p
XR2240	Prog Timer/Counter	16 pin DIL	400p
ZN414	TRF Radio Receiver	TO18	140p

OPTO-ELECTRONICS
PHOTO-TRANSISTORS

OCP70	40p
OCP71	120p
2N5777	60p
LDRs	
ORP12	70p
ORP60	75p
ORP61	75p

DRIVERS:

75491	84p
75492	104p
LEDS	
TIL209 Red	16p
TIL211 Green	36p
TIL32 Infrared	81p
0 2"	
Red	18p
Green	36p
Yellow	32p

SEVEN SEGMENT DISPLAYS

3015F	200p	DL707	160p
DL704	160p	DL747	250p

TRANSISTORS							
AC125	20p	BF178	30p	TIP42C	88p	2N5089	34p
AC126	20p	BF194	13p	TIP2955	85p	2N5296	65p
AC127	20p	BF195	11p	TIP3055	70p	2N5401	62p
AC128	18p	BF196	17p	TIS93	30p	2N6107	70p
AC176	20p	BF197	19p	ZTX108	11p	2N6247	175p
AC187	20p	BF200	40p	ZX300	16p	(Comp to 2N3055)	
AC187K	25p	BF257	34p	ZTX500	19p	2N6254	140p
AC188	20p	BF258	39p	ZTX504	60p	2N6292	70p
AC188K	25p	BFR39	34p	2N697	25p	40360	43p
AD149	54p	BFR40	34p	2N698	45p	40361	43p
AD161	39p	BFR79	34p	2N706	22p	40362	45p
AD162	39p	BFR80	34p	2N708	22p	40410	75p
AF115	22p	BFR88	37p	2N918	43p	40409	75p
AF116	22p	BFX30	38p	2N930	19p	40411	325p
AF117	22p	BFX84	30p	2N1131	20p	40594	90p
AF139	43p	BFX85	30p	2N1132	20p	40595	97p
AF239	48p	BFX86	30p	2N1304	45p	**FETs**	
BC107 B	10p	BFX87	30p	2N1305	45p	BF244	36p
BC108 B	10p	BFX88	30p	2N1306	48p	MPF102	40p
BC109 C	11p	BFY50	18p	2N1613	27p	MPF103	40p
BC147	9p	BFY51	16p	2N1711	27p	MPF104	40p
BC148	9p	BFY52	18p	2N1893	32p	MPF105	40p
BC149	10p	BRY39	45p	2N2219	25p	2N3819	27p
BC157	11p	BSX19	20p	2N2222	25p	2N3820	50p
BC158	13p	BSX20	20p	2N2369	15p	2N3823	54p
BC159	13p	BU105	175p	2N2484	32p	2N5457	40p
BC169C	15p	BU108	312p	2N2904/A	25p	2N5458	40p
BC171	12p	MJE340	49p	2N2905/A	25p	2N5459	40p
BC172	12p	MJ2955	130p	2N2906	25p	3N128	95p
BC173	13p	MJE2955	130p	2N2026RB	9p	3N140	95p
BC177	20p	MJE3055	80p	2N29260G	11p	3N141	95p
BC178	17p	MPSA06	40p	2N3053	20p	40603	63p
BC179	20p	MPSA12	62p	2N3054	54p	40673	70p
BC182	12p	MPSA56	40p	2N3055	54p	**UJTS**	
BC183	12p	MPSU06	78p	2N3442	151p	TIS43	40p
BC184	14p	MPSU56	98p	2N3702	14p	2N2160	95p
BC187	32p	OC28	90p	2N3703	14p	2N2646	48p
BC212	14p	OC35	90p	2N3704	14p	2N4871	40p
BC213	12p	OC71	25p	2N3705	14p	**PUJT**	
BC214	17p	TIP29A	50p	2N3706	14p	2N6027	60p
BC478	32p	TIP29C	62p	2N3708	14p	**DIODES SIGNAL**	
BC547	12p	TIP30A	60p	2N3709	14p	OA47	10p
BC557	12p	TIP30C	72p	2N3707	14p	OA81	15p
BCY70	22p	TIP31A	56p	2N3773	270p	OA85	15p
BCY71	24p	TIP31C	66p	2N3866	97p	OA90	7p
BD124	140p	TIP32A	63p	2N3904	22p	OA91	9p
BD131	39p	TIP32C	85p	2N3905	25p	OA95	9p
BD132	43p	TIP33A	97p	2N3906	22p	OA200	8p
BD135	54p	TIP33C	120p	2N4058	19p	OA202	10p
BD136	55p	TIP34A	124p	2N4060	19p	1N914	4p
BD139	54p	TIP34C	160p	2N4123	22p	1N916	11p
BD140	60p	TIP35A	243p	2N4124	22p	1N4148	4p
BDY56	225p	TIP35C	290p	2N4125	22p		
BF115	24p	TIP36A	297p	2N4126	22p		
BF167	25p	TIP36C	360p	2N4401	34p		
BF173	27p	TIP41A	70p	2N4403	34p		
		TIP41C	81p	2N4427	97p		
		TIP42A	76p				

RECTIFIER		BRIDGE RECTIFIERS	
BY100	31p	1A 50V	25p
BY126	12p	1A 100V	27p
BY127	12p	1A 400V	31p
1N4001	6p	1A 600V	37p
1N4002	6p	2A 50V	37p
1N4004	7p	2A 100V	44p
1N4005	7p	2A 400V	56p
1N4007	8p	3A 200V	70p
		3A 600V	75p
		4A 100V	84p
ZENER		6A 50V	90p
2 7 to 33V		6A 100V	96p
400mW	11p	6A 200V	108p
1W	22p	6A 400V	120p
		TRIACS	
		Amp Volts	
		3 400	130p
NOISE		6 400	162p
Z5J	140p	6 500	194p
		10 400	200p
		10 500	270p
		15 400	310p
		15 500	340p
DIAC		40430	108p
BR100	30p	40669	105p

MEMORY

2102 RAM	£2.70
2107 RAM	£10.80
2112 RAM	£4.70
2513 ROM	£8.50
74S262N ROM	£24.50

SCR THYRISTORS

1A 50V TO5	43p
1A 100V TO5	45p
1A 400V TO5	50p
3A 400V STUD	81p
8A 50V Plastic	142p
12A 400V Plastic	173p
16A 100V Plastic	180p
16A 400V Plastic	220p
16A 600V Plastic	270p
BT106 1A 700V STUD	130p
C106D 4A 400V Plastic	63p
MCR101 ½A 15V TO92	27p
2N3525 5A 400V TO66	120p
2N4444 8A 600V Plastic	200p
2N5060 0 8A 30V TO92	36p
2N5062 0 8A 100V TO92	40p
2N5064 0 8A 200V TO92	43p

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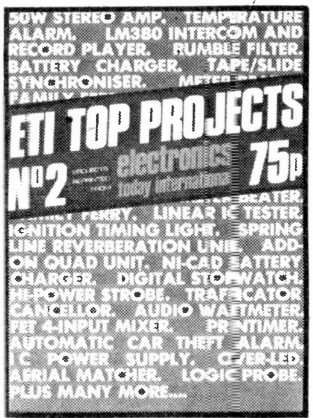

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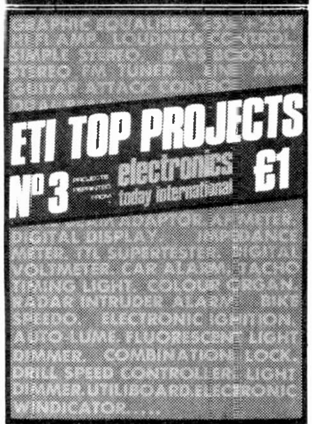

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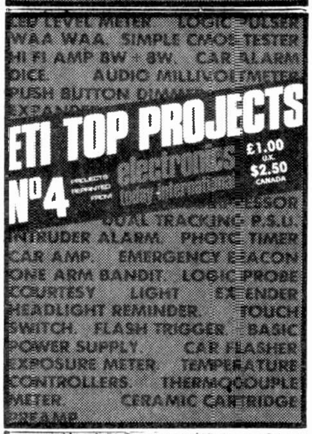

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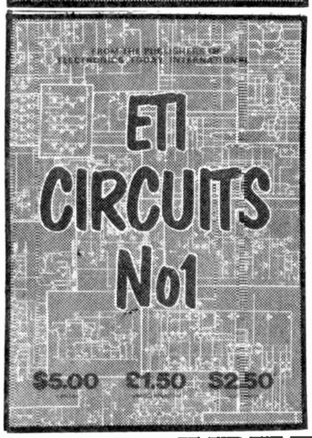

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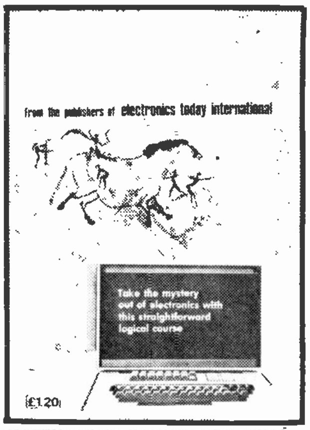

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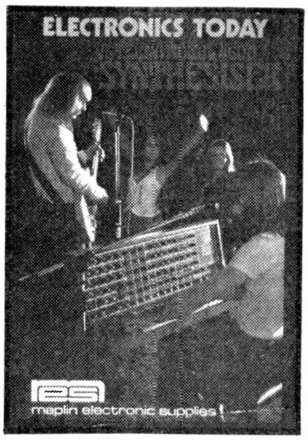

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This new tape format combines the performance potential of open-reel with the convenience of the cassette.

THE SONY ELCASET

THE COMPACT CASSETTE FORMAT introduced by Philips some years ago has been responsible for a number of remarkable developments in the field of tape recording. Major tape manufacturers have refined and improved oxide formulations and coating processes, equipment manufacturers have researched and developed new head designs using improved materials, and of course a number of noise-reduction systems have come into being.

Even so, the Compact Cassette has inherent restrictions. Even with the finest heads and tape, it is still not possible to record the highest audio frequencies on cassettes to give useful output levels; at extreme low frequencies problems still occur with replay equalisation and this gives audible performance deficiencies. It is clear the Compact Cassette is stretched to its performance limits at the present time, and whilst we can expect to see a continuation of the present trend of gradual improvement, it also seems unlikely that any major breakthrough is imminent that will solve the problems still remaining.

Compact Cassettes therefore remain a definite 'poor relation' to other signal sources for listeners requiring highest reproduction quality. Yet cassettes are undeniably easier to use than records, in the sense they are less easily damaged by handling and playing, and this no doubt accounts for a great deal of their popularity. Realising this, a number of manufacturers have researched the possibility of producing a new format embodying the convenience of Compact Cassettes with the quality potential of open-reel. One such format, which seems to have fallen by the wayside, was BASF's Unisette. Another is the Elcaset, the result of intensive research by a consortium of interested Japanese manufacturers.

THE ELCASET SOLUTION

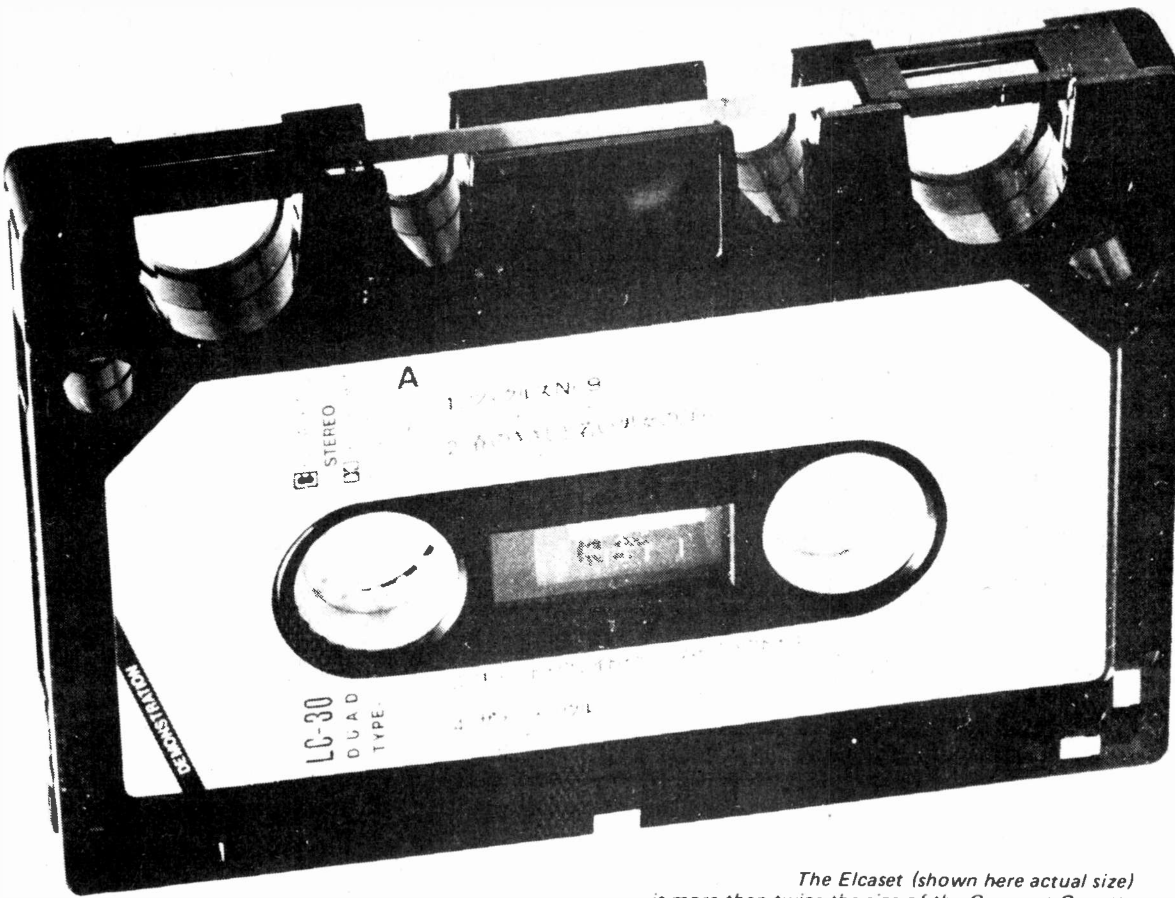
The Elcaset uses standard-width audio tape running at a speed of 9.5cm/sec. Like the compact cassette and unlike open-reel, the quarter track configuration is used to give mono compatibility — stereo pairs of signals are recorded on adjacent tracks, not alternate ones. The cassette itself looks basically similar to the familiar compact and miniature (dictating machine) types.

The differences, apart from size, are confined mainly to detail design aspects For example, erase prevention is by means of retractable lugs rather than break-off tabs, the spooling hubs are fitted with ratchet locks to prevent tape spillage when the cassette is removed from the recorder. The hubs are released by a recessed spring-loaded linkage operated by an appropriate bar fitted to the machine. Pressure pads are not used, tape being lifted out of the full-width aperture by moving guide posts.

The head assembly is fixed and, in the instance of the sample Sony EL-7 machine supplied for examination, uses a 'wrap-around' curved tape path. Tension on the tape is applied by two hinged guides on the cassette itself, working in conjunction with pinch roller/capstan assemblies to give intimate tape-to-head contact.

MEASURED PERFORMANCE OF SONY ELCASET DECK MODEL EL-7

Frequency Response:	20 Hz to 20 kHz $^{+0}_{-3}$ dB (−10 VU)			
	20 Hz to 15 kHz $^{+0}_{-3}$ dB (0 VU)			
Total Harmonic Distortion		**100 Hz**	**1 kHz**	**6.3 kHz**
	0VU	0.6%	1.0%	2.3%
	−10VU	<0.6%	<0.8%	<1.1%
Noise:	−52 dB (lin);	−59 dB (A)	Dolby Out	
	−54 dB (lin);	−64 dB (A)	Dolby In	
Wow & Flutter: (record to replay)	0.1% RMS Unweighted			
Sensitivity: (for 0 VU)			**Input Impedance**	
	Line	66 mV	86 kΩ	
	Mic	0.205 mV	4.5 kΩ	
Outputs:			**Source Impedance**	
	Line	830 mV	3.3 kΩ	
	Phones	2.6 V	136 Ω	
Crosstalk:	**100 Hz**	**1 kHz**	**6.3 kHz**	
	−40 dB	−46.4 dB	−48 dB	



The Elcaset (shown here actual size)
is more than twice the size of the Compact Cassette
(and that's two-dimensionally — it's even bigger if we talk about volume).

THE SONY EL-7

The drive system uses three motors, the Sony has incorporated its well-known closed-loop dual capstan system for constant-speed tape motion. All transport control functions are carried out using finger-touch push-buttons and use of servo-control enables a remote control unit to be added. Auto-stop, memory rewind and memory rewind/auto start facilities are incorporated and unattended automatic record and playback can be carried out using an optional timer control.

Outwardly, the review sample resembled a front-loading Compact Cassette unit. The obvious difference was a larger cassette compartment, fitted with a hinge-down transparent window with damped movement applied by a mechanical governor. To the left of the compartment was the power on/off switch, a three position toggle for use in conjunction with the optional timer, a further three-position toggle covering memory rewind functions and the three-digit tape counter with push-button zero reset.

Transport controls were fitted to an angled projecting strip below the compartment.

REMOTE AND OTHERWISE

The optional remote control unit, also supplied, duplicated all these functions but did not render the built-in controls inoperative. A feature of the remote control unit was a 'record-mute' pushbutton which, when depressed, reduced the level of a signal being recorded to zero — obviating the need for operation of the machine's master level control on completion of a recording.

The remaining controls were fitted to the area on the right of the cassette compartment. A pair of large VU meters, calibrated from — 20 to +5 VU, were placed close to the top edge of the front panel and were bounded on their right by a master level control, effective on both channels simultaneously and fitted with an adjustable detent preset system. Below this were dual concentric level controls for microphone and line inputs, flanked to the left witn a pair of three-position toggles for bias and equalisation adjustment.

Next was a further toggle controlling the multiple FM filter and alongside was a three-position rotary covering Dolby on/off and calibrate functions. Screwdriver presets were provided for Dolby record level calibration, using an inbuilt 400 Hz oscillator.

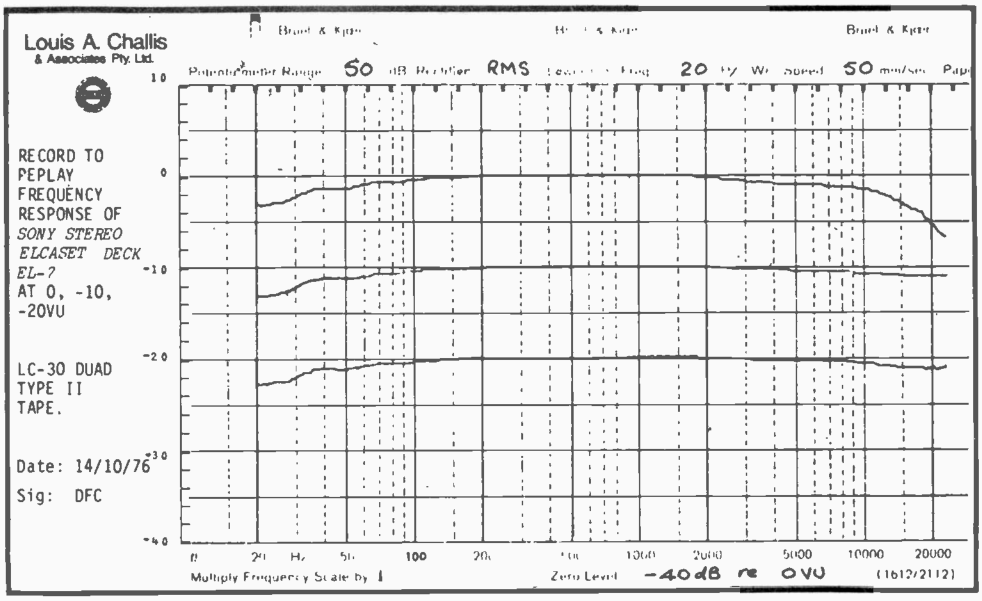
Remaining controls included a push-button for eject, a microphone attenuation control giving a choice of 15 or 30 dB reduction of level, an output level control for use with headphones and a tape/source monitor switch. Front panel sockets (standard jacks) were provided for microphone inputs (via tip and sleeve plugs) with an auxilliary line in socket and a headphone output — both using stereo tip, ring and sleeve plugs.

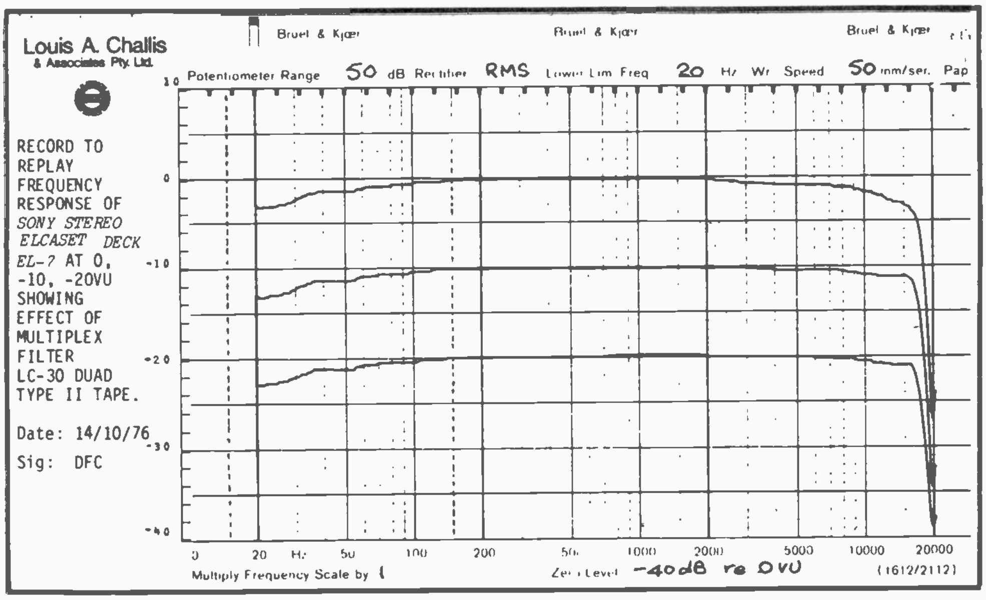
BRINGING UP THE REAR

Rear panel complement included RCA-phono sockets for line inputs and outputs,, a standard octal valve-base socket for connecting remote control or timer units, a pair of American-pattern AC outlets and an output level preset. A screw-type earthing post was also provided.

Standard of construction and finish appeared to be excellent, the front panel having a brushed aluminium overlay. The perforated metal cover was painted grey; removal of the cover revealed easily accessible circuit boards linked by slightly untidy wiring runs.

THE SONY EL 7 ELCASET





These graphs show the results of tests made in the laboratory of ETI's acoustical consultants.

The Sony EL-7 machine with the remote control unit on the right. This retails for around the £400 mark, depending where you buy it! There is a smaller EL5 recorder which comes for somewhat less — but has fewer facilities.

TAPES AND CONTROL

One aspect needing clarification was the tape selector controls. Three types of tape were covered — type I, type II and type III. The sample tape supplied was dual-layer ferrichrome and was designated type II. We presume, therefore, but cannot confirm (no instruction manual or relevant literature was supplied with the machine) that type I refers to low-noise tape and type III to chromium dioxide.

The demonstration tape supplied was recorded on one side with the usual spectacular sounds we have come to expect from such tapes. The remaining tracks were left unrecorded.

DOLBY GIVES AN EDGE

Overall record/replay performance was considered excellent, subjectively. The Sony electronics performed extremely quietly and with little audible distortion. Recordings, by direct comparison with source signals using the source/tape monitor switch, seemed only marginally inferior to the originals. The chief characteristic was a slight and barely audible loss of high frequency detail — a deficiency which we feel could only be noticed by direct comparison. With Dolby switched out, tape hiss was negligible and audible only during silences between musical sequences. With Dolby in use, no tape hiss was audible at average volume levels although the sound became slightly but noticeably edgy.

CONCLUSIONS

Assuming this sort of performance to be typical, it would seem that Dolby noise reduction is superfluous with this machine, we preferred to tolerate the small amount of noise heard with Dolby switched out than the distortion heard with noise reduction switched in.

No obvious frequency non-linearities were observed during listening tests. Even at low and high frequency tonal balance was well maintained at all level except when incoming signals caused severe record overload. There was no evidence of diminished high frequency response when high record levels were used.

