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electronics today

SEPTEMBER 1977 INTERNATIONAL

Registered for posting as a publication – Category C

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MICROCOMPUTER POWER SUPPLY

- ADD-ON FM TUNER
- PHASING SSB
- LIQUID CRYSTALS
- ULTRASONIC SWITCH

electronics today INTERNATIONAL

Editorial: Les Bell

Publisher: Collyn Rivers

PROJECTS

FEATURES

NEWS & INFORMATION

Cover: Our new computer power supply design is ideal for powering the Morrow front panel discussed last month. Cover photograph by George Hofsteters.

A Modern Magazines Publication
* Recomended retail price only.

WHY TAKE RISKS ? Buy from DICK SMITH The CB EXPERT !

Who is Dick Smith? He's Australia's CB expert! He's been selling CB longer than most of the 'backyarders' put together. He started a highly successful car radio business 8 years ago, which was the foundation of the famous electronics business which bears his name. He's sold more CB than anyone else and really is a name you can trust when you buy your CB radio!!!

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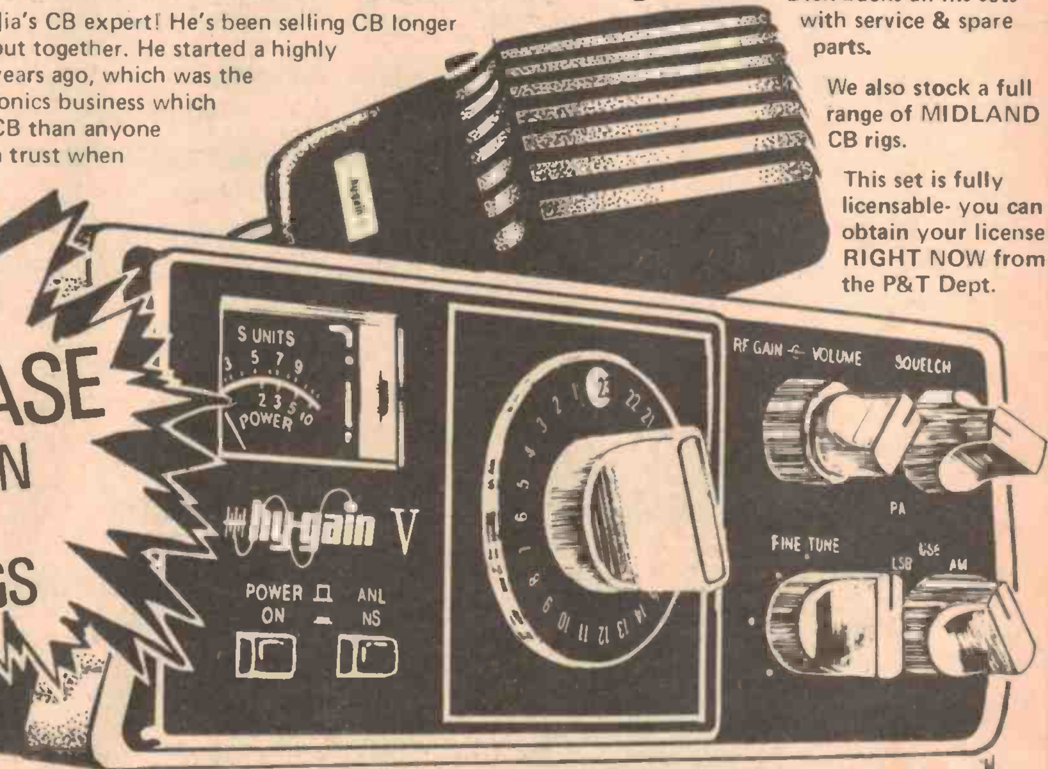

Of the 10 SSB CB transceivers reviewed in "CB Australia" magazine, June '77, only two stood out. Here's what the reviewer, Roger Harrison, said about the Hy-Gain V... ".. .. .. outstanding in functional design & operation.. .. .. the controls had the best feel of all the units.. .. .. good, clear sound.. .. .. handbook is very informative.. .. .." In fact he didn't have one point of criticism on this unit!