The Sony EL-7 was judged to be a very good performer, and certainly convinced us that the Elcaset format is a welcome introduction to the hi-fi field. Combining the performance potential of good open-reel machines, and the operating convenience of cassettes, the Elcaset system is likely to have enormous appeal to critical hi-fi enthusiasts. ●

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TERMINALS

WE HAVE HAD A LARGE NUMBER OF enquiries from readers of Microfile who have had problems getting a simple MPU system (i.e. an evaluation kit) to operate. Apart from power, all that is needed is a way to access the memory, a method to initiate the monitor program commands, and an 'information retrieval' system. In short — a terminal. We have some ideas to offer in this article on how this can be achieved.

Manufacturers of evaluation kits have universally designed their kits to interface with a teletypewriter terminal. Together the monitor program and terminal provide an easy and convenient way of developing, loading and running programs. But if you don't have a terminal and can't afford to buy a new one, (they cost over £500), what options if any are available to you?

Well, there are a number of options we can suggest and this article looks at methods of tackling the problem.

1. TELEPRINTERS AND TYPEWRITERS

The first method is to modify one of the older-style teleprinters. These are used by hams to send and receive RTTY and this has created an active second-hand market in teleprinters, so check out the electronic disposal stores.

Although they are serial devices, these older teleprinters do not use the ASCII code expected by all the monitor programs, so you will have to construct a suitable code converter. Most IC manufacturers offer pre-programmed ROMs to convert the Baudot code to ASCII, but converting ASCII to Baudot is difficult and not to be tackled by the uninitiated.

If you do manage to pick up an old teleprinter, try for a set of engineering manuals as well. These will give you the required information on the code it uses.

Typewriters. If you don't mind extra work there are always second-hand electric typewriters. There are many different models and the conversion technique for each will depend on how that model works, but the overall principle is to parallel the switches on the keyboard with your own switches.

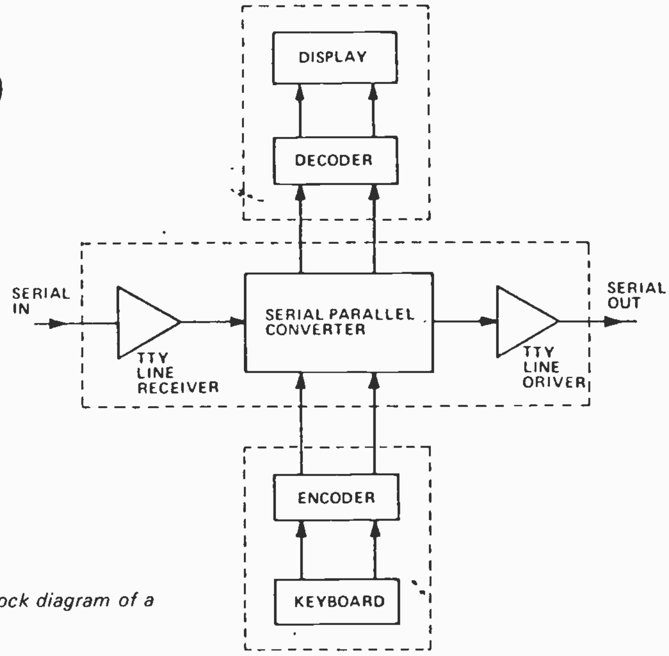

Figure 1: Functional block diagram of a terminal

However, not all electric typewriters have such switches, some have the keys operating mechanical interlocks and use the electrical part of the typewriter to provide only the muscle. So examine the machine offered carefully before you buy it.

Others, like IBM's Selectric models, offer an electrical interface to drive other devices. A code converter as well as a parallel-to-serial data converter are needed, but these are available in ROM for this model.

2. HOMEBREW

The second alternative is to build your own terminal from scratch. Ideally this would imitate a teletypewriter so the computer won't know the difference. Such a terminal would consist of three parts (1) the keyboard to input data, (2) the display to output data and (3) the serial/parallel converter to produce the teletype interface signals. See Figure 1.

Recently a number of ICs have become available to dramatically reduce the parts-count in such a terminal. For the keyboard there's special encoder ICs that scan a keyboard to detect a depressed key and then give out the appropriate 8-bit ASCII code. Chips are available for use with full alphanumeric or 16-key hex keyboards. Just such a project will appear in next month's ETI.

For displays there are chips that display hex and character generator chips to display a full set of alphanumeric characters over several rows.

HEX TERMINAL

Since most of the monitor programs use less than 20 out of the possible 128 ASCII characters, the cheapest way to make a keyboard is to use 20 push buttons and enough diodes to make a 6 x 20 matrix, see Figure 2.

The display section will need to consist of a memory, of minimum size 12 characters, and a readout capable of displaying the characters 0-9, A-F, and 4 or 5 unique shapes to represent the other characters the monitor will output. To make sense out of this output, all 12 characters need to be displayed at once.

Now available are some interesting 16-character plasma displays. These can be purchased ready made-up, just apply dc power and the least significant six bits of the ASCII code of the character you want to display. The module will store the character in its own memory, decode it, and display it in a 5 x 7 dot matrix. But these modules are expensive, costing around £100 each.

A cheaper alternative is to build your own out of seven segment LED displays. Selective lighting of the seven segments (plus decimal point) gives each display 128 unique states, more than enough for the 20 characters used by most monitor programs. Just pick twenty distinct shapes that are easily remembered. Since all the monitors use hex, 16

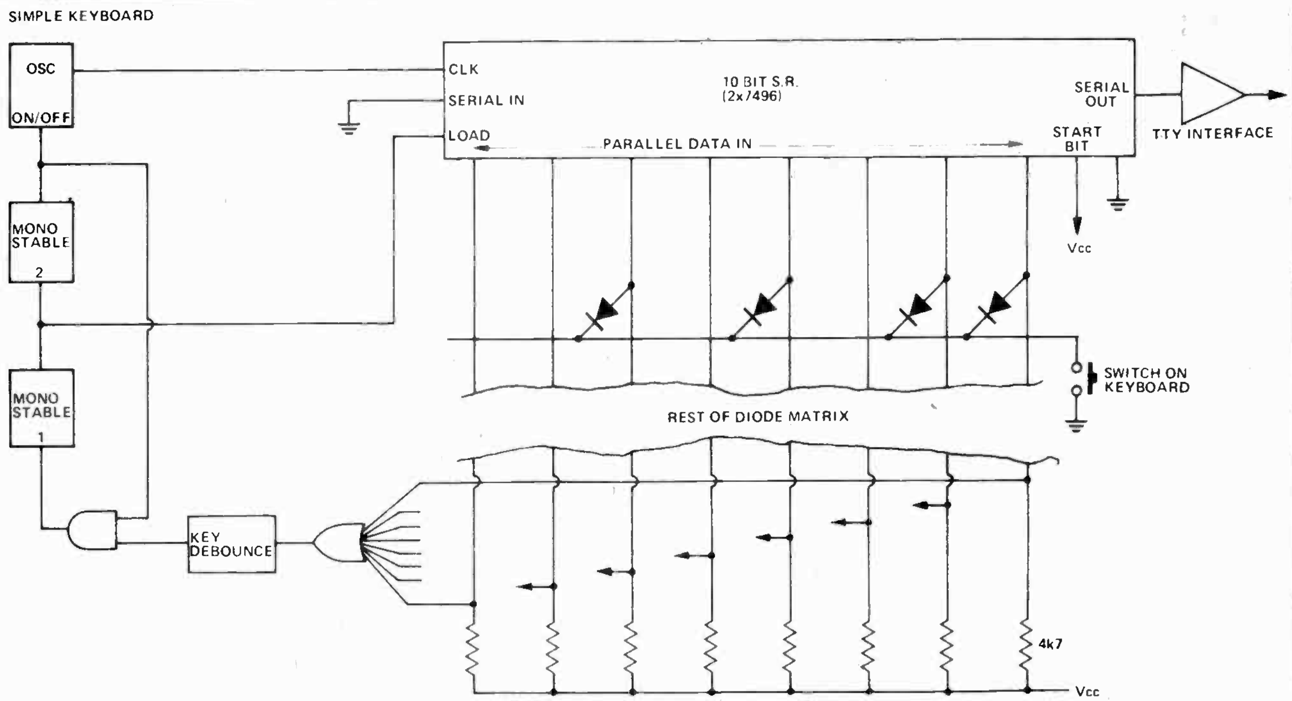

Figure 2: A simple keyboard. The circuit shows how pressing one key sets up a parallel code and instigates operation of the serial code generator. This circuit outputs an eleven-bit serial code: first a start bit (logical zero), then eight bits taken from the ASCII code, then two stop bits (logical one). To do this the shift register needs 11 clock cycles but if it gets more it doesn't matter with this circuit, it just gives out more ones. See figure 3.

of the shapes will represent 0-9 and A-F, something a seven segment display does quite well. The remaining symbols are used by the monitor to prompt the operator and so do not need to be identical to the shapes used in the ASCII set, just distinct enough to be remembered.

A decoder to drive such a display can be built using a seven-segment decoder IC and a few gates. For added clarity, light the decimal point for character other than hex.

The TTY interface and serial-to-parallel converter form the remaining section. The TTY interface does a conversion between the 0/1 current levels normally expected by a teletypewriter (TTY) to the 0/1 level required by the logic family in your serial-to-parallel converter. See Figure 3.

The converter is a shift register of 11 bits. Added to the eight ASCII bits of data is one bit at the beginning called the start bit. It's always a logic zero and it tells the receiving unit it's about to receive another 10 bits (8 bits of data followed by two bits called stop bits). The stop bits are logical ones.

The process is asynchronous so once started the receiver expects a new bit every 9.09 milliseconds. To make life simpler, several manufacturers now offer an IC called a UART (Universal Asynchronous Receiver/Transmitter) that has all the logic included in the IC to handle this serial-to-parallel conversion for receiving, as well as the parallel to serial conversion for transmitting. Internal logic will also check the parity and generate flag signals to say data available and data sent.

There is insufficient space available to describe the complete operation of the UART, but should you decide to use one it is definitely worthwhile getting an applications note about it.

Bulk Storage. A magnetic tape cassette recorder can be used with

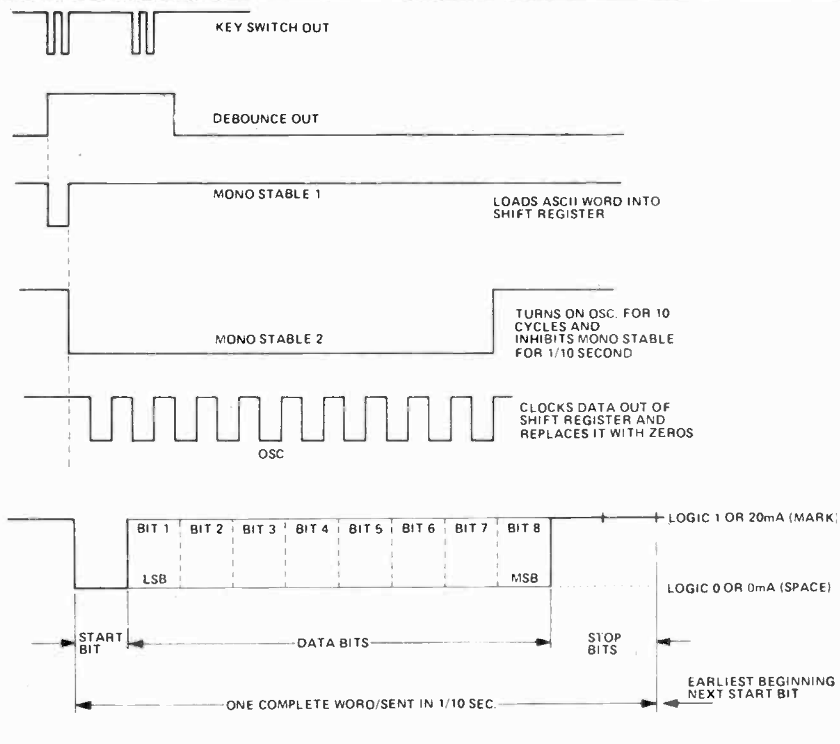

Figure 3: These waveforms show how the circuit in figure 2 works. The final waveform is that expected by the interface and monitor programs of the evaluation kits — it is the format used by a teleprinter to send and receive in ASCII.

microfile

your home-made terminal in place of a paper-type punch and reader. The string of serial 1s and 0s can be stored on magnetic tape by tone and no tone or by two tones of different frequencies. A tone of around 2kHz will do, since the data bit-rate is a low 110 bits/second (see Figure 3).

For better noise rejection use a stereo recorder and record the 1s on one channel and the 0s on the other. A 30-minute cassette will hold some 18,000 words of data. This is equivalent to a length of paper tape 50 metres long and unlike paper tape you don't have to roll it up by hand if you drop it.

3. THE FRONT PANEL

The last method of driving your micro-computer is not to use a terminal, but instead to use what is generally called an 'operating panel' or 'front panel'. With such a panel you lose the use of the monitor program. The operator has to use more tedious operating procedures.

But you do gain a fairly inexpensive way of driving your microcomputer. Such a panel is generally quicker to get working than building your own terminal and about half as expensive. A very simple one can be built for around £30 (excluding power supply and case). Adding refinements like incrementing address counters will take the cost to around £40-£60.

In this method, then, program execution in the microcomputer is halted and data is loaded into read-write memory one word at a time. The word comes from a row of toggle switches mounted on the front panel. The location in memory is selected by the value set up on another row of switches also mounted on the front panel.

To examine the contents of a memory location, the word comes back from memory to a row of LEDs on the front panel. In effect the front panel takes control of the microcomputer's buses and the microprocessor chip disconnects itself from the circuit by disenabling its output from driving the buses. This mode of operation is sometimes referred to as DMA mode (Direct Memory Access).

Likewise the switches on the front panel must be disconnected from the buses when the microcomputer is running. The logic to do this has to be built by you and included on the front panel. To this you should also add logic to allow the microcomputer to be single-stepped by the operator. Single-stepping is executing one instruction or cycle at a time and then going back to the halt mode. This allows the operator to step through his program an instruction at a time, and check as he goes that what ought to happen, does actually happen.

This mode of operation is essential to debugging a program without too much difficulty. Application information included with most, but not all, evaluation boards, shows how this is done.

One disadvantage of the simple front panel is it cannot directly load the display with the contents of the microprocessor internal working registers, it can only work on memory locations and consequently I/O devices seen as memory locations. The feasibility of adding hardware to overcome this depends on each microprocessor chip and is complicated. Fortunately it can be done with a simple software routine loaded by the operator when the microcomputer is first switched on.

A suitable front panel then consists of the following functional sections:

1. A row of toggle switches to set up addresses and input data.
2. A display to output data (say a row of LEDs driven by CMOS buffers, (e.g. 4009 s).
3. Buffers between the microcomputers buses and the front panel switches. Buffers must have three state outputs, such as 74LS365 or CMOS transmission gates like the 4016, where suitable.
4. Control logic to halt the microcomputer, enabling the buffers to single-step the microcomputer.

Those who decide to use the front panel method will also have to address the read/write memory to be able to run programs. All evaluation boards come configured so that pressing the reset button starts the microprocessor executing the program in ROM. If you do not use the ROM then the address of ROM and RAM must be changed so that pressing the reset forces the microprocessor to take its first instruction from RAM. This is where you put the beginning of any program you write, or at least the beginning of any software routine

MOTOROLA DESIGN NOTE

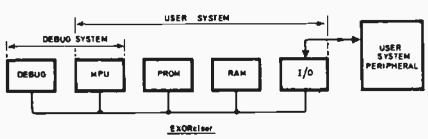

Fig. 1. Step 1 in the development cycle.

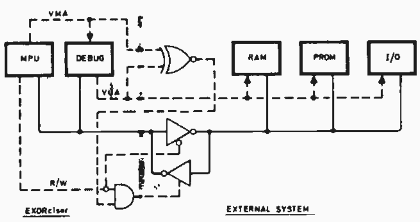

Fig. 2. Step 2 in the development cycle.

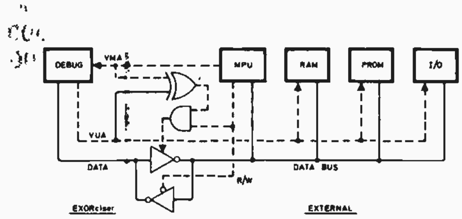

Fig. 3. Step 3 in the development cycle.

They say every picture tells a story — and there three are relating a tale of system development. Motorola Semiconductors Products Division have issued design note M40 which deals with the development of a 6800 system using an exorciser. Any system which uses the 6800 — or any other bus compatible components — can be analysed or evaluated.

As the diagrams suggest the note is very comprehensive, and is well worth reading even if you are not in a position to take its advice! Good general interest stuff. If you want one of these worthy epistles get onto Motorola at Motorola Semiconductor Products Division, York House, Empire Way, Wembley, Middx HA9 OPR.

SYSTEM 68 IS HERE!

With apologies for the delay we are now proud to announce the launch of System 68.

Our April issue will carry the first part of the hardware system — an ASCII encoded keyboard. The delay in bringing about publication has been due mainly to the fabulous rate at which improvements are made in the CPU field. Our original system had the shadow of the future dark across its path by the time we were set to begin. Several IC's looming on the horizon looked interesting enough to be menacing.

The system we will now be describing is undoubtedly more flexible — and more use — than our original concept. We think this justified the delay, and think you will agree with us.

Although the CPU board of our new system still uses a Motorola 6800 chip, one of the main features of the system is that we are calling 'non CPU dependance'. This means that by simple exchange of a pin compatible) CPU board, other MPUs can run System 68.

1. P.S.U. — generously rated, and self-contained as a module
2. CPU board — based on the M6800, but replaceable with pin compatible boards containing other MPUs i.e. SCAMP etc.
3. Memory Board — basic memory is 4K, expandable to 64K. See map.
4. Keyboard Interface.
5. VDU boards (2) — A new updated VDU system especially for System 68. Software will be provided to enable our 560 VDU unit to operate perfectly with the system.

Total cost of the operational system should be around £200-£250! As well as the (main) full ASCII keyboard we are working on a pocket sized economy version — costing less than £7 ! Details later. As mentioned previously we commence with the keyboard, and will progress in the May issue to give full details of the power supply and hardware for the mainframe.

MEMORY MAP FOR SYSTEM 68

	LOCATION	
BASIC 4K MEMORY	000 - 3FF	1K PROM - Program memory
	400 - 7FF	1K RAM
	800 - BFF	1K RAM - VDU memory
	C00 - CFF	Keyboard port
	D00 - DFF	Not used (yet)
	E00 - EFF	Not used
	F00 - FFF	Not used - RAM (256 bytes)
POSSIBLE 60K	1000 - FFFF	RAM (8K bytes) EAROM (4K) Extra peripherals I/O Cassette, TTY, Floppy Disk, etc. External device control i.e. relays, etc.

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ETI Project 155

DIGITAL VOLTMETER

EVERY NOW AND THEN AN IC drops into the public eye, which, on removal, proves to be a new-quick-answer to an old problem. Such a useful mote is the ZNA 116E from Ferranti. This is a DVM chip, which simplifies the construction of a 3½ digit instrument to a nicely ridiculous extent.

Armed with this device we set about the production of this project. In its present form it is an extremely accurate (< 0.1% error) with a 5V stabilised supply. It is very possible that we shall, in the future, extend the instrument to have multimeter capability, and with this in mind we leave space within our recommended case to accommodate this modification.

CONSTRUCTION COMMENCED

Although the circuit diagrams depict a complex device, construction is really very simple. The first thing to do is build the power supply as shown in fig. 9. Assemble the components onto the board as per fig 8. The regulator is mounted onto the rear of the case — no insulator is required, but be careful that the legs do not contact the case. Check the output of this — it should lie between 4.7V and 5.2V. Don't proceed if it doesn't! Wire up the mains switch and neon.

Once the supply is operational and mounted in the case, assemble the main PCB's. Follow the overlays given in figs 4, 5, and 7 — watch the orientation of the components. Fit link leads to the digital board, and mount this into the box such that the display locates behind the perspex panel you fitted there when you did the metalwork. (You did leave a hole for the displays — didn't you? . . . Oh.)

Next connect up the links to the analogue board and fit this into the case. Keep all inter board wiring as short as possible — and definitely less than six inches. The last block to

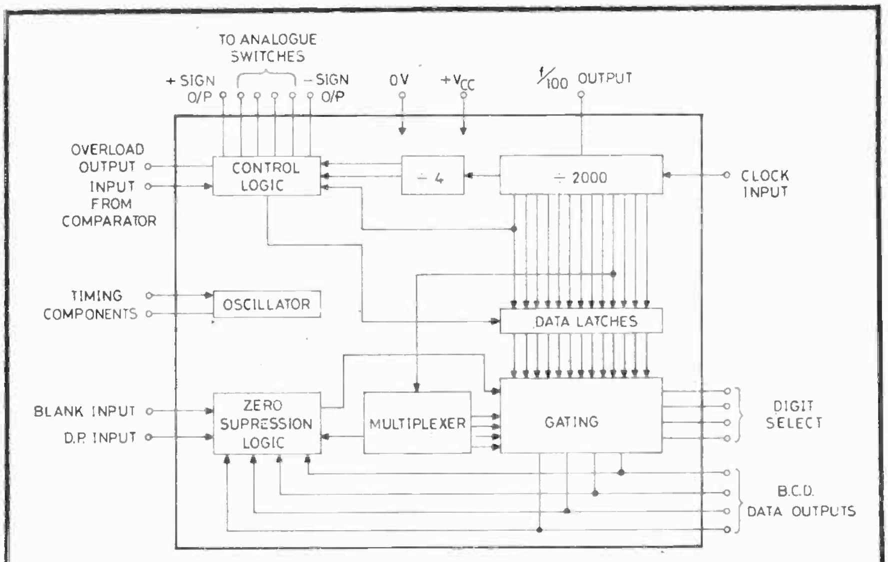
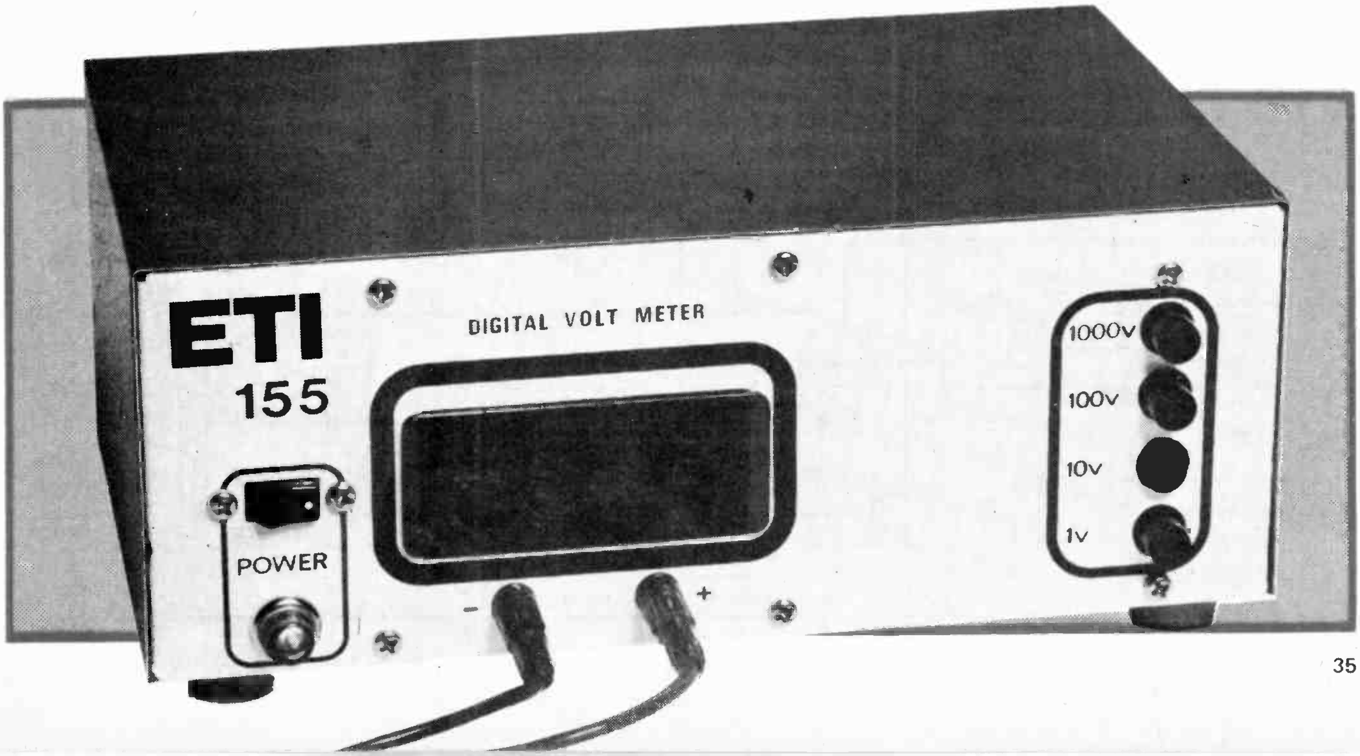


Fig. 1: Block Diagram of the ZNA116E.



Parts List

Resistors
R1 16k*
R2, 33 68k*
R3-9 150R
R10, 11, 12 1k5
R13, 18, 19, 20/3k3
R14 33k
R15, 26 15k
R16, 17 680R
R21 100R
R22, 23 100k
R24, 25, 31, 34* 10k
R27 27k
R28 1M*
R29, 30, 36 .51k*
R32 470R
R35 560R
R37 240k*
R38 180R
R39 180k*
R40 2M*
R41, 42 10M*
R43 22k*
(All Resistors 5% Ex * = 2% type.)

Potentiometers
RV1 100k Bourns 3009P
RV2, 3 5k Bourns 3009P
RV4, 5, 6 4k7 Min Hor. Trim.

NOTE!!
R1-R38 inc, RV1-RV3 inc
obtainable as pack from
Doram (997-134)
RV1-RV3 inc

Capacitor
C1 2n2
C2, 4 33n
C3, 5 68fi 10V electrolytic
C6, 10, 11, 12 100n
C7 2μ2
C8 10n
C9 470p
C13 2,200μ 16v electrolytic
C14, 15 220n
NOTE!!
C1-C12 inc Obtainable as pack from Doram (997-140)

Semiconductors
IC1 ZNA 116E
IC2 ZN 7447A
IC3, 4 ZN 424E
TRI, 2, 3, 4 ZTX 4403
TRI-11, 13-16 ZTX 108
TRI 12 ZTX 23
D1, 2 ZN 423
D3 1N 914 (see text)
BR.1 200V 1.6A Bridge Rectifier
REG 1 5V 600mA regulator TO3.
Display 1, DL701
Displays 2, 3, 4/DL707L

NOTE!!

IC1, D1, 2, TRI-4, TR12
Obtainable as pack
from Doram (997—112)

IC2, 3, 4, TR-11, 13-16
Displays 1, 2, 3, 4
Obtainable as pack
from Doram (997-128)

Switches
S1,2,3,4 4 blank assembly, 4 pole 2 way push button with cancelling action
Doram
4 x 338 — 636
4 x 338 — 563
1 x 338 — 254
S5 Off/On rocker

Transformer
T1 240V — 9V 1A type
Case
Samos S7 (Doram — 984-497)
Boards
The 2 main boards, Analogue and Digital, are available as pack from Doram (997-156)

Miscellaneous
Fuse holder, fuse, mains neon, 2mm red and black sockets, P.C.B. pillars, flex, 3 core mains flex, nuts and bolts etc., red perspex.

be positioned will be the switching bank and input attenuators. Wire this to the other boards once in place.

Before connecting *anything* to the PSU check over the boards again. Note the 'overload' diode D3, is mounted on the foil side of the digital PCB. Check the number of links. There are five on the analogue board, and twelve on the digital.

CALIBRATING AND ATTENUATING

Unfortunately there is no other way of calibrating such an instrument other than applying a known voltage. Before you do that put the range switch to 'one volt' position, and set RVI until the polarity indicator just flickers from '+' to '—'. (Carry this out with the input shorted).

Connect your known (accurate!) voltage preferably positive, to the DVM and adjust RV3 until the instrument shows this value. Reverse the terminals, and set RV2 so that the display is again correct. The basic accuracy is now achieved.

Each range of the attenuator is independent of the others, so each can be set individually.

Calibration is now complete.

USING THE METER

When the input voltage exceeds the maximum reading the display will flash and no further measurements can be taken — switch up a range. Decimal point is automatical-

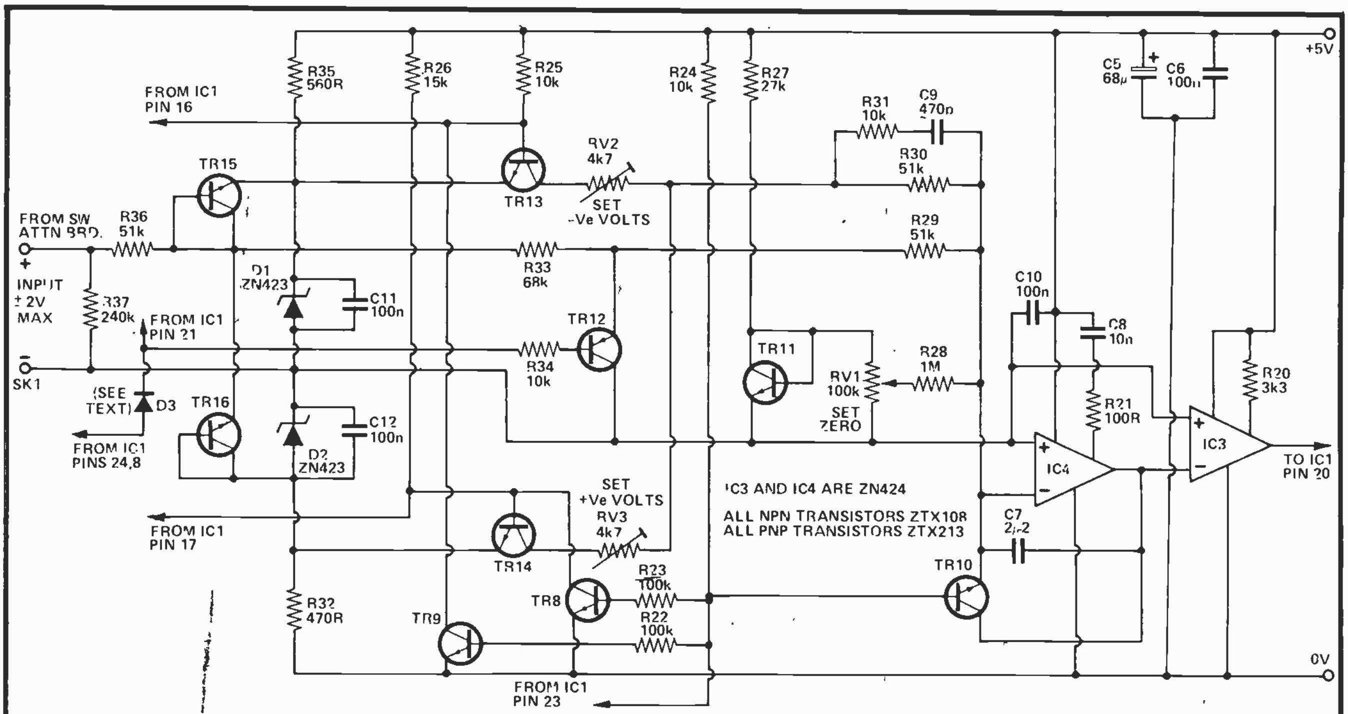


Fig 2: Circuit Diagram — Analogue Board

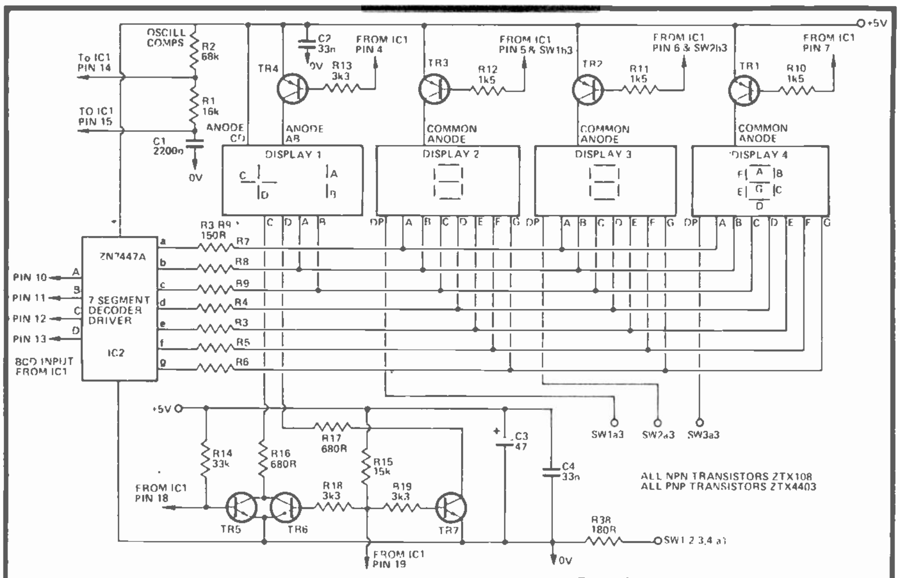


Fig 3: Circuit Diagram: Digital Board

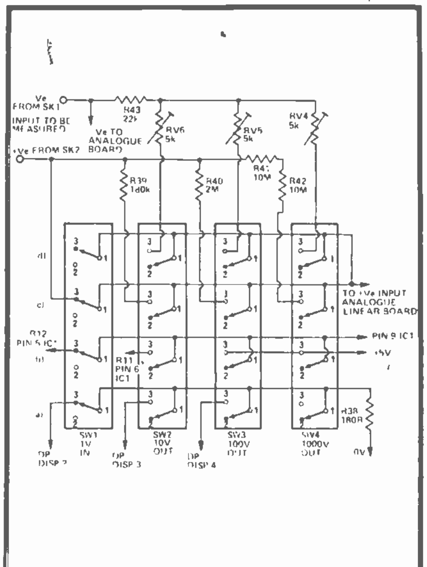


Fig 6: Circuit — Switching

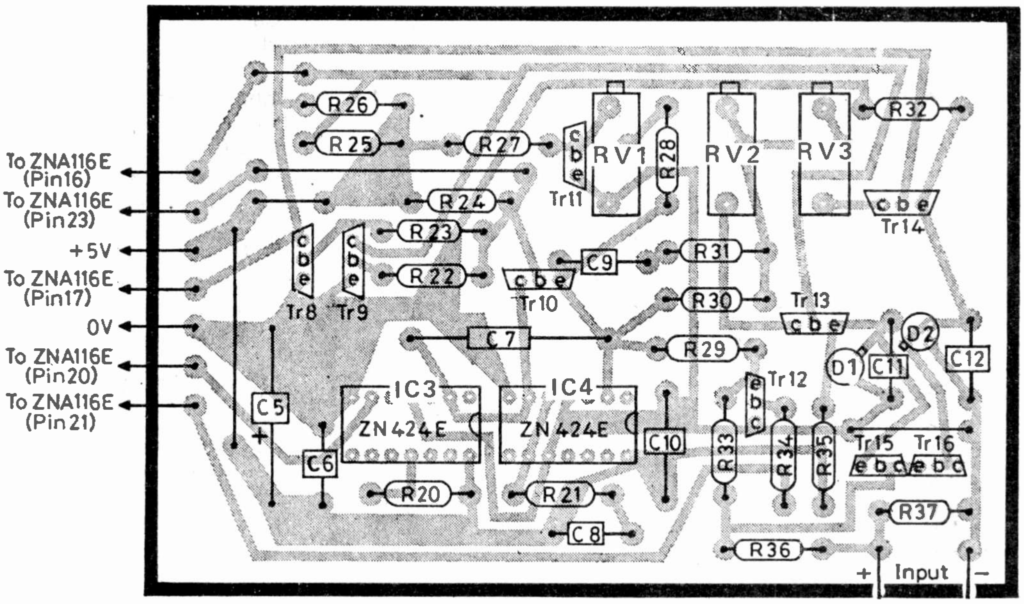
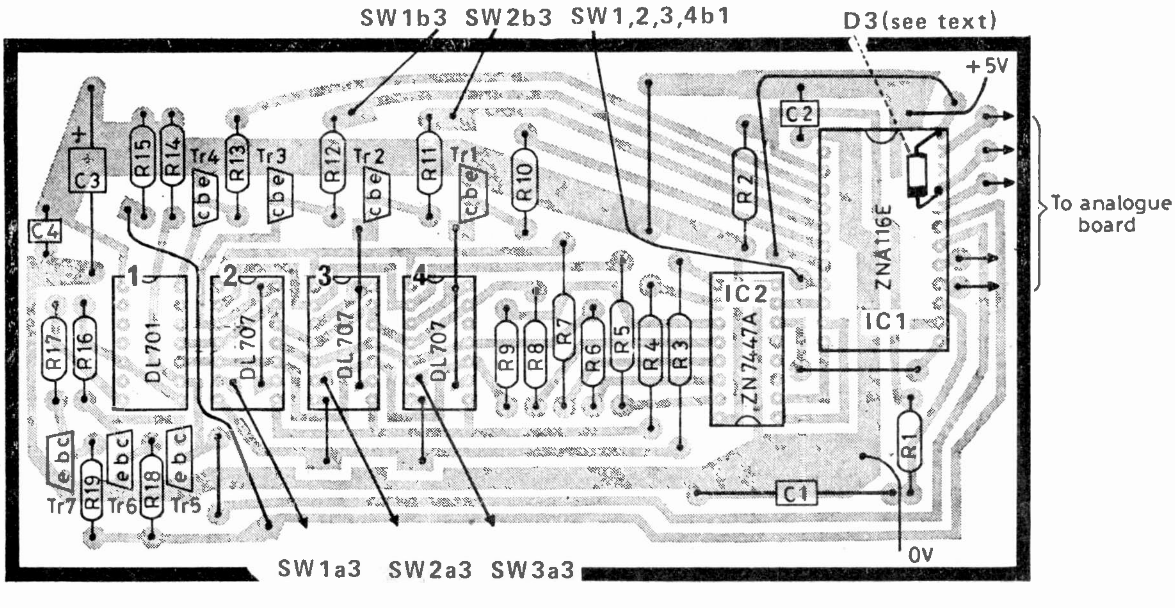


Fig 4: Overlay —Analogue Board

FROM SW/ATTN BOARD FROM SK1

Fig 5: Overlay — Digital Board



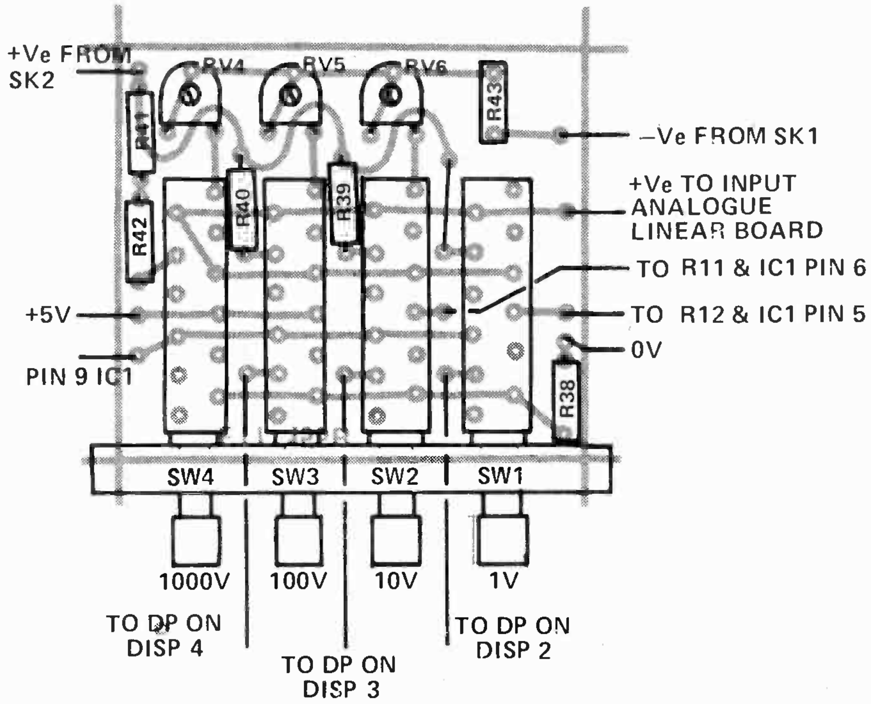


Fig 7: Overlay — Input Switching Board

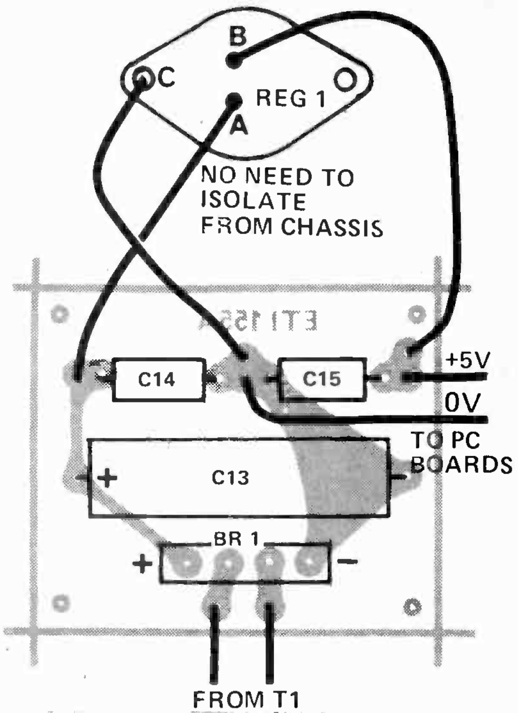
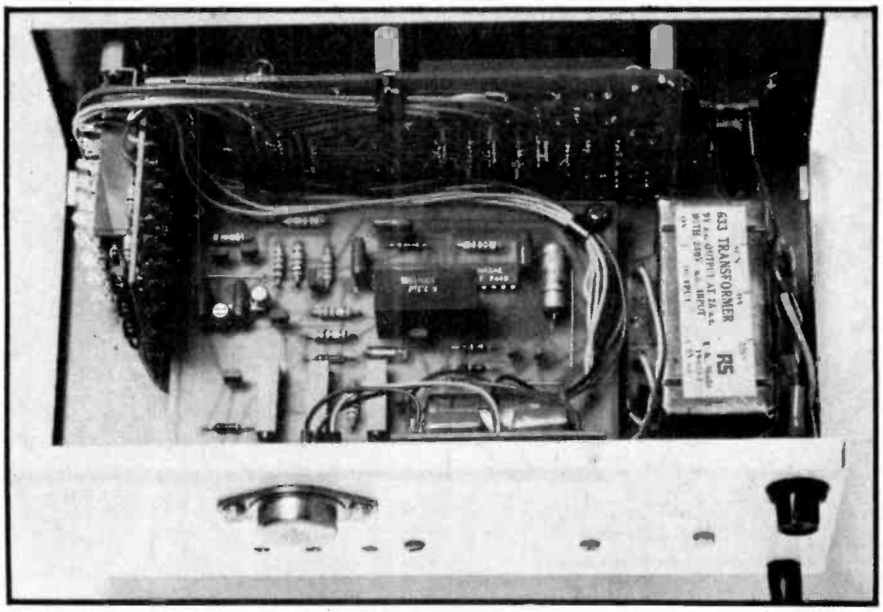


Fig 8: Overlay — Power Supply

ly set. Input impedance of the meter varies from 100kΩ on the 1V range to 20MΩ on the 1000V range. Maximum reading is ± 1999. If the accuracy of your setting-up is good — so is the DVM's! Insulting though it sounds, as the constructor YOU are the weakest link in the chain!



An internal view of the DVM unit. The display board is shown fixed in place upright against the front panel. Note the three holes in the back panel to adjust the three multi-turn presets on the analogue board. The voltage regulator need not be insulated from the back panel — but ensure the 'legs' do not short to the case.

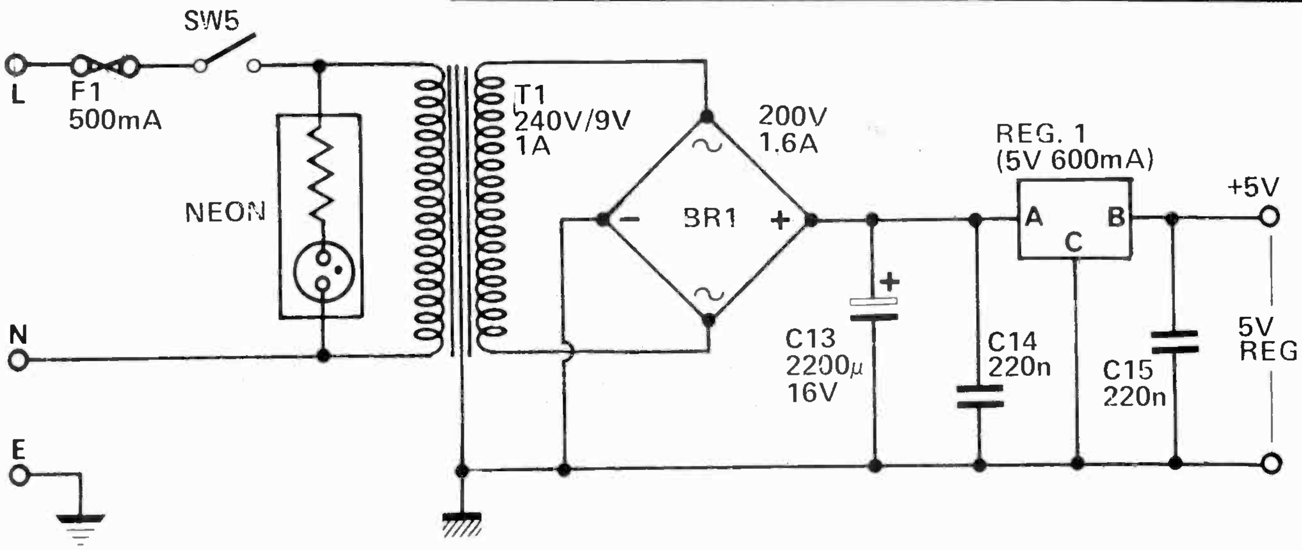


Fig 9 Circuit Diagram — Power Supply

How it works

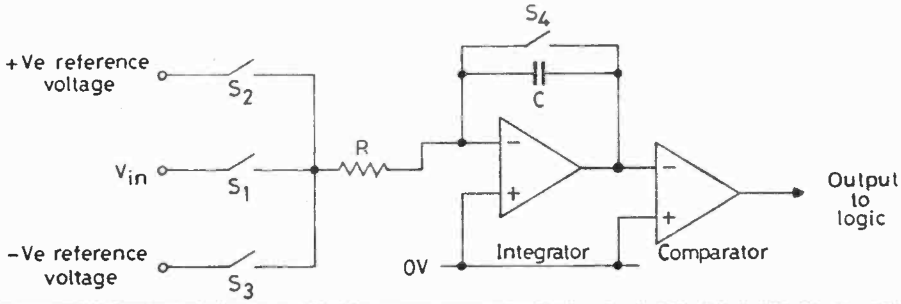
The method of A→D conversion used in the system is dual slope integration. Referring to the drawing below this operates thus:

At time T, S4 S3 and S4 are open, and S1 closes to apply the input voltage to the integrator. The integrator capacitor C will charge up linearly until time T_2(4000 clock pulses later). The voltage at the integrator is proportional to Vin.

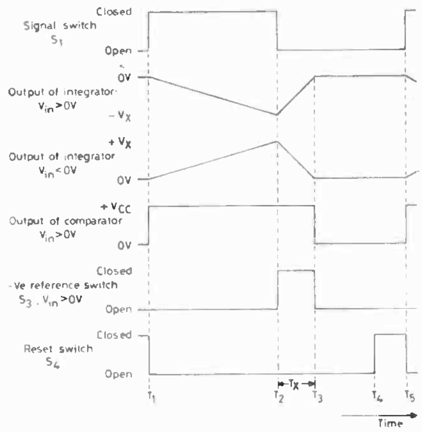
After time T_2 S1 opens and either S2 or S3 closes, applying a reference voltage (of opposite polarity to Vin) to the integrator. C now discharges at a constant rate, and at time T_3 the output of the integrator is again zero. This is detected by the comparator, and the ref. is switched off, and the number of clock pulses corresponding to Tx transferred to latches. This number is directly proportional to Vx, hence to Vin. If Tx is greater than 2000 clock pulses, an overload condition exists, and the display is flashed.