Cat. D-1704.. .. .. $279.50

This unit was selling for $310.00

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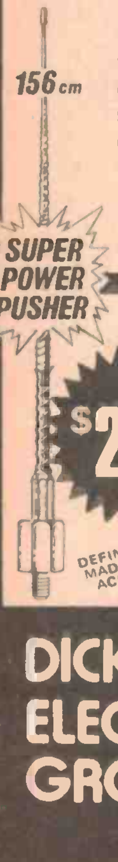

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Dashboard Technology

As microprocessors find their way under the bonnets of cars, research is progressing on other mobile applications for the beasties. General Motors are working on an LCD instrument panel which they have installed in a test car, and are hoping to take advantage of two features of LCD and CMOS technology: low power consumption and the small amount of space occupied by these displays.

Meanwhile, back at the Federal Screw Works, their Vocal Interface Division are working on a talking dashboard. This gizmo is designed to provide up to 27 different warnings to the driver, such as 'Low petrol', or 'Low oil pressure'.

This sounds great in principle, but we're inclined to view it as the thin end of a horrible wedge. I mean, before long these things will be smart enough to drive the car, and if they're not given the opportunity, it's almost certain they'll start to *nag*.

18-channel Progress

Dick Smith has released details of what is claimed to be the first CB radio designed to meet the Post and Telegraph Specification. The Midland 77A-857 is an AM, 18 channel rig with delta tune, noise limiter and PA facilities as standard. It will sell for $139.50, subject to changes in Duty and Sales Tax rates.

But Dicky's pride and joy is obviously the new range of CB's which bear his own brand name. These are specifically designed to meet Australian Specification RB249, and their names have been chosen to represent rigs with 'real sting'.

The 'Bumble Bee' is an economy 18 channel AM set, with the minimum of necessary controls and facilities. It also features a PA facility, and will sell for $119.

The 'Wasp' is also an 18 channel AM rig, but has better facilities and, presumably, performance. The channel readout is an LED digital type, and the set has a separate RF gain control, plus delta tune and a noise blanker/limiter. The Wasp will sell for $169.

For SSB users, the 'Hornet' is claimed to be the first Australian AM/SSB set. This rig has a lot of advanced features, including LED channel indication, noise blanker, noise limiter, and a DX/local switch. Of course, it is an 18 channel set, and will sell for $299.50. This rig looks like being a winner for Dick.

Finally, the 'Scorpion' AM/SSB base station completes the line-up. This has a full complement of features including all the usual things plus built-in SWR meter and jack for off-air recording as well as digital readout. The rig will also operate from 12 V for mobile use and will sell for $349.50. Further details from your nearest Dick Smith store or dealer.

Bipolar 8080A

Signetics (of 2650 fame) are cutting themselves in for a slice of the 8080 action by marketing an Emulator kit which uses Schottky bipolar bit-slice MPU's to produce an 8080A that runs an average of five times faster than the MOS part. The US$299 kit provides a PCB and all components necessary to run 8080 software and a manual which explains how you can use spare microinstruction locations to expand the instruction set.

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Cobra 132 AM/SSB $350.00

Delta Tine. P.A. Extension Speaker Facility. Illuminated Channel Indicafor and Metre. R.F. MIC Gain Control. N.B. Switch. Auto Noise Limiter.

o Sensitivity: AM.0.5 uV or better, SSB o.25 uV or better o Selectivity: 6 dB at 4 kHz, 50 dB at 20 kHz, 6 dB at 2.2 kHz, 60 dB at 5 kHz. o Audio Output: 3.5 watts typical.

THE COBRA 26 $120

The Cobra 26 is called "The Performance Radio" because professional drivers prefer the 26's top rated featrues and performance Just check this list: Switchable noise limiting (ANL), RF gain control, Delta Tune, Illuminated Power/S metre, adjustable squelch, PA output, detachable dynamic mike and much more.

The Cobra 26 operates at maximum legal power and critical sensitivities. What it really means to you is more enjoyable use of your CB operation. See for yourself why the Cobra 26 is the standard of comparison in the Citizens Band two-way radio industry.

No matter what the conditions, the Cobra 26 punches through loud and clear.

A BIG VOICE IN A SMALL PACKAGE.

THE COBRA 19M. $110.00

If you've ever heard a Cobra 21, you know it's hard to believe all that talk-power is legal. Cobra found the way to make their radios really talk and still obey the rules. Now you can talk just as loud and far with a smaller package.