S1 is made to be closed for a time which is an exact multiple of 20msec, the period of the mains, and hence any ripple superimposed on Vin will be integrated to zero. Very convenient.

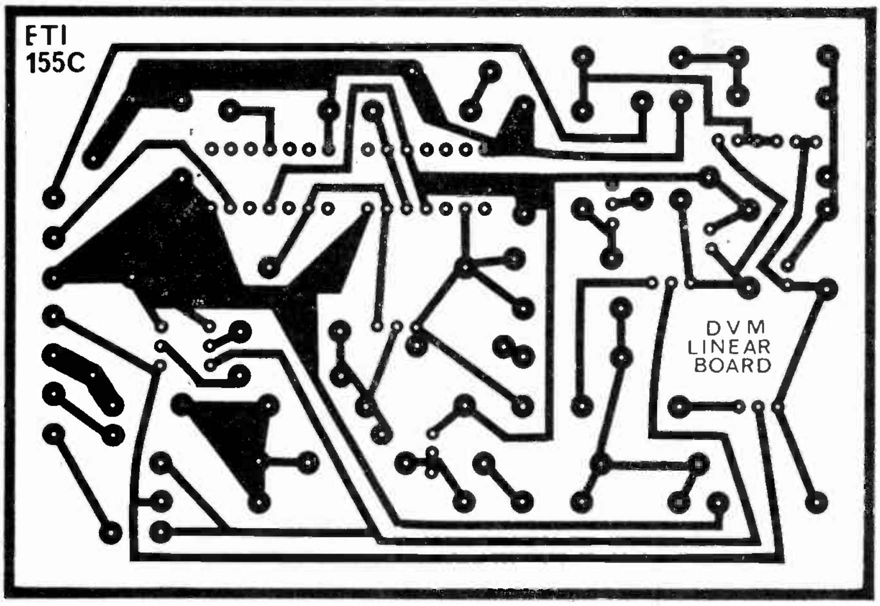
Using the dual slope technique means that neither the capacitor C nor the oscillator (clock) has to possess high stability.

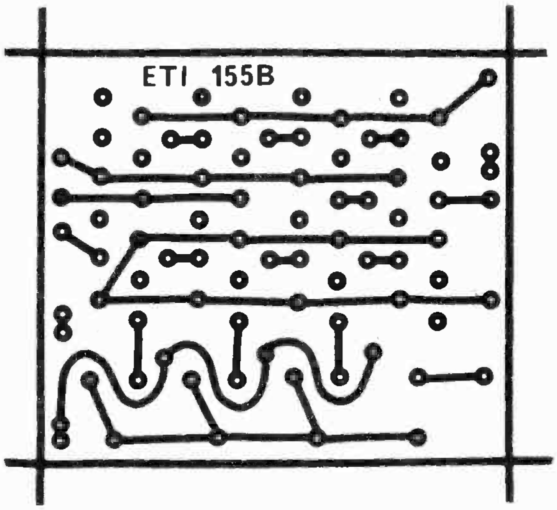


Referring our discussion to this circuit, IC4 forms the integrator, IC3 the comparator, IC1, the ZNA 116E is the control logic which

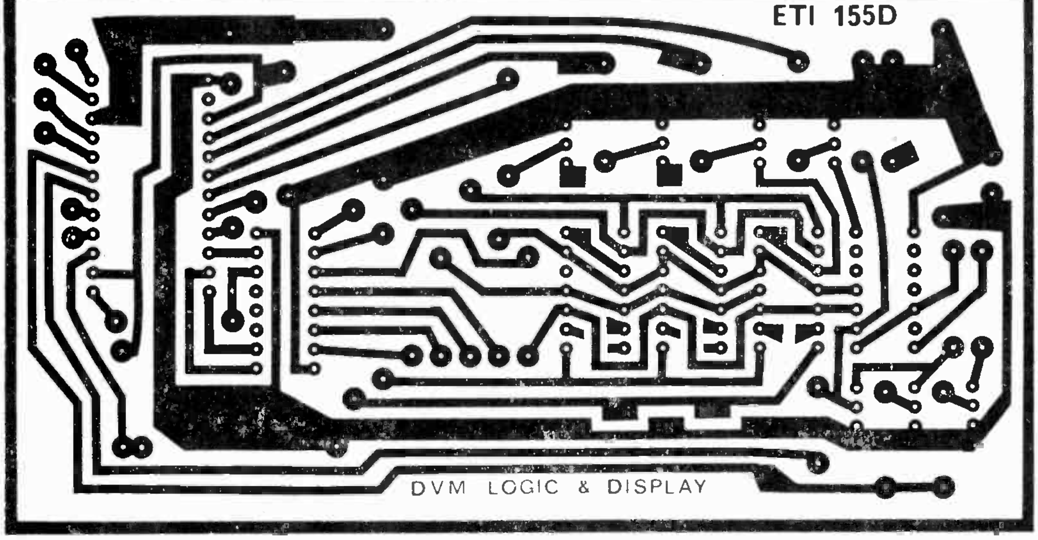


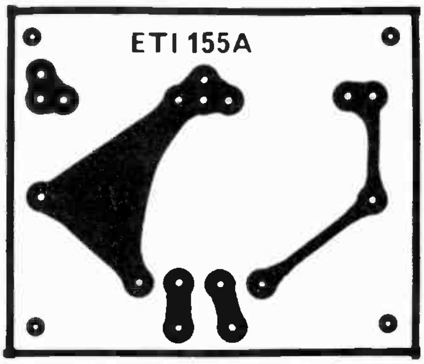
performs the transfer and timing for the system. A block diagram of this chip is given in fig. 1.





Our thanks to Ferranti who designed boards 155C and 155D for this project





biofeedback — instant yoga?

Using electronic biofeedback techniques you can monitor the internal operation of your body. But that's not all - knowing what's going on enables you to control usefully some of the processes, helping you to relieve tension and the disorders resulting from it. Collyn Rivers explains.

AN ESSENTIAL PART OF MOST control processes is some form of feedback information which enables the system to maintain a controlled equilibrium.

A room thermostat, for example, senses room temperature and regulates heat output accordingly — an indication of the heater's operation is 'fed back' to enable temperature to be automatically controlled.

When you learn the piano you see or sense where the keys are, and how hard you are striking them. The piano makes corresponding sounds which are fed back to your ear. Your brain now compares what you've got with what you hoped you had. This process of feeding back information about what you are achieving so you can compare it with what you are *trying* to achieve enables you to make appropriate corrections. In this example the acoustic feedback is vital.

A similar process is involved when you learn to ride a bicycle — the feedback process is so effective that balancing eventually becomes automatic.

Feedback is used when you first drive a strange car. The first time you brake you know only within wide limits the relationship between pedal pressure and deceleration. It may be as low as 5 kg or as high as 25 kg for (say) 0.4 G. But the very first time you press that pedal several feedback loops come into operation. Your stomach is sensitive to rate of change of velocity and it sends signals to your brain — your eyes sense the rate of change also — this data too is sent to your brain. If the tyres are squealing then there's an acoustic loop as well.

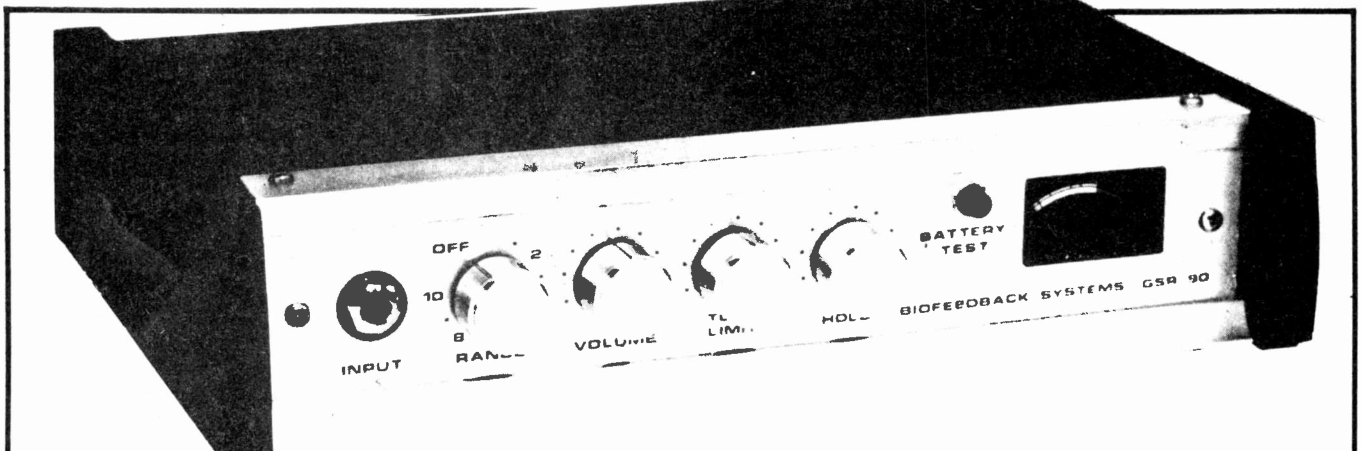
These and innumerable other physiological mechanisms collectively tell you whether you're pressing that pedal too hard or not hard enough, and you make a series of appropriate corrections — virtually instantaneously. Once you've done this a few times the response becomes automatic. You've used feedback to learn, and subsequently reinforce, a new skill.

THE AUTOMATIC NERVOUS SYSTEM

So far we've described what are primarily external feedback loops. But the body has a vast number of internal automatic mechanisms — what medics call the autonomic nervous system. These are internal feedback loops and whilst they're working correctly all one normally perceives is the end result. If the body is too hot it perspires — if you run for a bus your respiratory rate increases, if you walk from a light area to a dark area your pupils expand accordingly. And all these mechanisms work in very much the same way as their technological equivalents.

Until recently it has been taken totally for granted that man had no control over the autonomic nervous system. We could learn to control at least some of our external bits — but not our internal systems. We knew we could learn to use our hands — or even wiggle our ears — but to control body temperature or heart rate was something else again.

And until very recently Western science believed this implicitly — despite ever-increasing evidence to the contrary. Yogis have long maintained that *they* have some measure of control over their autonomic systems, but the evidence was always anecdotal rather than scientific. (It is only in the last decade that their performances have been monitored and scientifically authenticated.)



Galvanic skin response meter from Biofeedback Systems. A large external meter may be added to this unit.

biofeedback —

Then ten or so years ago the scene suddenly changed. It was caused by a now classical experiment involving the study of part of the brain's electrical activity. Researchers were studying a subject's alpha rhythms (a low amplitude 10 Hz generated when the subject is relaxed). It was found that if the subject could *perceive* a signal corresponding to his alpha activity he could learn to generate more or less of it at will. Even more excitingly, it was found that almost all subjects could do the same.

CONTROLLING YOUR INSIDES

For the first time it was proved scientifically that humans could control some internal processes once a visual or aural feedback loop was established. Yet the tremendous significance of this discovery was not at first appreciated by the medical profession, but rather by engineers and physicists who were of course more familiar with the use of feedback in control systems.

Subsequent experiments have shown that a very large number of internal functions can be controlled in the same fashion — and even more importantly that many partially mal-functioning mechanisms can be 're-programmed' so that newly-learnt patterns can become automatic.

One of the most important of these is conscious control of tension and anxiety, for this implies that it is possible to control tension-related conditions such as migraine, colitis, asthma etc.

Other work has shown that it is possible to control hypertension (high blood pressure), heart rate, muscular tension, body temperature — and of course to generate, or at least partially control, alpha, beta and theta brainwaves. It is in fact now commonly believed that it may eventually be possible to bring under some degree of voluntary control *any* physiological process that can be continuously monitored, amplified and displayed

GALVANIC SKIN RESPONSE

The skin is an extraordinarily sensitive and rapid indicator of stress. Some people know this only too well — they literally develop nervous rashes.

When you become tense a number of readily measurable changes take place. A major change is the massive shift in electrical resistance of the dermis (the layer beneath the skin's outside surface). This shift is not only large but also very swift and the reaction happens regardless of where the centre of stress happens to be. A minor change in tension of a stomach muscle will cause just as large a change as clenching your fingers.

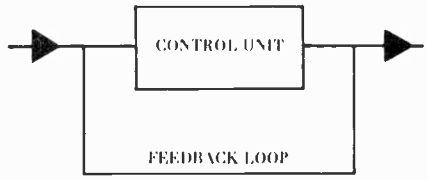
Galvanic skin response monitors (or GSR machines as they're generally called) monitor the resistance between two adjacent fingers of one hand. They translate and present this data as a meter indication or as a tone of related pitch (i.e. as tension decreases, pitch falls, and vice versa).

GSR machines are quite easy to build: they can be simply expanded-scale ohmeters covering the range 5000—100 000 ohms. A sensitivity control is essential, as is a readily adjustable method of switching resistance ranges.

Readout may be a simple analogue meter (digital tends to be harder to read in this application) or preferably a corresponding audio tone in which the pitch decreases as tension falls. Surprisingly perhaps GSR resistance *increases* as tension falls.

Electrodes may be made from any flexible conductive material — like steel wool, soft metal mesh etc — held firmly against the fleshy part of your finger tips by a velcro strap or something similar.

GSR machines are very easy to use. In fact one of the best ways is simply to switch on and try to cause the meter reading to fall — or the tone to drop in pitch. Usually you will find out how to do this within a few minutes.

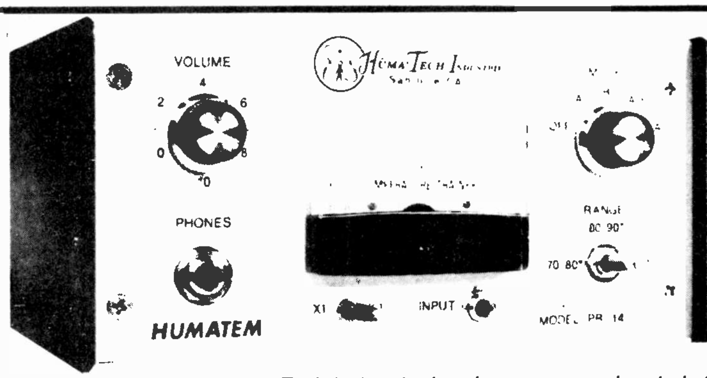


The basic feedback loop.

GSR machines make you *aware* of tension — and then enable you to *control* that tension. Eventually — after ten or so half-hour sessions the conscious control that you have learned becomes an automatic response. From then on the GSR machine is no longer required. In fact it becomes a handicap to further progress just like retaining 'training wheels' on a kid's bicycle.

Biofeedback thus operates in the opposite way to drugs. You can use sedatives to control tension if you wish. But if you do you've then got *two* problems. You still have the underlying tension — which will become only too apparent when you run out of sedatives. And you've become a drug addict as well.

To fully appreciate the efficacy of GSR machines in tension reduction it should be understood that there is an almost one-for-one relationship between mind and body. If you reduce muscular tension you will automatically reduce mental tension which in turn will reduce muscular tension yet further — and so on.



Temperature trainer from Huma-Tech Industries has three ranges each switchable to provide 0-10º or 0-1º fsd.

TEMPERATURE MONITORING

Tension is also reflected in skin temperature — particularly in the hands. A considerable amount of work in this field has been performed by Green and Green of the USA's Menninger Foundation research dept, who use this technique extensively in the control of migraine.

As with GSR, the technique and equipment is remarkably simple. Subjects are simply taught to raise their hand temperature — meanwhile monitoring the effect on an expanded-scale temperature meter. A small thermistor is taped to a finger tip to monitor changes and the output from this is backed off against a second thermistor within the instrument to compensate for ambient temperature changes.

instant yoga?

Advanced alpha/theta instrument from Bioscan uses digital filtering and threshold adjustment to eliminate interference from spurious phenomena.

At a recent demonstration (attended by the writer) some fifty subjects with no previous experience of temperature training all succeeded in varying their hand temperature (in some cases by as much as 5°C within a single twenty minute session).

If you're contemplating building your own temperature monitor choose thermistors with a two to three second response time. Build the thermometer so that ambient temperature can be backed off, thus enabling the meter to give a centre zero indication at the beginning of the experiment. The instrument should have two switchable ranges — ± 2.5°F and ± 7.5°F.

As with GSR machines the readout may be either a tone of varying pitch and/or a meter reading.

People teach themselves to use these devices very quickly — usually within ten to fifteen minutes. However, whilst almost everyone can effect a change of temperature, about 50% will find the change to be in the opposite direction to that intended! Nevertheless the correct technique is quickly acquired after a few more minutes.

ELECTROMYOGRAPHS

Feedback electromyographs (EMGs) provide information about muscular tension by visually and aurally displaying neuron firings caused by muscular activity. They are commonly used in both clinical and research applications for the observation and reduction of stress and anxiety, tension and migraine headaches, tension backaches, muscle spasms and tics, essential hypertension etc.

Unlike the far simpler GSR and temperature indicators, myographs necessarily need sophisticated electronic circuitry in order to monitor the very low level activity of neuron firings.

The actual signals are picked off by silver, silver-chloride or gold electrodes placed on the surface of the skin directly across the muscle concerned. In some cases the signal may be obtained via implanted electrodes.

Signal level is very low — often as small as 0.1 microvolts, so noise rejection must be high. A typical unit will have common mode rejection of better than 100 dB. A bandpass filter is usually incorporated. This typically rolls off at 18 dB/octave beyond 100—500 Hz. The output signal is generally averaged over an adjustable 0.5 to 5 second period.

This type of instrument is not really suitable for home designing or building.

HEART RATE

The heart is simply a four-chambered pump. It receives circulating blood, causes the blood to be pushed into the lungs where it picks up oxygen, then causes this blood to be returned to the heart and finally and very powerfully this re-oxygenated blood is forced through the body.

The rate at which the heart beats appears to be directly related to the metabolic requirements of the body, but the way in which this is done is not currently understood. However virtually every part of the brain yet examined appears to play some part in the determining and controlling heart rate.

Short of simply feeling one's pulse and timing it with a stopwatch, the next simplest method is to monitor fluctuations in blood density as the pulse occurs. This may be done opto-electronically using a simple light source and photocell attached across an ear-lobe or finger tip.

There is growing evidence that the ability to control heart rate via a biofeedback process would be of value in protecting it from undue stress. As with most biofeedback activities it is very easy to do this given the correct apparatus. Yogis have, of course, gained such

biofeedback

control *without* apparatus. Nevertheless it should be emphasised that less appears to be known about heartrate control than galvanic skin response or myography.

BRAINWAVE MONITORS

The brain produces four major electrical rhythms, classified by frequency. These rhythms may be monitored by an electroencephalograph (EEG) which detects, amplifies and displays them electrically.

The major rhythms are —
Beta: 13-30 Hz — associated with attention, anxiety.
Alpha: 8-12 Hz — associated with relaxation, well being.
Theta: 4-8 Hz — associated with imagery, meditation.
Delta: 0.5-4 Hz — associated with dreamless sleep.

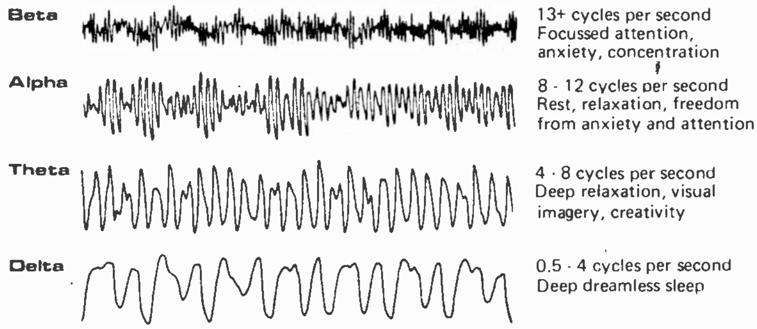
Generally the rhythms are produced in short bursts — often of 10–25 cycles — and generally non-overlapping.

The signals may all be monitored via one set of electrodes placed at the front and rear of the skull — a third electrode is also used to provide a 'reference'.

All four rhythms have very low amplitude — about a microvolt or two — so that good noise performance is essential if the equipment is to function correctly.

Very good filtering is also required to eliminate interference from stray 50 Hz signals and also to prevent interference from artifacts (spuria generated by muscular activity). Analogue filters having the required characteristics can be produced but digital filters should preferably be used. If an analogue filter is used, a good one is a three-pole Butterworth with 18 dB/octave rolloff.

The brain is constantly producing alternating electrical currents termed brain waves. Four major brain wave rhythms each falling within a typical frequency, have been identified, and each of these is generally associated with a particular set of mental and physical states as outlined below:



It is almost essential to use a differential input amplifier using low noise devices. Input cables must be shielded. Common mode rejection should be about 120 dB at 10 Hz and if possible at least 150 dB at 50 Hz. Input impedance should be no less than one megohm. The output indication should be aural. Most people prefer to have their eyes closed when trying to generate alpha rhythms.

Alpha training has become somewhat of a cult — particularly in the USA where a large industry exists simply to supply alpha monitors (of varying efficacy!)

Most people can learn to generate alpha rhythms at will and there is a great deal of evidence that a state of well-being and deep relaxation is associated with alpha production.

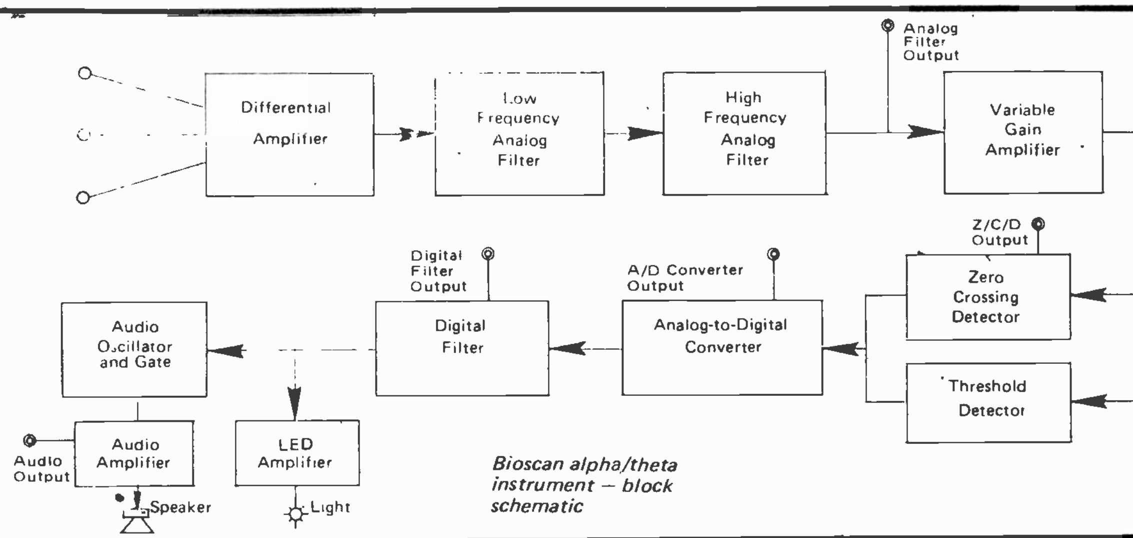
Alpha training is also used by clinical psychologists and psychiatrists particularly in attitude change and re-inforcement.

Theta waves are also controllable. This type of waveform appears to be in some way associated with creativity. It may well be that creativity can be enhanced by learning to control a theta state: we understand that some researchers are investigating this at present.

Biofeedback is still very much an infant and largely orphan science and at present it is difficult to forecast just what impact it will have on mankind.

There is ample evidence that by using biofeedback the average subject can in minutes learn to vary his state of tension, body temperature, heart rate, brainwave generation etc — techniques which have taken gurus a lifetime to master.

Many autonomic nervous functions clearly *can* be willfully controlled and there is growing evidence that many tension-related illnesses (and about 90% of illnesses are currently believed to be so related) can be alleviated or cured by biofeedback techniques. ●



Bioscan alpha/theta instrument — block schematic

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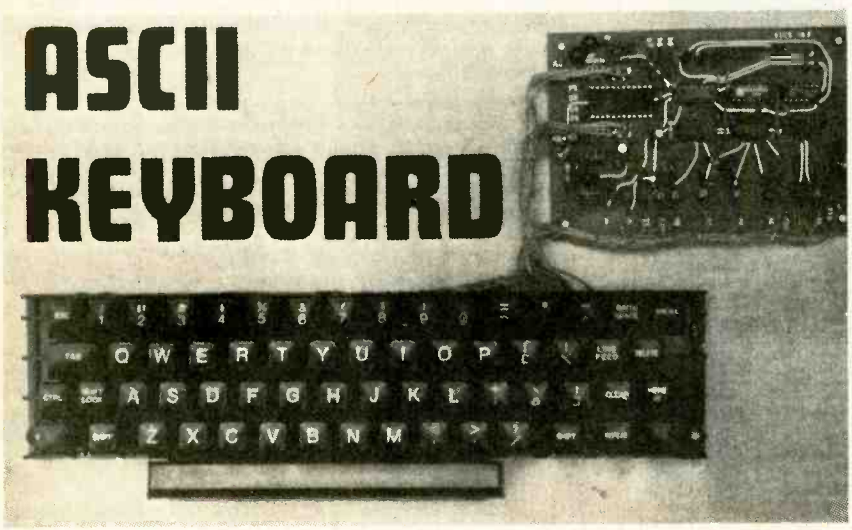
What to look for in the April issue, on sale March 4th

IT'S OUR 5th BIRTHDAY!

Yes, ETI in Britain will be five years old! Since we started in April 1972 we have grown enormously in sales and popularity — we are *still* one of the fastest growing magazines in any field.

In the five years not only have we increased our sales in Britain, we've also launched a Canadian and Dutch edition, both of which are prospering.

ASCII KEYBOARD



This marks the advent of System 68 (see page 33 for full details). However, it can be built as a free-standing unit: the output is the full ASCII code, and so will match any other system with this I/O requirement. The encoder can even be added to an existing keyboard if you have one.

35 741 Circuits

Readers thoroughly approved of our feature in the January 1977 issue on 555 Timer Circuits: so much so that in the next issue we carry an article in the same mould, 35 circuits using the 741 Op Amp. As with the 555 article, few of the circuits are standards and we're sure this is a feature you won't want to miss.

INDEX

The April 1977 issue will include a complete index to all ETI issues from the time we began. You'll be able to find any previous article easily — see what you missed — find out what's still available in back numbers (sadly most are sold out) and what's available in Project Books.

This index contains everything that was in the index published last year plus those things we have carried subsequently.

SHORT CIRCUITS

FUZZ BOX — we only realised this month that in five years we've never done a fuzz box! With such effect units as the phaser and the waa-waa behind us we're rectifying the omission next issue.

ALARM CONTROL — A simple intruder alarm control box using a CMOS chip!

BENCH P.S.U. — One more of our occasional 'worktop projects'. Here we present an easily assembled bench supply with variable current limiting and metered output to around 30V. And this is a 'Short Circuit'!

TOP PROJECTS 1 & 2

Normally when people like ETI say something's 'by popular demand' they're hoping that there is a demand rather than it existing in fact.

However, we've been turning away dozens of orders for Top Projects No. 1 for so long that we've given up. Additionally Top Projects No. 2 — which has been no less popular but of which we had large stocks, is running out fast (about three weeks' supplies left).

So we've put a combined Top Projects 1 and 2 back on the presses to produce a real bumper. See our ad on page 24 for more details.

Unique full-function 8-digit wrist calculator... available <u>only</u> as a kit.

A wrist-calculator is the ultimate in common-sense portable calculating power. Even a pocket calculator goes where your pocket goes – take your jacket off, and you're lost!

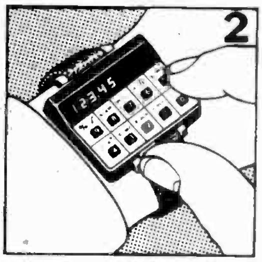
But a wrist-calculator is only worth having if it offers a genuinely comprehensive range of functions, with a full-size 8-digit display.

This one does. What's more, because it *is* a kit, supplied *direct* from the manufacturer, it costs only a very reasonable £9.95 (plus 8% VAT, P&P). And for that, you get not only a high-calibre calculator, but the fascination of building it yourself.

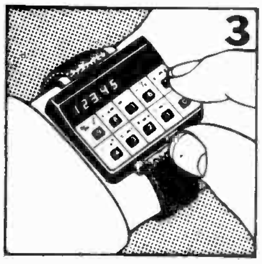
How to make 10 keys do the work of 27
The Sinclair Instrument wrist calculator offers the full range of arithmetic functions. It uses normal algebraic logic ('enter it as you write it'). But in addition, it offers a % key; plus the convenience functions $\sqrt{x}$, 1/x, x^2; plus a full *5-function memory.*

All this, from just 10 keys! The secret? An ingenious, simple three-position switch. It works like this.

1. The switch in its normal, central position. With the switch centred, numbers – which make up the vast majority of key-strokes – are tapped in the normal way



2. Hold the switch to the left to use the functions to the left above the keys...



3. and hold it to the right to use the functions to the right above the keys.

The display uses 8 full-size red LED digits, and the calculator runs on readily-available hearing-aid batteries to give weeks of normal use.

Assembling the Sinclair Instrument wrist calculator
The wrist calculator kit comes to you complete and ready for assembly. All you need is a reasonable degree of skill with a fine-point soldering iron. It takes about three hours to assemble. If anything goes wrong, Sinclair Instrument will replace any damaged components *free:* we want you to enjoy assembling the kit, and to end up with a valuable and useful calculator.

Contents
Case and display window.
Strap.
Printed circuit board.
Switches.
Special direct-drive chip (no interface chip needed).
Display.
Batteries.

Everything is packaged in a neat plastic box, and is accompanied by full instructions. The only thing you need is a fine-point soldering iron.

All components are fully guaranteed, and any which are damaged during assembly will be replaced free.

The wrist-calculator kit is available only direct from Sinclair Instrument. Take advantage of this 10-day money-back undertaking.

Send the coupon today.

**Sinclair Instrument Ltd,
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Tel: Cambridge (0223) 311488.**

**To: Sinclair Instrument Ltd,
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* Please send me . . . (qty) Sinclair Instrument wrist-calculator kits at £9.95 plus 80p VAT plus 25p P&P (Total £11).

* I enclose cheque/PO/money order for £ ....

* Complete as applicable.

Name ______________________

Address ______________________

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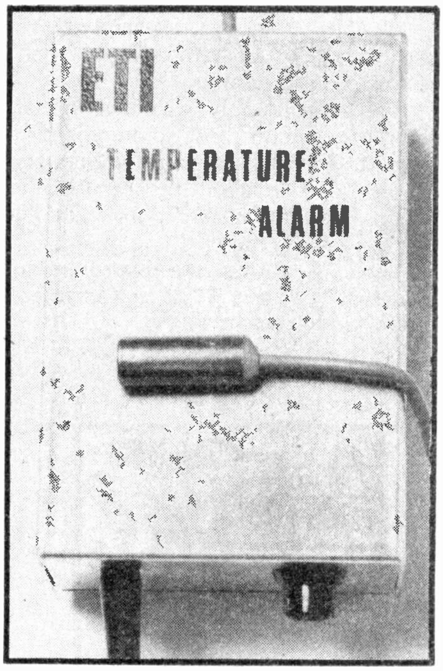
(Please print)
I understand that you will refund my money in full if I return the kit undamaged within 10 days of receipt. ETI/3

TEMPERATURE ALARM



A SIMPLE BUT VERSATILE monitor to provide for over or under alarm was the main aim of this circuit. It may be used to keep an eye on fish tanks, deep freezes (by monitoring the heat exchanger), cooking vessels, incubators etc etc.

The temperature at which an alarm is given is adjustable over a range predetermined by the combined values of the components RV1 and R1. RV1 is a potentiometer which is used to adjust the final 'set point' (the temperature at which the alarm is given).

Actual temperature sensing is done by a device called a 'thermistor'. This is basically a resistor in which the resistance value varies with changes in temperature. Thermistors are obtainable in innumerable shapes, sizes and temperature ranges.

The unit may be built so that a small loudspeaker provides an audible warning when the set limit is reached.

OVER + UNDER

The unit can be constructed so that the warning (or relay action) takes place as temperature *exceeds* the set limit - or so that the warning (or relay action) takes place as temperature falls *below* the preset level.

All that is required to convert either unit from one mode of operation to the other is simply to change over the position in the circuit of the thermistor and the combination RV1 and R1.

Figure 1a shows the unit with loudspeaker set up to warn if the temperature exceeds the limit preset by RV1. Figure 1b shows the circuit set up to warn when the temperature falls below the preset limit.

Figure 2 shows the circuit for adding a relay to enable a blower or heater depending on the circuit chosen, to be switched on.

How it works

Temperature is sensed via a thermistor. This is a resistor which varies its resistance as temperature changes. The one chosen for this application is an NTC (negative temperature coefficient) type in which resistance falls as temperature rises. The resistance at 25°C is about 47k falling to about 3k at 100°C. This thermistor forms a voltage divider with RV1 and R1.

The familiar 555 IC is the basis of the unit. The IC will oscillate if pins 2 and 6 are allowed to exceed approximately two-thirds of the supply voltage. However, the voltage divider, along with diode D1 can prevent this and while it does so the alarm will be off.

As temperature increases thermistor resistance falls and the voltage begins to rise at the junction of D1, the thermistor, and R1. When the voltage reaches $2/3\ V_S-0.6V$, the 555 begins to oscillate and causes the loudspeaker to sound (at about 1.2kHz). If an 8 ohm speaker is available then R4 must be included. However if an 80 ohm speaker is available then R4 may be left out - the sound will then be much louder.

The circuit may be arranged so that a relay is actuated rather than an alarm. Figure 2 shows how this is done. Here diode D2 and capacitor C2 rectify the output of the 555 IC. Resistor R4 is added to ensure that there is some overlap between pull-in and drop-out set points. The lower the value of R4 the greater the difference there will be between these two points (this effect is known technically as 'hysterisis').

TABLE 1
APPROXIMATE VALUES OF R1 + RV1 FOR DIFFERENT TEMPERATURES

°C	OVER ALARM	°C	UNDER ALARM
20	85k	12	37k
25	75k	14	35k
35	50k	16	31k
45	30k	18	29k
55	18k	21	27k
65	10k	24	25k
75	6k5	27	23k
85	4k	30	18k
95	2k5		
100	1k8		

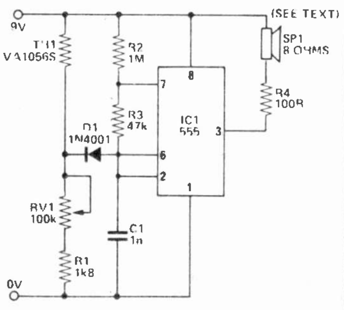


Fig. 1a OVER ALARM

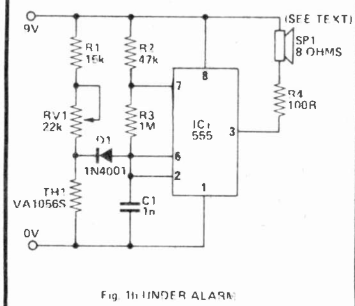


Fig. 1b UNDER ALARM

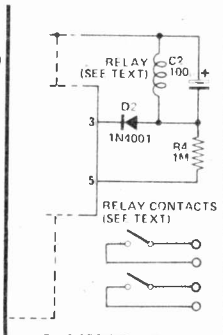


Fig. 2 ADDING A RELAY

Short Circuits

The relay is external to the board, and should be a 6V, 185R (min.) coil type. The contact rating needed will depend on the application.

CONSTRUCTION

The thermistor should be mounted in some thin-walled glass tube, say an old perfume bottle (or cap!). If this component is not sealed, its working life will be very truncated to say the least! Electrolytic action quickly dissolves the leads. Our's lasted a day!

Obviously though, if all you're monitoring is air temperature, then sealing is unnecessary.

The power supply is a conventional series-pass circuit, and no comment is needed. The stabilisation components are included on the PCB. The use of a supply is recommended as the standing current is quite high.

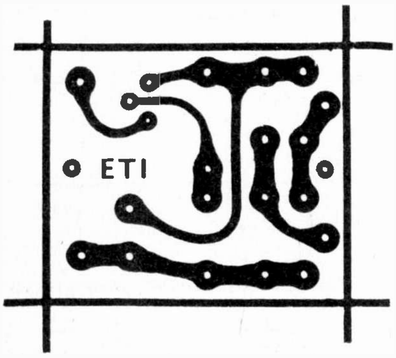
Table 1 shows the approximate values of RV1 and R1 to cause triggering at various temperatures.

Parts List

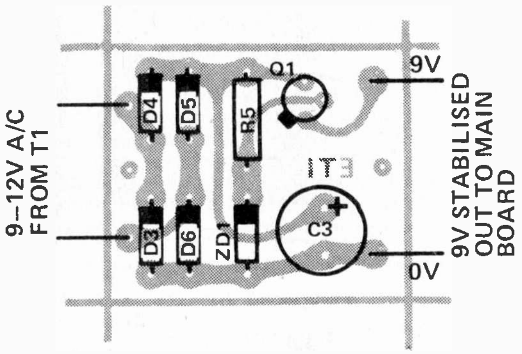
	OVER ALARM WITH 8Ω SPEAKER	UNDER ALARM WITH 8Ω SPEAKER	CHANGES FOR USING RELAY
RESISTORS			
R1	1k8	15k	---
R2	1M	47k	---
R3	47k	1M	---
R4	100R	100R	1M
R5	270R	270R	---
	All ½W 5%	All ½W 5%	
CAPACITORS			
C1	1n ceramic	1n ceramic	---
C2	---	---	100u 16V electrolytic
C3	470u 16V electrolytic	470u 16V electrolytic	---
SEMICONDUCTORS			
Q1	BFY 51	BFY 51	---
IC1	555 Timer	555 Timer	---
D1, 3 - 6	1N4001	1N4001	---
D2	---	---	1N4001
ZD1	9V1 400mW Zener	9V1 400mW Zener	---
POTENTIOMETER			
RV1	100k Mini Trim	22k Mini Trim	---
THERMISTOR			
TH1	VA 1056s (N.T.C.)	VA 1056s (N.T.C.)	---
TRANSFORMER			
T1	240V - 9V - 150mA	240V - 9V - 150mA	---
FUSE/HOLDER			
F1	To suit 250mA fuse	To suit 250mA fuse	---
BOX	4½"x 3"x 2" 114 x 75 x 52mm.	4½"x 3"x 2" 114 x 75 x 52mm.	---
RELAY			To suit applications with 6V 185Ω (min) coil.

MISCELLANEOUS
3-core flex, 2-core flex, P.C. board spacers, glass tube, grommets, etc.

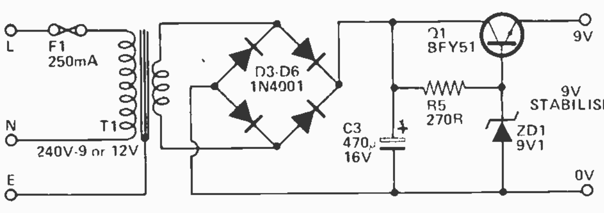
Cost £4-£6



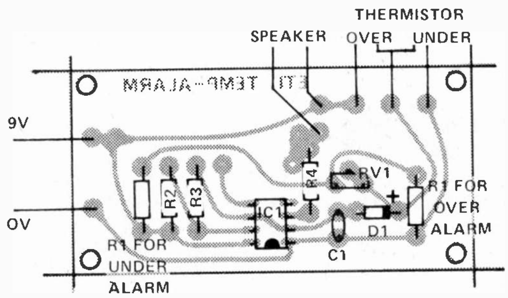
Temp Alarm P.S.U. Board Foil Pattern — Full Size



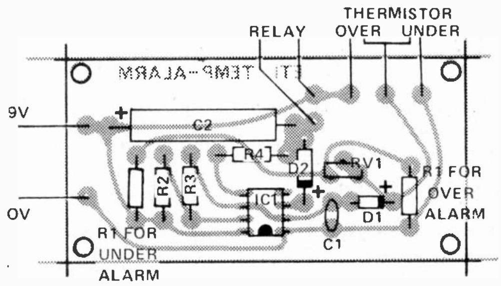
Temp Alarm P.S.U. Overlay



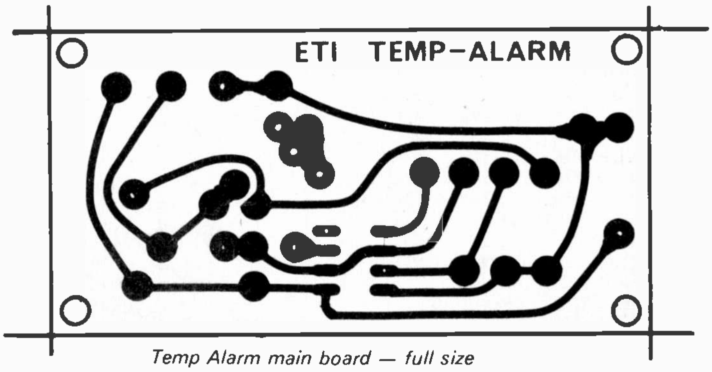
Temp Alarm Power Supply Circuit



Component Overlay — Alarm with Speaker



Component Overlay — Alarm with Relay



Temp Alarm main board — full size

FUNCTION GENERATOR

IT IS NOT AN UNREASONABLE prediction to say that this circuit will find great usage as a general servicing implement. It produces greater test flexibility than the usual sine-wave signal injector, providing 1kHz square and triangle waves as well, and is both cheap and simple to build.

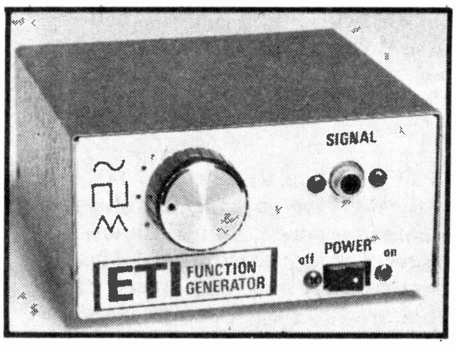
As it stands the output is around 3V ptp on square wave, and 2V r.m.s. on the sine-wave. A switched attenuator could easily be added should you wish to be kinder to the circuit you're testing, but being heartless to electrons, we haven't included one! Operation is from a PP6 battery which should last you as long as it would on the shelf!

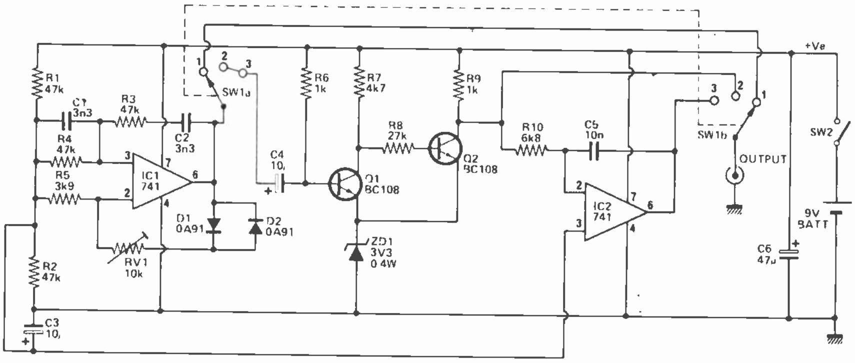
CONSTRUCTION

Assemble the components onto the PCB as shown in the overlay, and watch the orientation of the zener, electrolytics and ICs. To set up the circuit, simply adjust RV1 until the sine-wave is just *below* clipping level. This gives you the best sine-wave from the oscillator. The square and triangle do not need any further setting-up.

How it works

IC1 is set up as a Wien bridge running at 1kHz. Amplitude control is provided by the diodes D1 and D2. The output from this IC is switched through either to the output socket or to the squaring circuit. This is coupled to SW1a via C4 and is a Schmidt trigger (Q1-Q2). The zener ZD1 forms a 'hysterisis-free' trigger. The integrator of IC2, C5 and R10 produces the triangular wave from the input square wave.





Circuit Diagram of the Generator

Parts List

RESISTORS

R1,2,3,4	47k
R5	3k9
R6,9	1k
R7	4k7
R8	27k
R10	6k8

All ¼W 5% H.S.

CAPACITORS

C1,2	3n3 polystyrene
C3,4	10u10V electrolytic
C5	10n ceramic
C6	47u 16V electrolytic

SEMICONDUCTORS

IC1,2	741 8-pin DIL
Q1,2	BC108 or similar
D1,2	OA91 diodes
ZD1	3V 3/4W zener

POTENTIOMETER

VR1 10k vertical miniature trim

SWITCHES

SW1 a/b	2-pole 3 way rotary
SW2	Single pole off-on rocker

MISCELLANEOUS

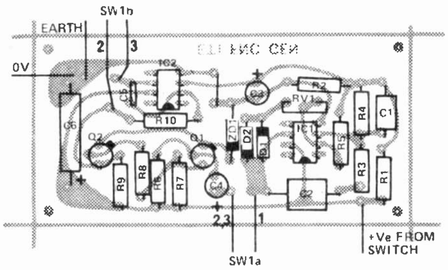
Phono socket, knob, board spacers, nuts, bolts, etc. P.P.6 battery, P.P.6 battery clip.

CASE

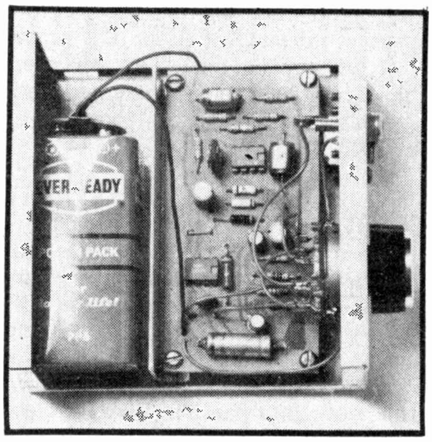
Samos: S2 Doram 984 - 447.

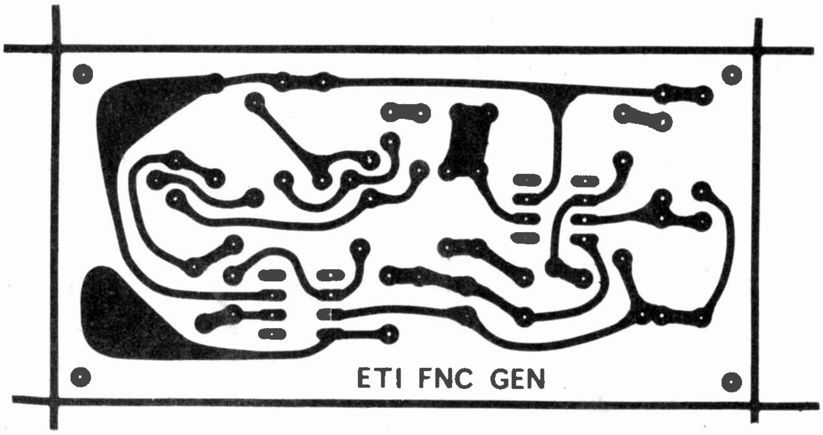
COST

£4.77 inc. VAT, battery, + board.



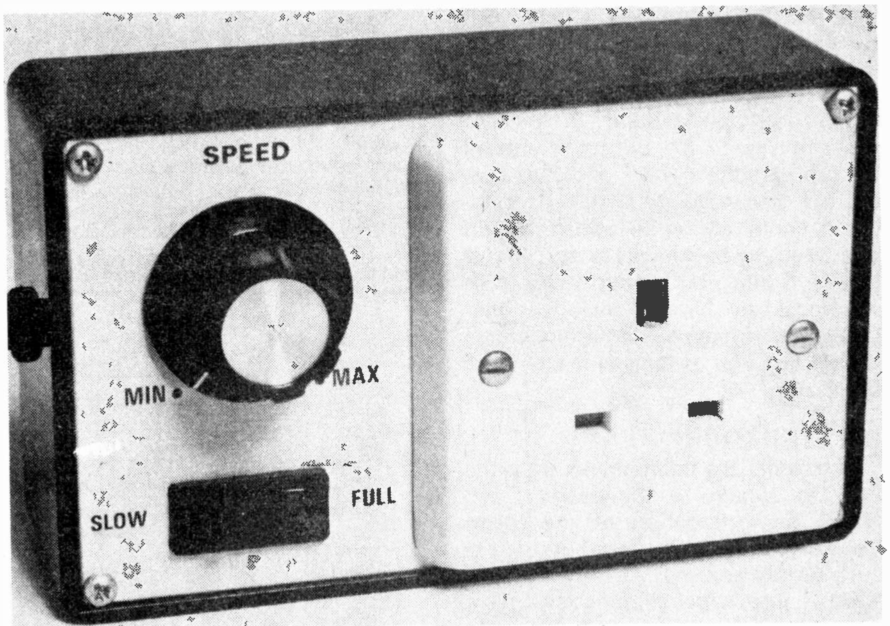
PCB Overlay For The Function Generator





PCB Foil Pattern — Full Size

DRILL SPEED CONTROLLER



IF YOU'VE EVER HAD TO USE your drill for anything but holes in aluminium panels, you will know how useful a speed controller is! Masonry bits need a very slow speed to be effective (they work at high speed, but not for very long); wood drills need a medium speed (too fast and the wood bursts into flames!); metalwork usually needs the full speed but better control can be obtained with the exact speed for the drill/bit combination.