Cobra 19M is thin and narrow enough to mount conveniently in any car, even the latest subcompacts. And the 19M has other features you'd expect from a Cobra, such as a plug-in dynamic mike, external speaker jack, and now, even an illuminated RF/signal strength metre.

The Cobra 19M has the same receiver sensitivity and selectivity as its big brother, Cobra 26. It has an efficient automatic noise limiter too; you'll hear clearly in the heart of heavy traffic.

o Dimensions: 1½" H x 51/8" W x 8" D. o Power Output: Factory adjusted to 4 watts legal maximum. o Modulation: 100 percent. o Sensitivity: Less than 1.0uV for 10 dB (S½N)/N o Selectivity dB: 6 dB at 4 kHz, 40 dB at 20 kHz o Image Rejection: 30 dB o If Rejection: 80 dB o Audio Output: 2.5 watts into 8 ohms.

CB AERIALS

ASIC. 5ft Fibreglass vertical helical whip aerial with base (Guard Mount) complete with 12ft cable & plug $26.73.

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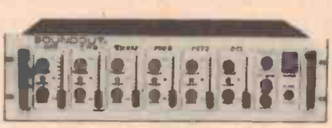
and so many more all over Australia

SERIES III MONO

DL6 CABINETS



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- Package includes Series III mono (170 watt) inbuilt Amp.
- 2 DL6 cabinets, vinyl covered with 2 x 12" full range speakers, ported cabinet
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NEW FROM SOUNDOUT. 200 watts per channel stereo switchable to 400 watts mono

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1 ohm to 10 megohm
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TE1025
Volume control stereo mono selector switch. Frequency response 20-16000Hz. Matching impedance 4-16 ohms
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Volume control only. Frequency response 20-2000Hz. Matching impedance 4-16 ohms.
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Price $30.90

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COUNTER KITS

USING NATIONAL CMOS 4 DIGIT/DECADE COUNTER-DRIVER, Multiplexed output. End stackable to infinity in 4 digit groups, with carry out, reset zero, latch. All on single modular board interfacing directly at right angles to bottom of display, giving single unit 4 digit counter for + 5 Volt supply with choice of .3" or .5" displays. Max input frequency 2MHZ and TTL compatable.—Would need another page to explain so if in doubt send SAE for Data/description.

CK10;

74C926—Straight 4 decade with carry out.

CK20;

74C927—Second most significant digit ÷ 6, i.e. 10HZ in gives count to 9 minutes 59.9 seconds. Team with CK10 for 99,999 minutes 59.9 seconds or 9 minutes 59.99999 seconds.

Techniparts 10HZ Crystal time base to suit $8.00.

PRICES;

CK10 and CK20 counter module kits complete; with NSB 3881 Display $22.00; with NSB 5881 Display $23.00.

LED DISPLAYS All displays end stackable.

4 DIGIT MULTIPLEXED COMMON CATHODE	NSB3881	.3"	$8.00
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Data supplied with each purchase.

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Those TI Calcs

We've gleaned a little more information on those Texas Instruments Programmable 58 and 59 calculators. They appear to have identical features, except that the 58 provides only 480 steps of RAM program memory compared to the 59's 960; and the 59 has a card reader which the 58 does not.

The key feature of the new machines is a 5,000-step plug-in ROM, called by TI 'Solid-State Software' and the machines are supplied with a 'Master Library Module'. The ROM and RAM are evidently addressed similarly, as programs in ROM can call the user's RAM programs as subroutines, or vice versa; and programs can be loaded into RAM from ROM for modification. In the case of the 59, programs and data can also be loaded into RAM from a magnetic card.

When switched on, the 59 has 480 program steps and 60 memories; however program steps can be swapped for memories at the rate of 80 steps for 10 memories, or memories can be swapped for program steps. So one can have 800 steps and 20 memories, or 240 steps and 60 memories, or other combinations. The 58 has 240 steps and 30 memories on switch-on.

Both have 10 index registers, and can use all memories for indirect addressing. Six levels of subroutines are possible, and TI's Algebraic Operating System allows 8 pending operations with 9 sets of parentheses. There are 10 flags, 10 user-definable keys and 72 possible labels.

When combined with the PC100A printer, both calculators can list programs, print results, print headings for programs and prompt the user. You can even plot graphs or curves automatically.

Needless to say, the keyboards on both these little beauties is pretty crowded (45 keys, all but 3 with multiple shifts). Plug-in 'Solid State Software Modules' are available for various fields, though electrical engineering doesn't seem to be one of them. We don't have Australian prices yet, but in the US the 58 sells for $124.95 ($99.95 discount) and the 59 sells for $299.95 ($249.95 discount).

FCC in US Looks at Other Bands

The US Federal Communications Commission's Office of Plans and Policy some months ago released a report on 'Spectrum Alternatives of Personal Radio Service' prepared by the Personal Radio Planning Group (i.e. CB). The report altogether considers seventeen (17!) alternative bands between 25 MHz and 1000 MHz for expansion of the CB service in the United States.

The Group selected seven possible segments on the basis of relocation cost, user loading and TVI potential:

26.95 MHz – 26.96 MHz
27.54 MHz – 28.00 MHz
29.80 MHz – 29.89 MHz
29.91 MHz – 30.00 MHz

222 MHz – 224 MHz
894 MHz – 902 MHz
928 MHz – 947 MHz.

Current problems with their Class D allocation seems to rule out expansion in the HF region to 39 MHz. Some commercial interests strongly favour 22 MHz, along with sections of the CB camp, but it is also strongly opposed by the powerful National Association of Broadcasters (NAB) and the ARRL of course. Other commercial interests favour 900 MHz, as do the amateurs it seems.

It is going to be interesting to see just where, if at all, the American CB service obtains further spectrum for expansion.

For Things That Go Thump in the Night

The Security Systems Group of GTE Sylvania has developed a way of turning an ordinary chain-link fence into a microphone sensitive enough to 'listen' for intruders, so that operators can tell what is happening. The Fence Protection System is based on a patented transducer cable that is clipped to the fence, and can locate the disturbance and indicate this on a display. It can also discriminate and ignore 'interference' from rain, wind, or tree branches.

Sansui Stereo Integrated Amplifier: The Super Power Package.

From Sansui, the Stereo Integrated Amplifier AU20000, a super power package that pushes out 170 watts per channel. We call it integrated because it is a combination of the Definition BA-3000 power and CA-3000 preamplifier within the one unit.

That means the AU20000 is more compact to handle and is available at a price to please every true audiophile.

Specifications

Power Output: Min. RMS, both channels driven, from 20 to 20,000Hz, with no more than 0.05% total harmonic distortion 170 watts per channel into 4 and 8 ohms.

Power Bandwidth: 20 to 20,000Hz at or below rated min. RMS power output and total harmonic distortion.

Total Harmonic Distortion: Overall (from AUX) less than 0.05% at or below rated min. RMS power output.

Intermodulation Distortion: (70Hz:7,000Hz = 4:1 SMPTE method). Overall (from AUX) less than 0.05%.

Frequency Response (at 1 watt): Overall (AUX to power output) 10 to 50,000Hz + 0dB, −1.0dB
Power Amplifier Only
10 to 70,000Hz + 0dB, −1.0dB

Damping Factor: approximately 80 to 8 ohm load

Channel Separation at rated output 1,000Hz:
Phono 1–better than 55dB (at 3mV sensitivity)
Phono 2–better than 55dB (at 3mV sensitivity)
Tuner–better than 60dB
Aux–better than 60dB
Tape Monitor–1,2,3 better than 60dB
Power Amplifier–better than 65dB

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RANK AUSTRALIA

CU148/77

News Digest

Unitrex Calculator Contest

The winner of the July Contest is Douglas Ray, of Thornbury, Victoria. The correct answer for the length of the feeder is 17.15 m, and this follows from the general principle that the sum of the squares of opposite diagonals from a point equals the sum of the squares of the other two diagonals. So, adding 15 squared plus 13 squared minus 10 squared gives 294, and the square root of this is the answer.

We were amazed at the number of proofs we received, some of which we are still grappling with! And now, on to this month's problem, which is a variation on a well-known operations research boggler:

In the year 1991 galactic bases are a common sight. An astronaut is to make an exploratory trip round Ganymede (a moon of Jupiter). This type of operation is new to the astronaut as surface travel is normally restricted by the limited fuel capacity of the lunar buggies.