The circuit used is not the most sophisticated available but it is reliable and cheap. As mains voltages are involved in all parts of the circuit, extreme care should be taken, when constructing, to make sure nothing can come loose or touch anything it shouldn't. Also all exposed metalwork *must* be connected to mains earth.

Because of the simplicity of the circuit, some juddering may occur at low speed. Inserting capacitor C1 across RV1 will reduce this effect, however, the torque will be slightly reduced. The value of C1 can be from 1uF to 4uF (63 VWG at least).

How it works

The silicon-controlled rectifier conducts in one direction only, and then only when it has a voltage at its gate. This triggering signal is provided by the voltage from RV1 wiper rising enough to forward bias D2. Hence RV1 provides the trigger at different parts of the mains cycle, so turning on the SCR for different amounts of time according to its setting - hey presto: speed control!

As the back EMF from the motor tends to reverse bias D2, this affects the trigger point as well. In fact at low speeds the motor back EMF is lower, and so the gate voltage is higher, providing earlier triggering - more power. This to some extent compensates for excessive loading of the drill. Switch SW1 bypasses the SCR to give full speed.

CONSTRUCTION

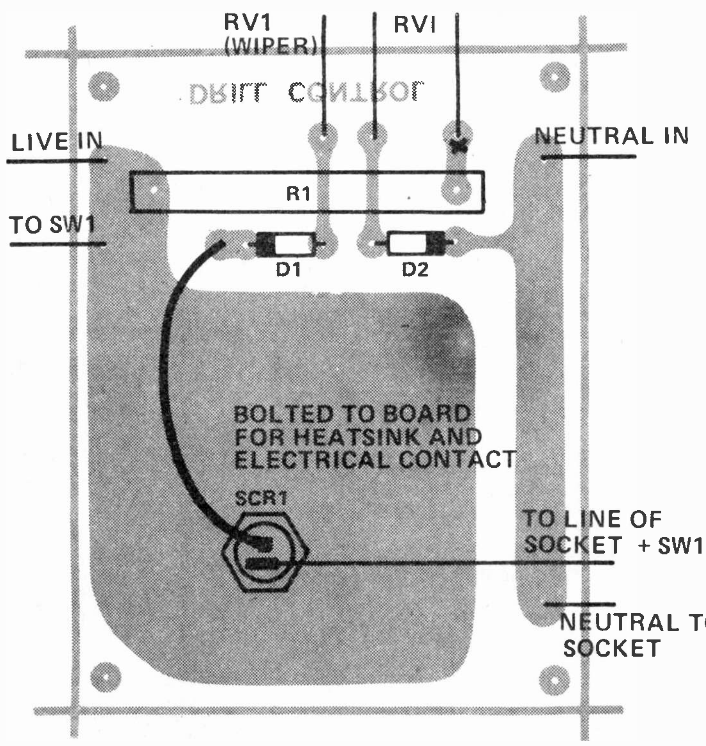
We used a PCB as this ensures that the parts can't move around (very dangerous at mains voltage), also the SCR uses it as a small heatsink. A 13 amp socket was used as the prototype as this gives maximum flexibility - however, your drill could be wired straight in if you intend to use the same drill all the time.

R1 is specified as a 10W device. Don't use one with lower rating as it will get very hot - as rated it gets warm so keep all wires away from it.

If C1 is used, make sure it's positive side is connected to R1 (point X on PCB overlay), otherwise it will self-destruct!

SCR1 is bolted to the PCB and must make electrical contact with the copper side, which also acts as a heatsink. Because of this, the PCB *must* be mounted on insulating pillars.

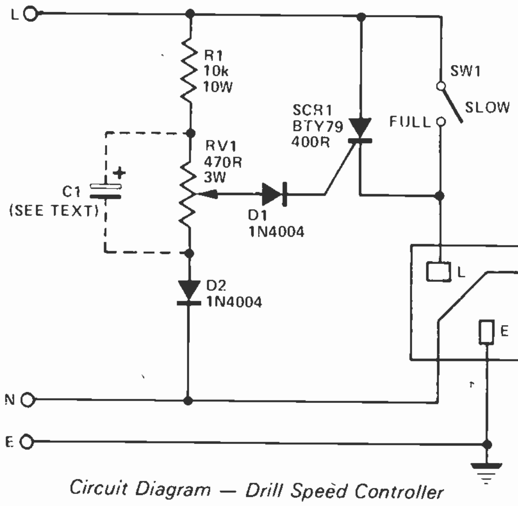
A 3 amp fuse should be fitted to the controller's mains plug to protect the circuit from any faults in the drill.



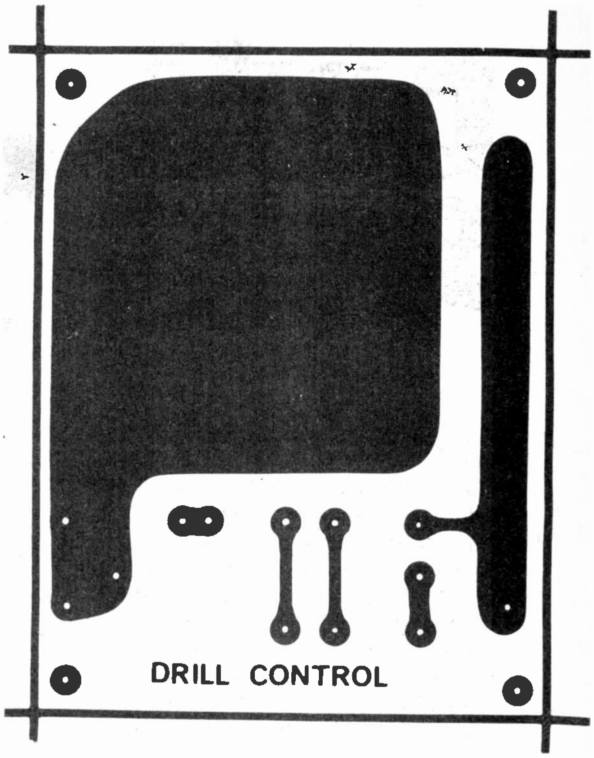
Component overlay for Speed Controller

Parts List

RESISTORS:		MISCELLANEOUS:	
R1	10k 10W wire wound	SW1	Single pole on/off 240V 5A
RV1	470R 3W wire wound	Case	6 x 3½ x 2in. 155 x 94 x 50mm.
CAPACITOR:		3-pin mains outlet to suit	
C1	See text	3-core mains cable	
SEMICONDUCTORS:		PC board, spacers, nuts, bolts, etc.	
D1, D2	1N4004	Cable grommet, clip, knob.	
SCR1	BTY79/400R or similar (6A 400 PIV)	Cost around £6.00.	



Circuit Diagram — Drill Speed Controller



Speed Controller — Foil Pattern — shown full size.

ELECTRONICS —it's easy! PART 37

Memory and microprocessors

PERIPHERAL MEMORY

THE STORAGE MEDIA LISTED previously gives high-speed rapid access but all are expensive. Many other and cheaper forms of storage can be used if short access time requirements are relaxed.

Magnetic Tape — This is basically the same as reel-to-reel domestic tape recording, magnetic tape storage used in computing however records digital rather than analogue data on the magnetic coating of the tape. Reels are generally 10.5 inch in diameter with multiple track use. They are run at much greater speeds than domestic units. They can store around 30 bits per millimetre and maybe run as fast as 25 metres/second. Speeds used are not standardised to any degree. Each track on the tape can only be accessed serially: to obtain a specific data word may involve the whole tape being run through with subsequently long access time. Figure 1 shows a typical reel-to-reel unit.

Magnetic Disks — These are thin disks coated with magnetic recording material. Their advantage is that they can be accessed at any point on the surface by moving the read in read out head to the appropriate part of the disk, as the disk rotates, (at speeds of 3000 r.p.m.). In an alternative procedure the reading is done by a fixed head for each track. Each track may store 36 000 bits. The moving head disk storage unit shown in fig.2 can store up to 7.5 million words.

Even greater storage is obtained by permanently stacking as many as 72 disks on top of each other on a common drive spindle. Each surface has its own head giving access to any part of any surface. Such a unit could store 600 million words. Access time is, however, limited by mechanical response times — typically 100-300 ms. Small interchangeable disk stacks are also used. These are known as disk packs. Floppy disks are a variation of the disk memory.

Fig.1. The Hewlett-Packard 7970 magnetic tape unit designed as a peripheral to EDP systems.

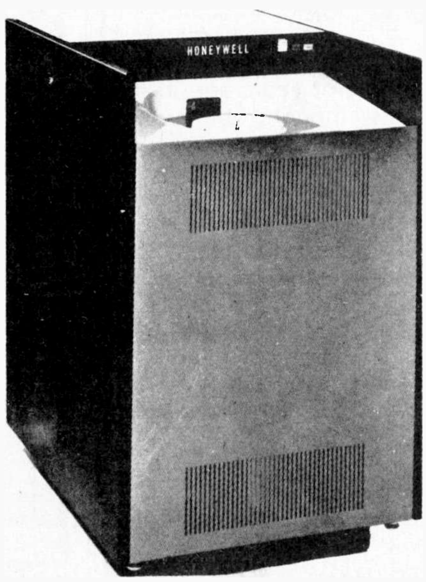


Fig.2. Honeywell model 4720 moving-head disk storage device.

Magnetic Drums — Where better access times than disks are needed, but not at the cost of magnetic core, the magnetic drum may be suitable. A large drum (0.3-0.6 m in diameter) coated with magnetic material rotates continuously at high speed. Reading heads are stacked up the drum. Access time with these is as low as 5 ms. Storage is upward of 2000 million characters.

Other magnetic arrangements include short strips of tape that are individually selected to be drawn through a reading head, and magnetic cards which are held in magazines ready for automatic sorting in a special console. Card systems are not as slow as might be thought — any one of, say, 500 million characters can be accessed in 100 ms by a suitable design arrangement.

MICROPROCESSORS

We saw in the previous part that computers are based upon the availability of a CPU, stores, input/output units and other peripherals. Integrated circuit manufacturing methods become economical only when very large volume sales result and it was to the computing systems market that the IC makers looked around 1970. The main problem, however, was the need to devise a basic general-purpose integrated-circuit that would satisfy a large enough group of users.

At first the trend was to manufacture special-purpose computing systems that were hardwired (connections made permanently) to cause the system to perform a stated computing function — such as a pocket calculator for commercial or scientific computation.

The trend then moved toward another philosophy — the microprocessor. These single card integrated-circuit systems (one is illustrated in Fig.3) possess the ability to be programmed to perform the task needed by the customer. Although the overall system is usually more complex than hardwired specials, the much greater increase in demand has reduced the price to quite unbelievable levels — a few hundred pounds buys a complete basic micro-processor system with as much power as the minis of a decade ago. Predictions, at present, are that they could fall further to a mere £5.00.

To make a microprocessor system, the user has to write a software program at a basic machine-language level. Each microprocessor has its own instruction set built in — this tells the system what to do with data. It is written in mnemonic code using code letters to denote operations — such a list is given in Fig.4.

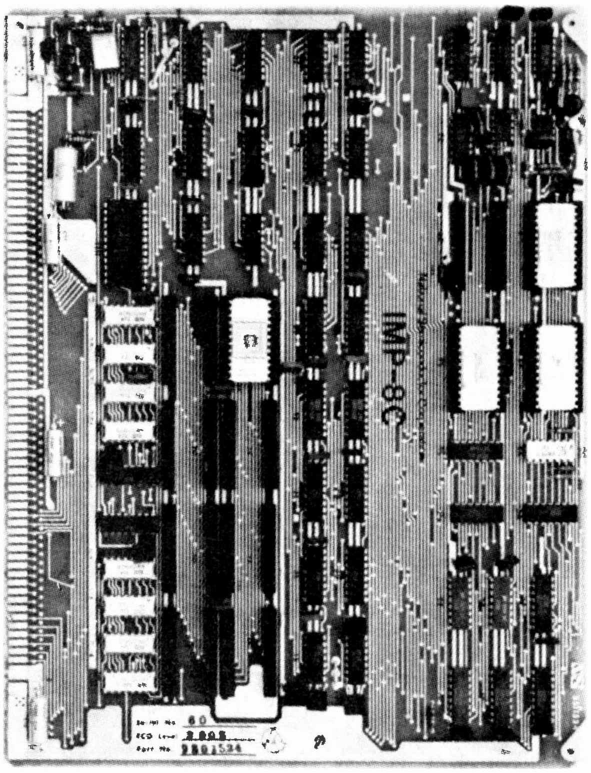


Fig.3. This National Semiconductor IMP-8C general purpose processor uses MOS/LSI devices.

ABA	Add Accumulators	INS	Increment Stack Pointer
ADC	Add with Carry	INX	Increment Index Register
ADD	Add		
AND	Logical And	JMP	Jump
ASL	Arithmetic Shift Left	JSR	Jump to Subroutine
ASR	Arithmetic Shift Right		
		LDA	Load Accumulator
BCC	Branch if Carry Clear	LDS	Load Stack Pointer
BCS	Branch if Carry Set		
		LDX	Load Index Register
BEQ	Branch if Equal to Zero	LSR	Logical Shift Right
BGE	Branch if Greater or Equal Zero		
BGT	Branch if Greater than Zero	NEG	Negate
BHI	Branch if Higher	NOP	No Operation
BIT	Bit Test		
BLE	Branch if Less or Equal	ORA	Inclusive OR Accumulator
BLS	Branch if Lower or Same		
BLT	Branch if Less than Zero	PSH	Push Data
BMI	Branch if Minus	PUL	Pull Data
BNE	Branch if Not Equal to Zero		
BPL	Branch if Plus	ROL	Rotate Left
BRA	Branch Always	ROR	Rotate Right
BSR	Branch to Subroutine	RTI	Return from Interrupt
BVC	Branch if Overflow Clear	RTS	Return from Subroutine
BVS	Branch if Overflow Set	SBA	Subtract Accumulators
CBA	Compare Accumulators	SBC	Subtract with Carry
CLC	Clear Carry	SEC	Set Carry
CLI	Clear Interrupt Mask	SEI	Set Interrupt Mask
CLR	Clear	SEV	Set Overflow
CLV	Clear Overflow	STA	Store Accumulator
CMP	Compare Index Register		
		STS	Store Stack Register
COM	Complement	STX	Store Index Register
CPX	Compare Index Register	SUB	Subtract
		SWI	Software Interrupt
DAA	Decimal Adjust		
DEC	Decrement	TAB	Transfer Accumulators
DES	Decrement Stack Pointer	TAP	Transfer Accumulators to Condition Code Reg.
DEX	Decrement Index Register	TBA	Transfer Accumulators
		TPA	Transfer Condition Code Reg. to Accumulator
EOR	Exclusive OR	TST	Test
		TSX	Transfer Stack Pointer to Index Register
INC	Increment	TXS	Transfer Index Register to Stack Pointer
		WAI	Wait for Interrupt

Fig.4. Typical microprocessor instruction set.

ELECTRONICS–it's easy!

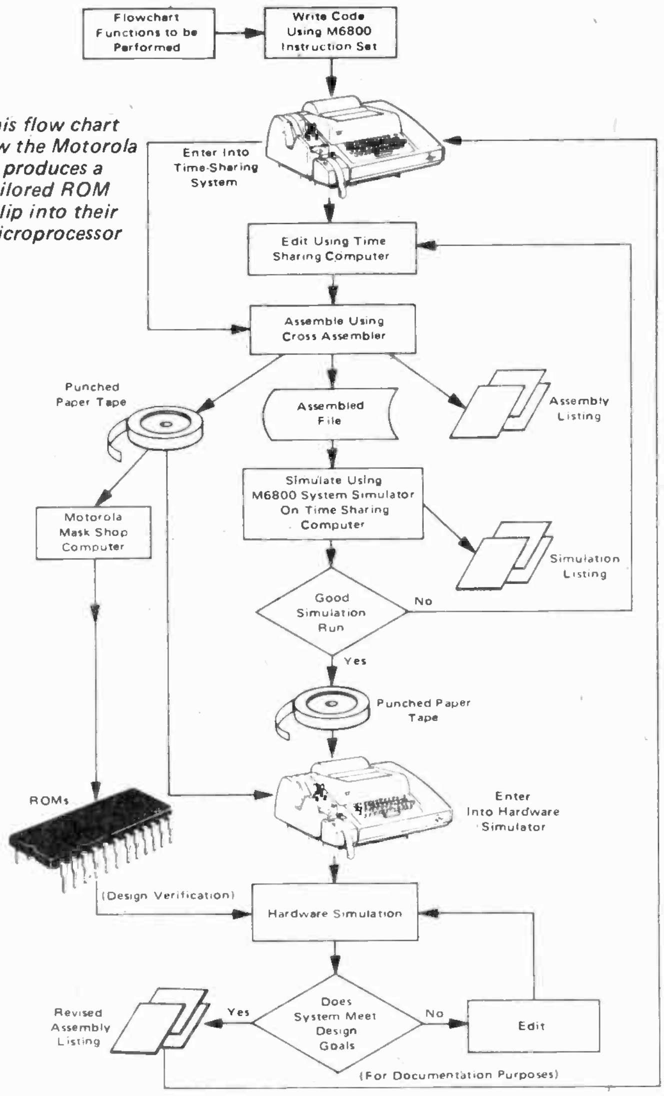


Fig.5. This flow chart shows how the Motorola Company produces a custom-tailored ROM ready to slip into their M6800 microprocessor system.

The program, thus written in mnemonic code, is further translated into the circuit binary form (object code) with an assembler. The object form of code is then ready to be fed into the Random Access Memory (RAM) or Read Only Memory (ROM) of the microprocessor system. Figure 5 shows a system design and verification procedure used to produce custom made ROMs. The peripherals are then interfaced to the unit and the complete computing system is ready to go.

The process may sound easy, but as can be imagined considerable skill is needed to set up a microprocessor. Such skill demands extensive customer training material — large handbooks, application and hardware — see Fig.6. In fact the stage has been reached where makers will soon have to face a situation where descriptive literature is as expensive or more expensive than the hardware itself. To this end they continually strive to reduce the complexity and to standardise design. We should soon be in the position where microprocessors are sold as standard tools which are each used in exactly the same way to service the enormous number of custom jobs available. Literature may degenerate to a short-form pamphlet. The actual computing part of an Everyman's Complete Microprocessor System is a very small part of the whole. Peripherals and software are now the major cost consideration. It is not feasible to describe microprocessors more fully in this series.

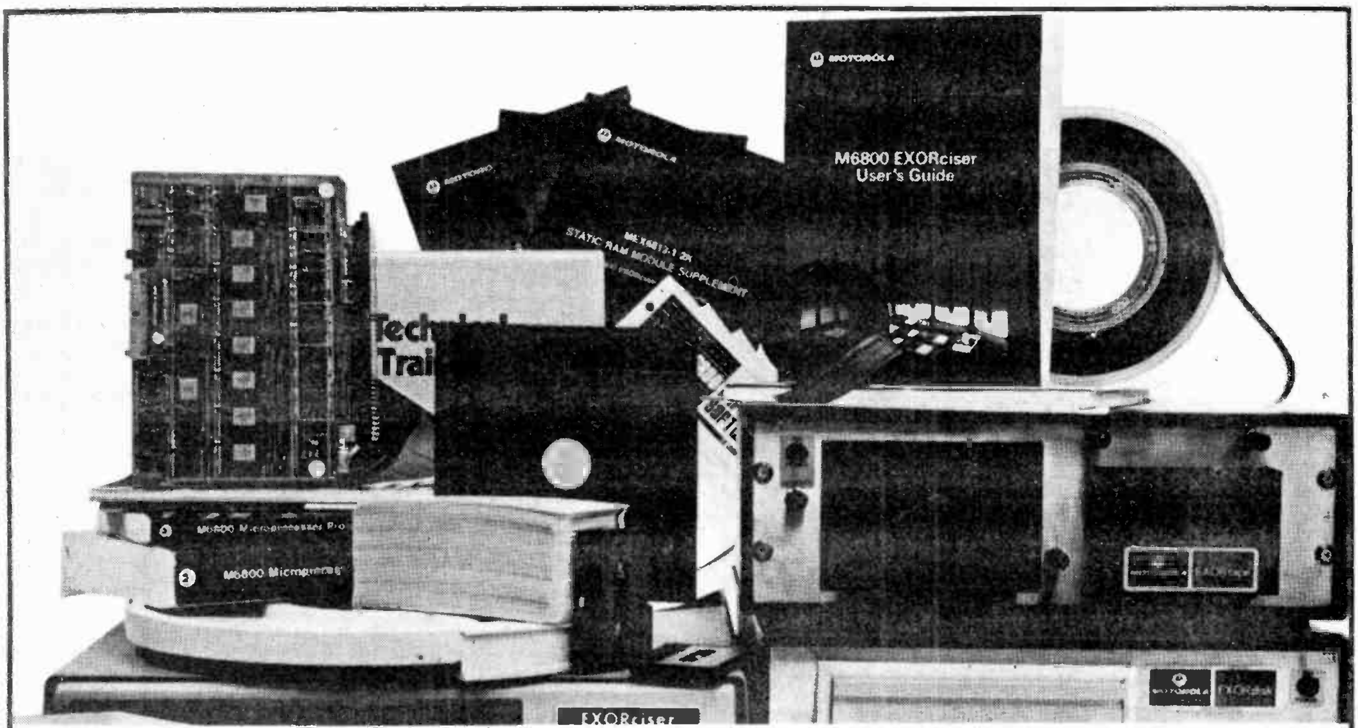


Fig.6. Array of support products for Motorola M6800 microprocessor systems.

Further reading — References listed in the previous part provide descriptions and illustrations of computer peripherals and storage methods. "Computers at Work" by J.O.E. Clark, Bantam Books, is a worthwhile discussion on how and where computer interfaces are used for all manner of needs.

Infotech International of Maidenhead, have recently released 12,000 pages of state-of-the-art reports on computer operation and trends. They are, however, much too expensive for the reader to procure. The sets cost over £1,000 on an individual basis!

The subject of microprocessors has recently been discussed in depth in several electronics publications — Electronics Today International and Wireless World have each run introductary series. "Development and Trends of the Microprocessor by J. Tobias is an extensive study and it concludes a summary chart of dozens of systems offered.

"Microprocessors — an Introduction" by F. Horne, NS Application Note AN114, 1974, is a basic statement.

"Microprocessors — Why They Evolved and What They Are" by M. Levi, N.S. Imp Brief 1, 1974, is also useful as a starting point.

"New Blocks for the Computer Builder" by D. Aspinall, New Scientist, 18 September, 1975 gives a basic survey including some facts about production. An extensive self-contained introduction is "Introduction to Microprocessors", H. Tireford, Motorola Semiconductor Products, 1975.

Manufacturers of microprocessors will freely supply descriptive data to aid the user of their own style of unit. ●

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2N697	0.30	2N3705	0.15	40363	1.20	BC167	0.12	BD136	0.37	BFY50	0.34
2N698	0.62	2N3706	0.16	40406	0.58	BC168	0.12	BD137	0.38	BFY51	0.38
2N699	0.55	2N3707	0.18	40407	0.45	BC169	0.12	BD138	0.38	BFY52	0.36
2N706	0.24	2N3708	0.16	40408	0.65	BC170	0.16	BD139	0.40	BFY53	0.34
2N706A	0.12	2N3709	0.18	40409	0.65	BC171	0.14	BD140	0.40	BFY90	1.37
2N708	0.21	2N3710	0.16	40410	0.65	BC172	0.12	BD239	0.40	BRY39	0.50
2N709	0.50	2N3711	0.18	40411	2.85	BC177	0.20	BD240	0.45	BSX20	0.31
2N718	0.27	2N3712	1.20	40594	0.75	BC178	0.20	BD241	0.45	BSX21	0.32
2N718A	0.50	2N3713	2.30	40595	0.85	BC179	0.23	BD242	0.47	BU105	1.50
2N720A	0.80	2N3714	2.45	40673	0.73	BC182	0.11	BD243	0.60	BU205	2.20
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2N916	0.30	2N3716	2.80	AC127	0.44	BC183	0.11	BD245	0.65	ME0404	0.15
2N918	0.38	2N3771	1.85	AC128	0.37	BC183L	0.14	BD246	0.66	ME0412	0.20
2N929	0.25	2N3772	2.00	AC151V	0.35	BC184	0.12	BD529	0.42	ME4102	0.10
2N930	0.26	2N3773	2.90	AC152V	0.50	BC184L	0.14	BD530	0.47	ME4104	0.10
2N1131	0.60	2N3789	2.90	AC153	0.49	BC207	0.12	BDY20	1.13	MJ480	1.35
2N1132	0.60	2N3790	3.10	AC153K	0.55	BC208	0.11	BF115	0.38	MJ481	1.55
2N1613	0.35	2N3791	3.10	AC176	0.40	BC212	0.14	BF117	0.70	MJ490	1.35
2N1711	0.37	2N3792	3.50	AC176K	0.60	BC212L	0.17	BF121	0.55	MJ491	1.85
2N1893	0.38	2N3794	0.20	AC187K	0.55	BC213	0.14	BF123	0.55	MJ2955	1.25
2N2102	0.60	2N3819	0.36	AC188K	0.55	BC218L	0.16	BF152	0.25	MJE340	0.58
2N2218	0.33	2N3820	0.38	AD161	0.85	BC214	0.16	BF153	0.25	MJE370	0.58
2N2218A	0.37	2N3823	0.75	AD162	0.85	BC214L	0.17	BF154	0.25	MJE371	0.60
2N2219	0.30	2N3904	0.21	AF106	0.55	BC237	0.14	BF159	0.35	MJE520	0.45
2N2219A	0.32	2N3906	0.22	AF109	0.75	BC238	0.12	BF160	0.30	MJE521	0.65
2N2220	0.35	2N4036	0.67	AF124	0.65	BC239	0.15	BF161	0.60	MJE2955	1.40
2N2221	0.22	2N4037	0.55	AF125	0.65	BC251	0.15	BF166	0.40	MJE3055	0.85
2N2221A	0.26	2N4058	0.20	AF126	0.65	BC253	0.22	BF167	0.38	MP8111	0.35
2N2222	0.25	2N4059	0.20	AF127	0.65	BC257A	0.17	BF173	0.38	MP8112	0.40
2N2222A	0.25	2N4060	0.20	AF139	0.69	BC258A	0.17	BF177	0.30	MP8113	0.45
2N2368	0.25	2N4061	0.17	AF186	0.50	BC259B	0.18	BF178	0.35	MPF102	0.30
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2N2906A	0.25	2N5191	0.70	BC115	0.19	BC317	0.14	BF196	0.14	TIP29A	0.45
2N2907	0.21	2N5192	0.75	BC116	0.19	BC318	0.12	BF197	0.17	TIP30A	0.49
2N2907A	0.22	2N5195	0.90	BC116A	0.20	BC327	0.20	BF198	0.18	TIP31A	0.50
2N2924	0.15	2N5245	0.35	BC117	0.22	BC328	0.19	BF200	0.35	TIP32A	0.50
2N2926	0.13	2N5294	0.40	BC118	0.16	BC337	0.19	BF225J	0.25	TIP33A	0.80
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2N3393	0.15	2N5459	0.29	BC141	0.45	BCY34	1.20	BF459	0.45	TIP32c	0.75
2N3394	0.15	2N5484	0.34	BC142	0.30	BCY38	2.00	BFR39	0.28	TIP33c	1.10
2N3439	0.88	2N5486	0.38	BC143	0.30	BCY42	0.60	BFS21A	2.60	TIP34c	1.20
2N3440	0.64	2N6027	0.53	BC147	0.12	BCY58	0.25	BFS28	1.04	TIP41c	0.85
2N3441	0.85	2N6101	0.65	BC148	0.12	BCY59	0.25	BFS61	0.30	TIP42c	0.95
2N3442	1.35	2N6107	0.42	BC149	0.13	BCY70	0.25	BFS98	0.27	TIP2955	0.65
2N3638	0.16	2N6109	0.42	BC153	0.27	BCY71	0.26	BFX29	0.38	TIP3055	0.55
2N3638A	0.16	2N6121	0.38	BC154	0.27	BCY72	0.24	BFX30	0.40	TIS43	0.30
2N3639	0.30	2N6122	0.41	BC157	0.12	BD115	1.20	BFX84	0.40		
2N3641	0.20	2N6123	0.43	BC158	0.11	BD116	1.20	BFX85	0.41		
2N3702	0.17	2N6126	0.45	BC159	0.14	BD131	0.51	BFX87	0.40		
2N3703	0.15	40361	0.45	BC160	0.50	BD132	0.54	BFX88	0.40		

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CA3028B	1.29	LM3900	0.75	TAA930B	1.05
CA3030	1.24	LM3905	1.60	TAD100	1.95
CA3030A	1.89	LM3909	0.68	TBA120	0.65
CA3045	1.40	MC1035	1.75	TBA400	1.50
CA3046	0.89	MC1303	1.47	TBA500	2.21
CA3048	2.23	MC1304	1.85	TBA500Q	2.30
CA3049	1.66	MC1305	1.85	TBA510	2.21
CA3052	1.62	MC1306	1.00	TBA510Q	2.30
CA3053	0.60	MC1310	1.91	TBA520	2.21
CA3080	0.68	MC1312	1.98	TBA520Q	2.30
CA3080A	1.88	MC1327	1.54	TBA530	1.98
CA3086	0.51	MC1330	0.92	TBA530Q	2.07
CA3088	1.59	MC1350	0.75	TBA540	2.21
CA3089	2.52	MC1351	1.20	TBA540Q	2.30
CA3090	3.80	MC1352	0.97	TBA550	3.13
CA3130	0.94	MC1357	1.45	TBA550Q	3.22
LM301A	0.65	MC1458	0.91	TBA560Q	3.22
LM3D1N	0.44	NE555	0.53	TBA570	1.29
LM3D4	2.45	NE556	1.05	TBA570Q	1.38
LM307N	0.65	NE565	1.20	TBA641B	2.50
LM308C	1.82	NE566	1.65	TBA651	1.80
LM308N	1.17	NE567	1.80	TBA700	1.52
LM309K	2.10	SAS560	2.50	TBA700Q	1.61
LM317K	3.00	SAS570	2.50	TBA720Q	2.30
LM318N	2.25	76001N	1.57	TBA750	1.98
LM323K	6.40	76003N	2.55	TBA750Q	2.07
LM339N	1.75	76008K	2.50	TBA800	1.20
LM348N	1.91	76013N	1.70	TBA810	1.16
LM360N	2.75	76013ND	1.57	TBA820	1.03
LM370N	3.00	76018K	2.50	TBA920	1.79
LM371N	2.25	76023ND	1.57	TBA920Q	2.99
LM372N	2.15	76033N	2.55	TBA940	1.62
LM373N	2.25	76110N	1.46	TCA160C	1.85
LM374N	2.25	76114N	1.87	TCA160B	1.61
LM377N	1.75	76116N	2.06	TCA270	2.25
LM378N	2.25	76131N	1.30	TCA280A	1.30
LM379N	3.95	76226N	1.94	TCA290A	3.13
LM380-8	0.90	76227N	1.51	TCA420A	1.84
LM380N	0.98	76228N	1.75	TCA730	3.22
LM381A	2.45	76530N	0.91	TCA740	2.76
LM381N	1.60	76532N	1.50	TCA750	2.30
LM382N	1.25	76533N	1.30	TCA760	1.38
LM384N	1.45	76544N	1.44	TCA800	3.13
LM386N	0.80	76545N	2.09	UAA170	2.00
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LM389N	1.00	76552N	0.65		
LM702C	0.75	76570N	2.08		
LM709C	0.65	76620N	1.10		
LM709N	0.45	76650N	1.10		
LM710C	0.60	76660N	0.60		
LM710N	0.60	76666N	0.92		
LM723C	0.85	TAA301A	1.50		
LM723N	0.75	TAA320A	1.15		
LM741C	0.65	TAA350A	2.48		
LM741N	0.50	TAA521	1.00		
LM741-8	0.40	TAA522	1.90		
LM747N	0.90	TAA550	0.60		
LM748-8	0.50	TAA560	1.60		
LM748N	0.50	TAA570	2.30		
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CD4012	0.24	CD4028	1.02	CD4511	1.79
CD4013	0.64	CD4029	1.30	CD4516	1.56
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SN7408	0.29	SN7430	0.21	SN7451	0.21	SN7481	1.10	SN7495	0.78	SN74150	1.66	SN74167	3.70	SN74197	1.17
SN7409	0.29	SN7432	0.39	SN7453	0.21	SN7482	0.67	SN7496	1.03	SN74151	1.11	SN74174	1.52	SN74198	2.93
SN7410	0.21	SN7437	0.55	SN7454	0.21	SN7483	1.33	SN74100	1.15	SN74153	1.11	SN74175	1.35	SN74199	2.93

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METAL FILM RESISTORS

PART 8

Following the last article on carbon film resistors this part now looks at metal film types. Next month we will continue with resistors by looking at metal glaze and wire-wound types and potentiometers.

THESE RESISTORS ARE MUCH THE same in appearance and size to desposited-carbon resistors. The resistive film is deposited on a ceramic or glass former by evaporating a metal or alloy in a vacuum, the metal condenses on the surface of the former, forming a hard, dense film. Nickel-chrome alloys are most commonly used. Some manufacturers use a chemical deposition process to coat a former with a nickel alloy. Packaging and protection for metal film resistors is similar to carbon film resistors.

The temperature coefficient of these resistors is superior to most other types with the exception of precision wirewound resistors. The TC is typically ± 100 ppm/°C but they are available with a TC as low as ± 20 ppm/°C. The construction of these resistors makes it possible to supply them in controlled values of temperature coefficient over a wide range of values. Typical TC ranges for such types are as follows:—

0 ± 50 (ppm/°C)	0 + 50 (ppm/°C)
0 ± 100 "	0 + 100 "
0 ± 150 "	0 – 50 "
0 ± 200 "	0 – 100 "

The thickness of the film establishes the resultant temperature coefficient. This is positive for thick films; the magnitude decreasing with decreasing film thickness, passing through zero and then turns negative for thin films.

The noise level of metal film resistors is very low, being typically 0.015 μV/V which is only rivalled by metal-glaze resistors. However, wirewound resistors are superior to all the others.

Stability of these resistors under ordinary use is generally better than 0.2% which is only bettered by precision wirewound resistors. As a consequence, metal film resistors are available in tolerances as low as ± 0.25% and ± 0.5%. Generally they are available in tolerances of ± 1%, ± 2% and ± 5%.

Some types of metal film resistors are available in hermetically sealed glass envelopes. The envelope is filled with helium and this type of construction permits a substantial increase in rating. Operation at ambient temperatures as high as 150 to 200 °C at full ratings and up to 250 °C at one third rating is possible. These types also have stability equivalent to precision wirewound resistors.

Most types of metal film resistors have a hot-spot temperature of 150 or 155 °C and are derated from 100% load rating at 70 °C ambient. The derating curve is given in Figure 2. Miniature tenth watt and eighth watt metal film resistors produced by some manufacturers may have a hot-spot temperature of only 125 °C, but are still derated from 70 °C as shown in Figure 3. Mil-spec types are rated for full load operation to either 120 or 125 °C and may have a hot-spot temperature of 170 °C or as high as 200 °C from some manufacturers. Two typical derating curves are shown in Figure 4.

STABLE COMPANION

In general, metal film resistors offer all the advantages of deposited-carbon film resistors as well as exhibiting much superior stability and temperature coefficient characteristics. They generate much lower noise in operation than most other types of resistors. Frequency characteristics are much the same as for carbon film resistors, the construction being largely the same. Metal film resistors are available in wattage ratings from 0.1W to 1W, generally, but higher power types are available.

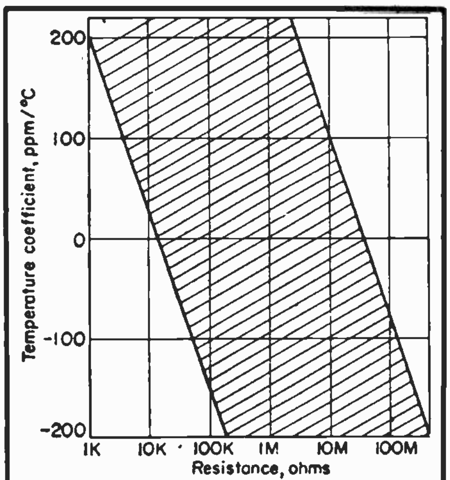

Fig. 1. Range of temperature coefficients available for various values of metal film resistors having controlled TC characteristics.

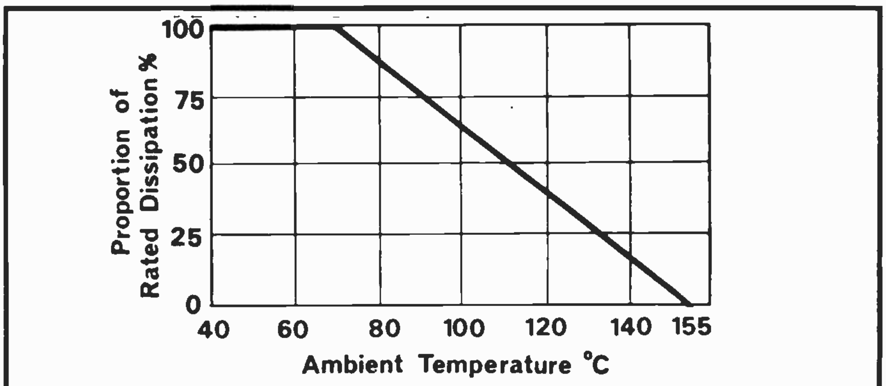

Fig. 2. Derating curve for common metal film resistors. It also applies to metal oxide film resistors up to 1W rating.

Rated Wattage @ 70 °C	Max. Working Voltage	Max. Operating Temp.	Critical Resistance	Typical Sizes Length	Diameter	Typical Resistance Ranges Metal Film	Metal Oxide Film
0.125 W	200 V	125/155 °C	0.25 M	6.8 mm	2.3 mm	20 Ω – 300 k	10 Ω – 270 k
0.25 W	250 V	125/155 °C	0.36 M	10.3 mm	4.3 mm	0.47 Ω – 9.9 Ω	10 Ω – 360 k
0.25 W	250 V	155 °C	0.36 M	9 mm	2.8 mm	20 Ω – 560 k	10 Ω – 270 k
1 W	350 V	230 °C	0.12 M	12 mm	5.5 mm	0.47 Ω – 10 Ω	
1 W	350 V	230 °C	0.12 M	12 mm	4 mm		0.39–13 Ω/15 Ω–22 k
2 W	350 V	230 °C	56 k	15 mm	5.5 mm		0.47–27 Ω/30 Ω–100 k
3 W	500 V	230 °C	82 k	24 mm	8 mm		0.47–27 Ω/30 Ω–100 k
3 W	600 V	250 °C	12 M	22 mm	8 mm □		1 k – 100 k
5 W	750 V	230 °C	11 M	40 mm	8 mm		1–27 Ω/ 30 Ω–100 k
7 W	750 V	230 °C	82 k	52 mm	8 mm		1–27 Ω/ 30 Ω–150 k

(1) Rated Wattage assumes voltage limit not exceeded.
(2) Max. Working Voltage assumes wattage rating not exceeded.
(3) Max. Operating Temperature is equal to hot-spot temperature.
(4) Sizes given are body sizes for axial-lead types.

TABLE 3. General characteristics of Metal Film and Metal Oxide Film Resistors

Metal film resistors are mostly used in applications where reliability, close tolerance and high stability are required or where controlled temperature characteristics are called for. They are generally somewhat more expensive than composition or deposited carbon film resistors but the price differential is decreasing as their use becomes more widespread.

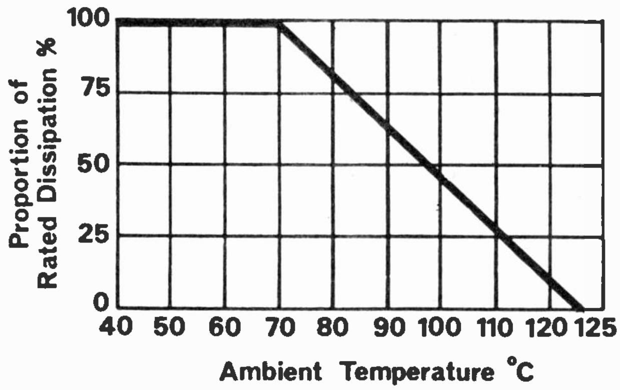

Fig. 3. Derating curve for some types of miniature 1/10 W, 1/8 W and 1/4 W metal film resistors.

METAL OXIDE FILM RESISTORS

In this class of film resistor conducting oxides of tin and antimony are formed on a glass or ceramic rod which is at red heat. The chemical reaction produces hard, glass-like oxide on the surface of the former. The oxide film is conductive and is inert to common chemicals. The resistance value required is obtained by cutting a helical groove in the film, along the former, as explained in the last section. General construction and terminations are similar to the other film resistors. The resistive element is usually coated with a flame-proof epoxy material.

The noise and temperature coefficient characteristics do not vary widely with resistance value, these resistors being superior in this respect than deposited-carbon film resistors. The noise is generally around 0.03 μV/V and may be as low as 0.02 μV/V. The TC of common types is generally ± 250 ppm/°C but may be as low as ± 50 ppm/°C. As the film is of a semiconductive nature, the TC may be either positive or negative. The limits of precision in controlling the composition of the film produces resistors which have a positive TC over a certain range of values, and a negative TC over a different range of values.

Stability of metal oxide film resistors is better than 0.5% which is better than composition or carbon film resistors but not quite as good as metal film resistors. However, this is better than most commercial grade wirewound resistors. With a stability of the order quoted, metal oxide film resistors are available in tolerances of ± 1%, ± 2%, and ± 5%.

The general characteristics of metal oxide resistors are similar to deposited-carbon film and metal film resistors. They are rated for full load operation to 70 °C for all types. The hot-spot temperature for types up to 1W rating is

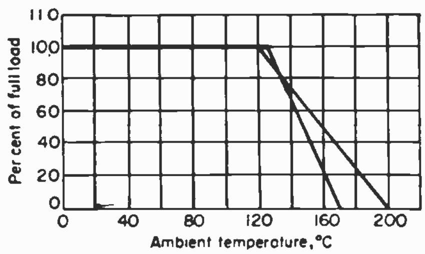

Fig. 4 Two typical derating curves from different manufacturers for Mil-spec metal film resistors.

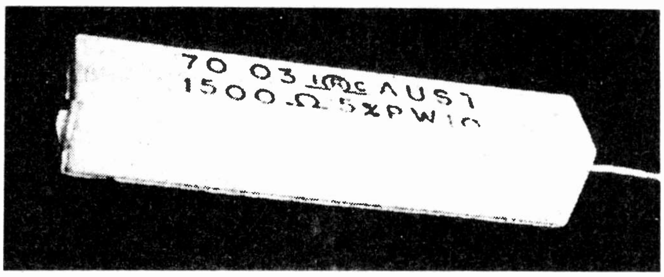

Fig. 5. Square section, 'ceramic boat' style medium power film resistor.

METAL FILM RESISTORS

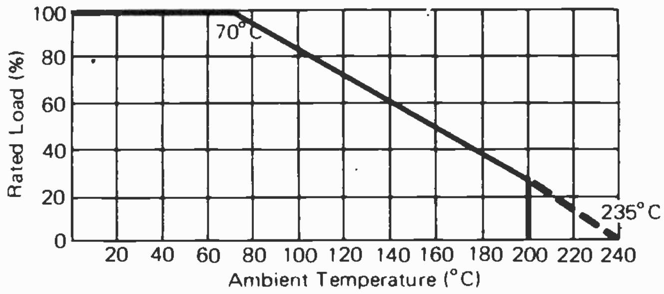

Fig. 6 Derating curve for cylindrical style metal oxide film resistors with ratings between 1 W and 7 W.

generally 150–155 °C and the derating curve is the same for common metal film resistors, as shown in Figure 2.

HOT SPOTS

The particular characteristics of metal oxide film resistors enables them to be made in wattage ratings up to 7 W in the standard axial-lead type of construction. However, much higher power types are produced. Standard ratings above 1 W are 2, 3, 5 and 7 watts, in axial-lead cylindrical styles and 3, 4 and 10 watts in the square-section 'ceramic boat' style (Figure 5). The derating curve for the cylindrical style is shown in Figure 6. Note that much higher hot-spot temperatures make these resistors useful in high temperature applications. For the square-section style power metal oxide film resistors, the derating curve is given in Figure 7. They have a somewhat higher hot-spot temperature than the cylindrical type.

To be continued . . .

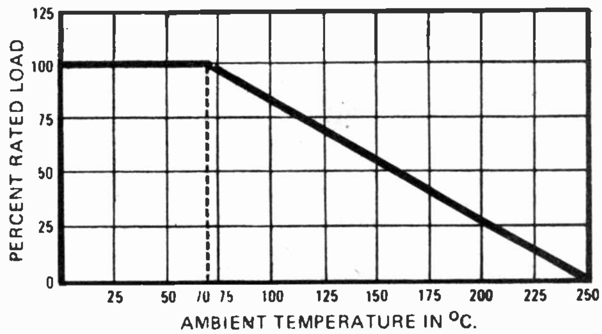

Fig. 7. Derating curve for square-section style power metal oxide film resistors

ELECTRONICS TOMORROW

by John Miller-Kirkpatrick

CONGRATULATIONS TO UNCLE CLIVE on the eventual birth of his two-inch television. At last we can now predict that wrist or pocket TV communications units will soon be with us! (Can I put in my application now for one of the first Citizens Band TV communications licences?) To be a little more serious, now that Sinclair's TV is a reality, and with TIFAX decoders (apparently) now available — will it really be very long before we see a pocket colour Teletext unit? Or at least a small desk Viewdata unit.

MARKETS FOR AMATEURS

A more interesting application from an amateur's point of view is as a small VDU unit for a microprocessor, coupled to a calculator style keyboard (but still in QWERTYUIOP format) and a low current MPU — and you have the basics of a *very* portable microcomputer about the same size as a desk calculator. If Mr Sinclair would like to make his unit available without a tuner section and with a video input somewhere then I think he might be able to sell a few to an unthought of market.

SUNK ON SYNC?

For a VDU project I was working on recently I required a TV sync generator in as few chips as possible. One method is to use a couple of 555 timers or CMOS oscillators at 50Hz and 15KHz and link them to form the required sync signals. This system is rather prone to changes in frequency and thus loss of sync. A more accurate method is to use one master oscillator and divide down to give a line frequency and an interlacing frame frequency signal and then to use these as control signals to the VDU as well as mixed sync. In the latter system you would have to use several counter chips and gating chips with a total package count of about a dozen ICs. With these factors in mind I looked for a single chip solution, and found the Ferranti ZNA134 CCIR/EIA TV synchronising pulse generator. This sixteen pin package had all of the dividers and logic gates required by the accurate method enclosed in one chip. The ZNA134 uses a 2.5625MHz crystal as a reference source to generate all the horizontal, vertical, mixed blanking and synchronising pulses necessary for the raster generation in 525 or 625 line.

ON BENDED KNEE

So I begged and pleaded in the right direction and eventually one arrived on my desk and soon found itself nicely tucked up (with a few other fantastic new ICs) generating a nice warm environment for the crystal. Now there was the problem, crystals of a non-standard frequency are notorious for ten or sixteen week gestation periods, and as a lot of these circuits can be fooled by a capacitor I decided to try a CR oscillator in order to get the chip working. It worked but took a long time to settle down and seemed very prone to changes in frequency at the first hint of a change in temperature or voltage. As it was designed to take a crystal I could see no alternative but to order one. After a couple of ridiculous delivery quotes the kind man at McKnight Crystals came to my rescue (with his 33% surcharge for seven day delivery) — worth remembering if you find yourself in similar circumstances. (The crystal hasn't arrived yet and so I cannot report on the success of the mission.) Ferranti have only made one tiny mistake with this chip and that is their pricing policy.