Galactic bases are normally equipped with specially adapted earth type 'dune buggies' with pressurised cabins, heat shields and two fuel tanks, one fixed and one detachable. The astronaut will utilise one of these buggies to circumnavigate the moon.

His problem is that the lunar bug will only travel one fifth of the circumference of Ganymede on its fixed fuel tank, though with the extra detachable tank he can cover another one-fifth.

The astronaut can refuel as many times as he needs; he can also deposit a full detachable fuel tank on the surface and then return to base, refuel and pick up another spare tank.

Preliminary trips in any direction to deposit tanks on the lunar surface as fuel depots will be necessary to complete the final assault in one direction, but the astronaut must minimise the amount of fuel used on both preparatory trips and the actual journey.

What is the minimum number of fuel tanks the astronaut will need (in both preparatory and final trips) to circumnavigate Ganymede in one direction?

Send your answer on the back of an empty envelope (don't forget to add your name and address) to: Unitrex Calculator Contest (Sept.), ETI Magazine, 15 Boundary Street, Rushcutter's Bay, NSW 2011. Closing date is October 21st.

Calculator / Clock

This really neat calculator follows the latest trend and is ultra-thin, ultra-lightweight, as well as having an extremely long battery life. But the thing that makes it really worth having as a back-up to your present scientific calculator is the fact that it also features a digital clock, with a 24-hour alarm feature! The Panasonic JE-8323U will be available in the shops soon at a price around $70.

Program Form Freebie

If you turn to page 82 of this issue you will find a blank Programming Form which ETI readers are free to copy and use. We've cleverly constructed this so that you can write assembly language programs first and then go back to hand assemble, using the columns on the right. This also makes the object code easier to follow when keying it into your computer. Every eighth line is underscored, which makes it easy to check addresses in hex or octal (provided you write object addresses and data in columns, not across the sheet, your choice!). So, if you want to make a neat copy of your programs for future reference, just photocopy this one and away you go.

MELBOURNE SCENE

Electronics Today International is seeking a free-lance contributor to cover the Melbourne electronics and hi-fi scene. The work entails occasional visits to companies and distributors in Melbourne and coverage of Melbourne exhibitions. If you are interested, write to the Publisher, Electronics Today International, 15 Boundary Street, Rushcutters Bay, NSW 2011.

64 kbit Memory

Nippon Telephone and Telegraph claim to have developed the first 64 kbit memory, in conjunction with Nippon Electric, Hitachi and Fujitsu. The new memory is equivalent to 160,000 transistors, 1000 IC's or 50 LSI packages. It looks as though the Japanese VLSI programme is a serious attempt and is well on the road to success.

Slim Slimline TV

Hitachi are reportedly about to market a mini TV which utilises an LCD display in place of a tube. The display is 245 x 195 x 40 mm. How long before the LCD TV appears on your wrist?

AM Stereo Chip

With all the interest in the FCC's trials of AM stereo, it is significant that Sprague Electric's Semiconductor division has announced plans to develop an AM stereo decoder for Delco and other car radio manufacturers. Although the FCC hasn't yet decided on which system to use (see ETI July), Sprague are ready to build chips for any of the four, at a price of under $1.

10 good reasons to sound out Luxor.

1 Luxor's advanced design incorporates the latest in Swedish electronics technology.

2 12 months guarantee on parts. 10 years guaranteed parts availability.

3 20 watts per channel (sine wave) amplifier.

4 Sensitive AM/FM radio, 5 preset FM stations, accepts stereo FM.

5 Semi automatic belt driven turntable with excellent cartridge.

6 A pair of highly responsive bass reflex speakers.

7 Three in one also incorporates easily operated top class cassette recorder.

8 Luxor music centres – convenient operation without sacrificing quality in sound.

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LIQUID CRYSTAL DISPLAYS

Many watches, calculators, and electronic measuring instruments now use liquid crystal displays — this article by Robin Moorshead B.Sc. explains how they work.