PRICE OF FAME

The ZNA134 is over £20 in quantities of 1's, 100's and up to 999, only at 1000 off does the price change. It is unlikely that your friendly retailer is going to buy 1000 at a time so if you want to know more about it contact Ferranti direct (phone 061-624 0515). On the other hand, if all you want is a mixed sync signal (you can always separate it) there is a chip on the market from General Instruments which takes a 2MHz oscillator, CMOS with a crystal or LC network, and produces a mixed sync output along with a few other useful outputs. For instance it has a simple seven segment character generator for the display of two two digit counters on the TV, multiple cursor controls which enable the movement of several cursors in two dimensions, a very nice boundary output signal and a rather unique random cursor which can travel to any position on the screen. In addition to the above features there is a signal which can be used as an audio warning device if the random cursor happens to come in contact with some of the variable cursors or if the random cursor should accidentally disappear by managing to cross the line defined by the previously mentioned screenboundary output.

IT'S GAME IF YOU ARE

The application of some of these features in a VDU system is not very clear and the limitation in the numeric only character generator is an unforgivable design fault.

The AY-3-8500 is a reasonable answer to the sync generator problem but I feel that GI should take heed of my advice and continue to sell it mainly as a superb TV games chip!

In this latter form it is possible to make up a portable TV games unit with very few additional components — in fact with only two ICs and about a dozen discretes it gives a video output.

COLOURING IN

When I first started building Teletext decoders about two years ago (none worked) I couldn't understand why you could not display colour on a colour TV by going into the aerial input. If it can be done inside a TV camera why not inside a teletext decoder? Well, whilst Texas have been working on the TIFAX decoder some genius at National Semi has come up with the LM1889 video modulator. This takes in colour signals from TV games and modulates them to produce a signal suitable for injection to the aerial socket of a colour TV set.

Apart from the obvious applications, what happens when you connect up one of these to a synthesiser or even to an audio signal? Your own home light show connected up to your favourite radio programme or recording.

I can see it now, millions of pairs of square eyeballs avidly watching Beethoven's Ninth or Floyd's Dark Side of the Moon.

If you would like one of these modern "come up and see my etchings" devices your first step is to ring NatSemi (0234 211262) and ask for the LM1889. It should be available at reasonable prices in a couple of months. ●

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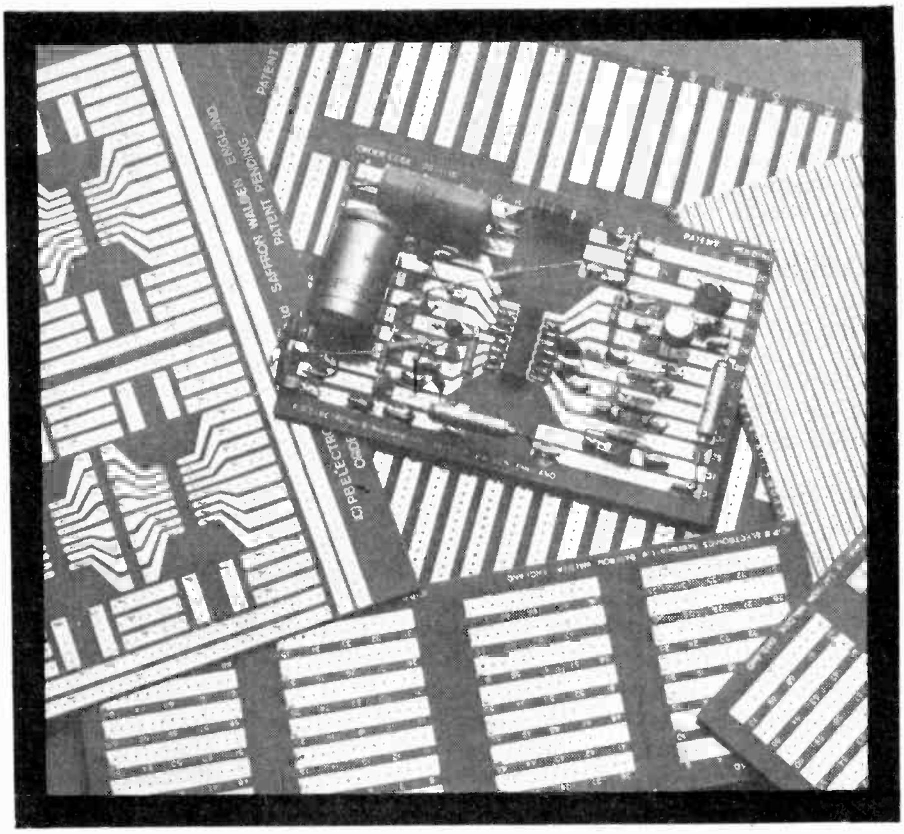

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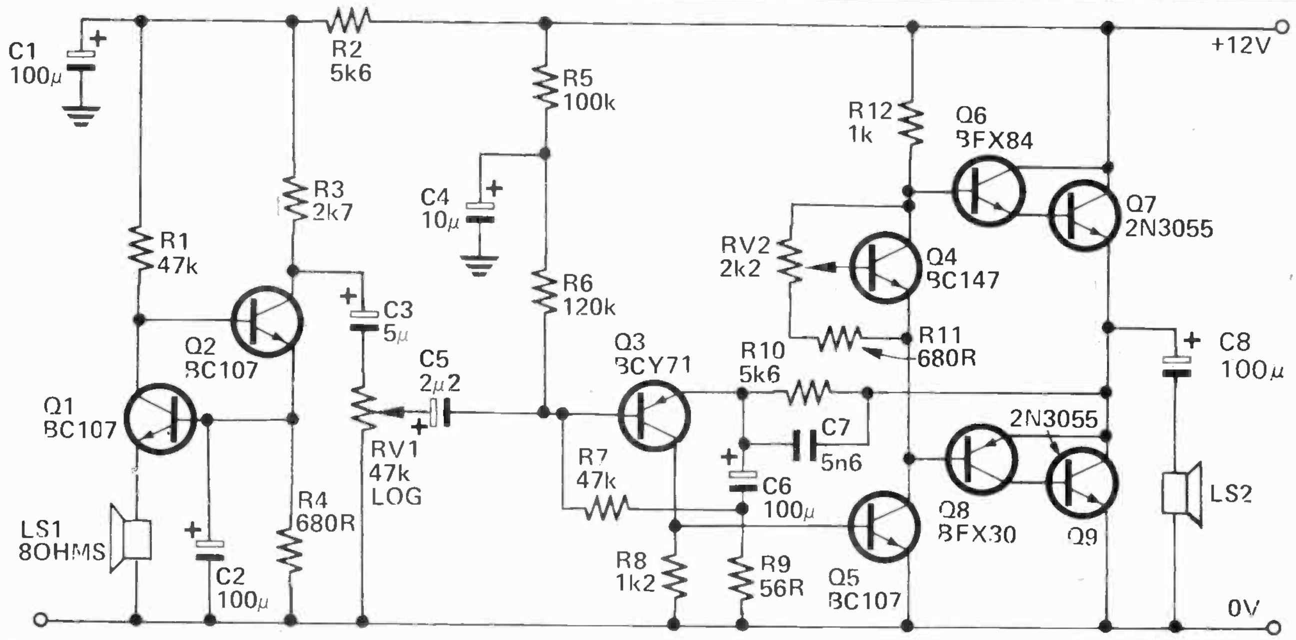
DUE TO PHENOMENAL RESPONSE WE ARE REPEATING THIS OFFER

tech-tips

Tech-Tips is an ideas forum and is not aimed at the beginner. We regret we cannot answer queries on these items.

ETI is prepared to consider circuits or ideas submitted by readers for this page. All items used will be paid for. Drawings should be as clear as possible and the text should preferably be typed. Circuits must not be subject to copyright. Items for consideration should be sent to ETI TECH-TIPS, Electronics Today International, 25-27 Oxford St., London W1R 1RF.



12V P.A. SYSTEM

This circuit was originally built for use in a negative earth car. A miniature speaker, impedance immaterial, is connected in the emitter circuit of Q1, and acts as a microphone.

Q1 operates in the common base mode and a highly amplified signal appears at its collector. Q2, used in the common emitter mode, provides further amplification and the signal from its collector is fed via the blocking capacitor C3 to the volume control VR1.

Overall de-stabilisation is provided by obtaining Q1's base bias from the emitter of Q2.

The power amplifier is fairly conventional and fitted with a heavy duty output stage to enable a pair of 3Ω P.A. type horns to be driven in parallel. Under these conditions 8W is available. A single 3Ω unit can be driven to 4W.

Since the unit is intended for the reproduction of speech a wide bandwidth is not required and C7 is incorporated to roll off the response above 5kHz. C6 also provides a rapid roll off in the bass region. Q7 and Q9 should be fitted to a 5" x 4" finned heatsink and the body of Q4 should be thermally in contact with this.

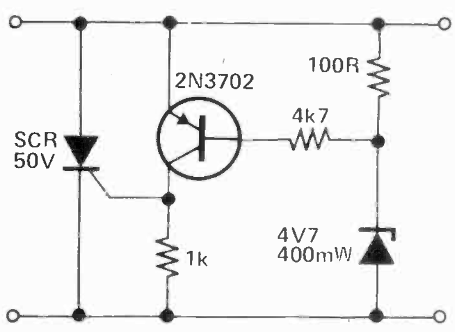


Fig. 1

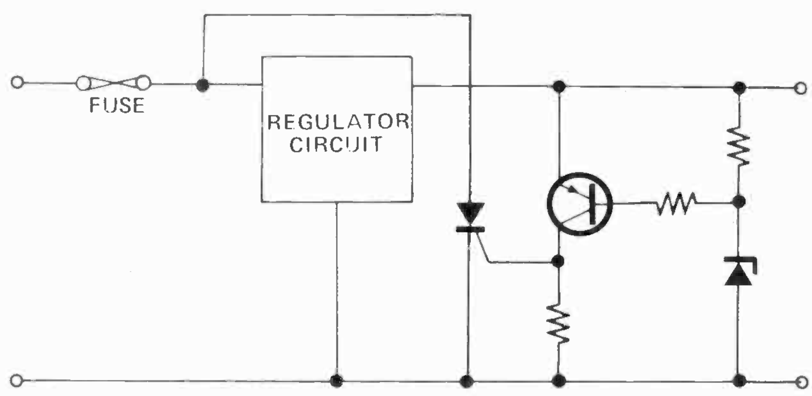


Fig. 2

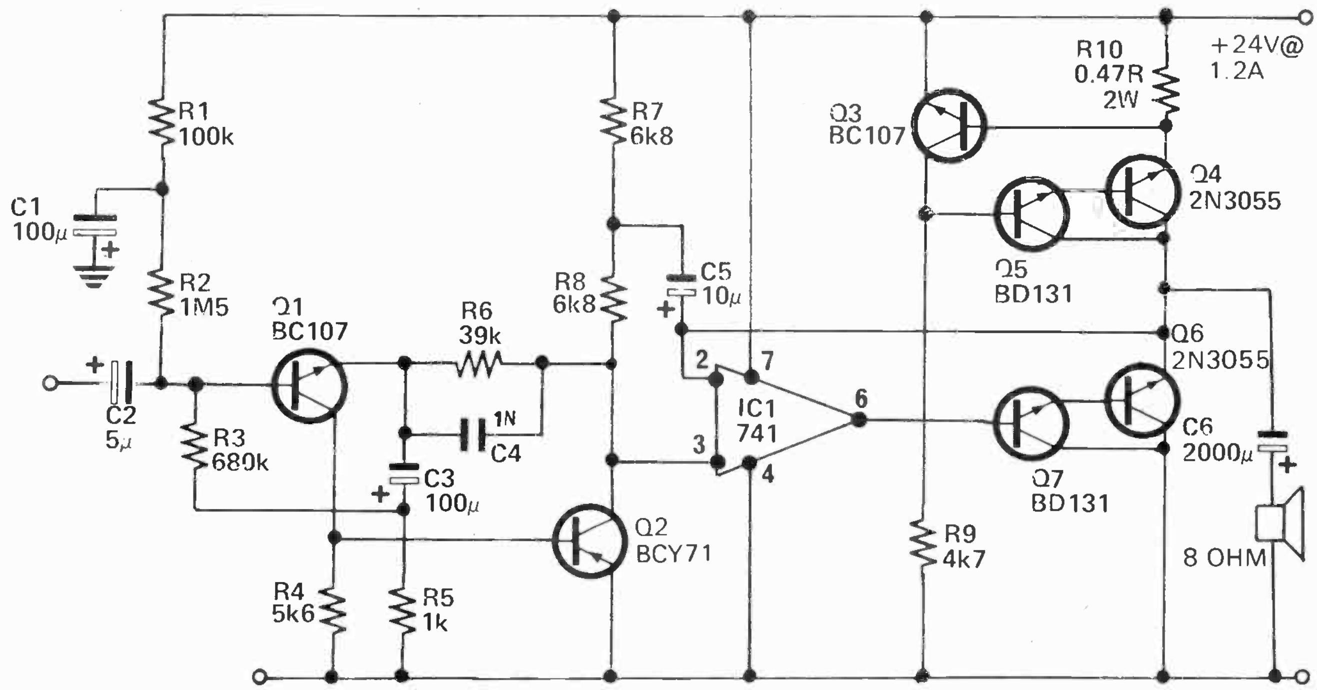
SIMPLE CROWBAR CIRCUIT

This circuit provides overvoltage protection in case of voltage regulator failure or application of an external voltage. It is intended to be used with a supply offering some form of short circuit protection, either foldback, current limiting or simple fuse. The circuit is less effective in the latter case however, as a good deal of damage can be done in the time taken to blow a fuse.

The most likely application is a 5V logic supply, since TTL is easily damaged by excess voltage. The values chosen in Fig.1 are for a 5V supply, although any supply up to about 25V can be protected by simply choosing the appropriate zener diode. When the supply voltage exceeds the zener voltage +0.7V, the transistor turns on and fires the thyristor. This shorts out the supply, and prevents the voltage rising any further. In the case of a supply with only fuse protection, it is better to connect the thyristor across the unregulated supply as shown in Fig.2 to prevent damage to the regulator circuit when the crowbar operates.

The thyristor should have a current rating about twice the expected short circuit current and a maximum voltage greater than the supply voltage. The circuit can be reset by either switching off the supply, or by breaking the thyristor circuit with a switch.

tech-tips



CLASS A AMPLIFIER

The main advantage of class A amplifiers is the absence of crossover distortion. Against this major advantage must be weighed the disadvantage of permanently hot heatsinks and large capacity power supplies.

The circuit shown here contains several novel features and will deliver 5W of pure class A sound into an 8µ load.

Q1 and Q2 form, with the associated components, a high quality voltage amplifier with overall ac and dc feedback applied from the collector of Q2 via R6 to the emitter of Q1.

The output stage proper, consists of Q6 and Q7 connected as an emitter follower darlington pair. These transistors are driven by IC1, a 741 op amp, and are included in the latter's feedback loop.

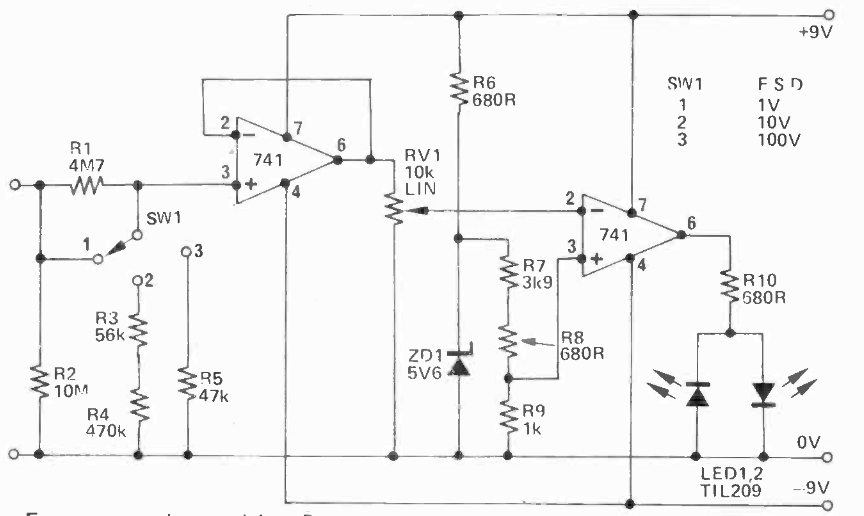
These three form a near perfect output stage with an input impedance of several megohms and a bandwidth extending from dc to over 100KHz.

Quiescent current is provided by the constant current source Q3, Q4, Q5, R9 and R10. The use of a constant current source here effectively isolates the output from line variations and ripple.

With the components shown, the circuit has a bandwidth of 10Hz - 30KHz -3db, a distortion of less than 0.1% before the onset of clipping, an input impedence of 1.5MΩ and a sensivity of 180mV for full output.

Transistors Q4 to Q7 must be mounted on an adequate heatsink, a 5" by 4" finned type is suitable, but must be mounted vertically and in such a position as to allow ample ventilation.

COMPARATOR VOLTMETER



This circuit, although simple, is capable of accurate voltage measurement. The input is applied to the high impedance input of IC1 via the attenuator comprising of R1 to R5 inclusive.

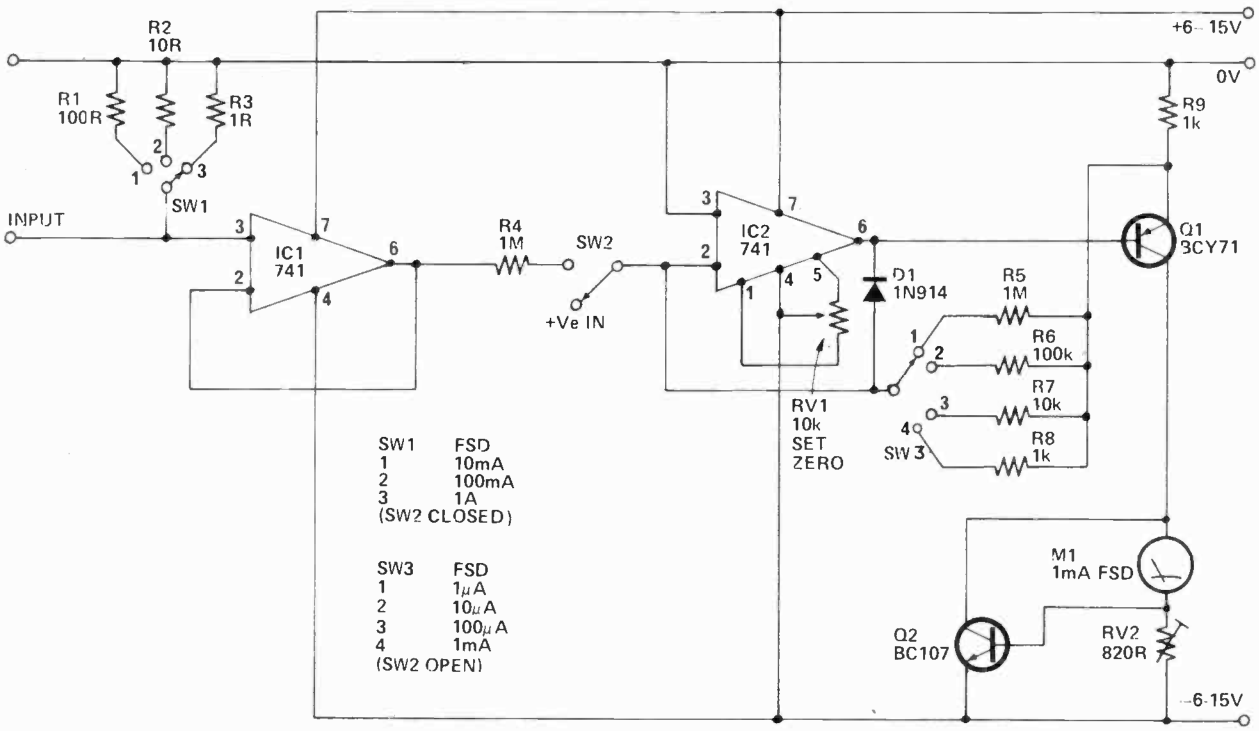
Since this IC is used as a unity gain buffer, the output at pin 6 is equal to the input voltage at pin 3, but at a low impedance. IC2 is connected as a comparator driving a pair of LEDs, D1 and D2.

The inverting input samples a portion of the unknown input voltage, whilst the non-inverting input is connected to a 1V reference obtained from the stable voltage across ZD1.

In use VR1 is adjusted till D2 just illuminates. At this point, if the control knob is of the 0 - 10 calibrated type, the pointer will indicate the input voltage.

For example, with SW1 in position 2, and with a reading of 2 on VR1, the input voltage will be 2V. With a little practice, the voltage can be read to ±2%, comparable to a moving coil instrument. The input impedance on all ranges is 3.2MΩ.

tech-tips



WIDE RANGE AMMETER

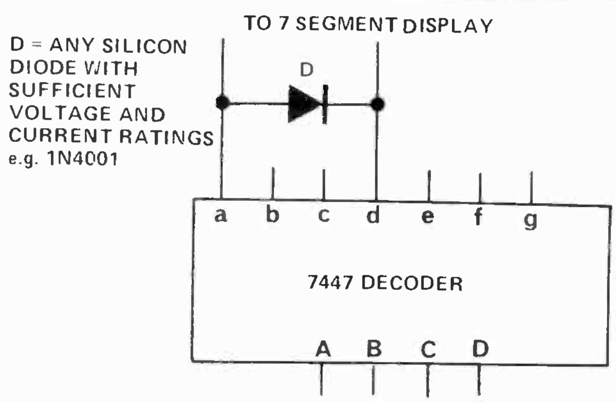
The instrument shown will measure currents from 1μA to 1A F.S.D. in seven ranges.

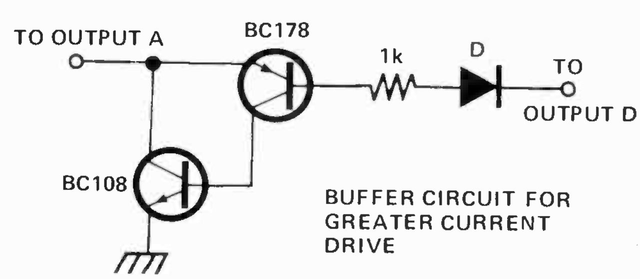
IC1 is connected as a unity gain buffer and the input current flows through the resistor selected by SW1 to earth. In so doing a voltage proportional to the input current is developed across the resistor and this appears at the output, pin 6.

Small currents are measured by IC2. In this mode the current flows into the non inverting input. Since this is a virtual earth, the output will generate a voltage proportional to the input current.

In practice, this voltage is developed across R9 and hence provides a proportional current through Q1 and M1.

Q2 and RV1 form a meter protection circuit and the latter component should be adjusted so that Q2 starts to conduct at F.S.D. D1 is included to prevent damage to the base emitter junction of Q1 in the event of an input of wrong polarity.





BUFFER CIRCUIT FOR GREATER CURRENT DRIVE

IMPROVING 7-SEGMENT DIGIT APPEARANCE

The display font of some 7-segment output devices produce the digit 6 without the top bar. Examination of the font reveals that whenever the bottom segment ('d' segment) is on, so is the top segment ('a' segment) for all the other digits. Hence all that is needed is a diode connected so as to light segment 'a' whenever segment 'd' is on. The diagram shows the idea applied to a 7447 decoder. The drive capability of the device may be exceeded by this addition, so a buffer circuit may be required as shown.

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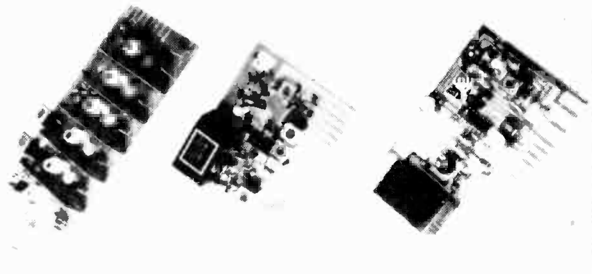

From left to right, the EF5800 6 circuit varicap FM tunerhead with the 7030 linear phase IF and the 91196 PLL stereo decoder with integral 55kHz 'birdy' filter. The system provides afc muting, meter drives, agc, auto stereo switch, & a specification that exceeds broadcast requirements. Now available with a new EF5801 tunerhead, with FET buffered oscillator output for synthesiser/frequency readout facilities.

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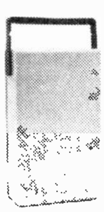

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