AS DAY follows night, there are certain patterns of change in the physical world which we hold to be always true. Perhaps one of the earliest that we learn is that matter exists in three states, solid (crystalline), liquid or gas. The particular state in which a substance exists depends on temperature. At low temperatures substances tend to be solid, at higher temperatures liquid, and yet higher, gaseous. Furthermore, the transition between the states is clear and precise, for example, ice changes to water at 0° C, there is no gradual transition.

Simple materials which fit into this description have another property; their physical characteristics are the same from whichever direction they are approached. This is termed "Isotropic". Examples of isotropic materials are glass, steel or water. Their electrical refractive index and strength are the same from whichever direction we measure them.

Against the grain

However, by no means all materials are isotropic, wood for example is much stronger across the grain than with the grain, graphite has a higher electrical resistance when measured through it's "plate" structure then when it is measured along the plates. Such materials as these are termed "anisotropic".

It would be surprising if wood and graphite were isotropic, since they are constructed of rods (cellulose fibres) and plates (the graphite). In the same way we would not expect roof slates to fall into a box in a random arrangement, they will have a strong tendency to fall flat and so order themselves into an anisotropic arrangement.

Rods and plates

In exactly the same way many of the large molecules found in organic chemistry have rod- or plate-like shapes and have anisotropic crystal structures. The tendency towards ordered arrangements in these substances is so great, that when they melt they retain a degree of order until the temperature is considerably increased. As a result the

A typical LCD (Liquid Crystal Display) used in watches because of its low power consumption and ability to be seen in all light conditions.

liquid has anisotropic properties, some flowing in a gliding stepwise fashion, or interfering with the passage of light. When this happens the substance is said to possess a liquid crystalline phase (sometimes termed a mesomorphic or paracrystalline state).
So we have:

	Increasing temperature
For an isotropic material:	solid→liquid→gas
For an anisotropic material:	solid→ liquid crystal → isotropic liquid →gas

It is of interest to note that this property has been well known since 1890, and some 0.6% (15,000—20,000) of organic chemicals show this behaviour.

Nematic and smectic

Liquid crystals fall into two main categories: Nematic (from the Greek thread) and Smectic (from the Greek for soap).

Smectic liquid crystals have many interesting properties but have found little practical application, so they will not enter into the article any further.

Nematic liquid crystals have many applications and form the substance of this article. There are several types of nematic materials.

Some nematic liquid crystals possess properties which cause them to interfere with the passage of light in an applied electric field, or with changing temperature. They are of great interest in modern electronic displays for several reasons:

(1) The power consumption of such displays is extremely small, between 2 μA and 0.2 μA per segment of a 7-segment display, about 10 μW per cm^2 of display, whereas a similar LED display consumes 500 mW.

(2) They are made of the commonest elements, carbon, hydrogen, oxygen, nitrogen, rather than the more expensive elements such as gallium, germanium, etc.

(3) Since they do not emit light themselves, but interfere with the passage of incident light, they cannot be "washed out" by strong incident light.

(4) They are compatible with PMOS circuits.

There are, needless to say, disadvantages as well:

(1) Since they are passive, i.e., they do not emit light, they cannot be read in the dark, however, this can be overcome by providing background illumination. This increases power consumption; the power consumed however does not have to pass through the addressing circuit, as it does in LED displays.

(2) Since they are operating in a phase between solid and liquid their temperature range is limited, at a maximum between -20° C and 100° C, but more typically 0° C to 60° C.

Below this temperature the display freezes, above the maximum the liquid is isotropic and no display is visible. Furthermore the response time near the freezing point is rather slow, in the

LIQUID CRYSTAL DISPLAYS

order 0.2-second rise time and 0.6-second fall time. Freezing or liquifying the display does no permanent damage, but temperatures in excess of 150° C may cause irreversible damage. There is no doubt that future developments will broaden this temperature range considerably.

(3) The lifetime is still limited, but provided conditions are ideal it is now well in excess of 10000 hours. Future development of materials with higher purity, and chemical stability will improve this a great deal.

Stability may be affected by several factors. Firstly, certain liquid crystalline materials undergo irreversible chemical changes under dc conditions, it is critical that such display have no dc components whatsoever in the addressing circuit, secondly chemical changes are caused by impurities. Thirdly, certain liquid crystalline materials are affected by ultra-violet light.

The actual material used in a display is not usually pure, it is more frequently a mixture of two or more nematics. This has the advantage of increasing the liquid range by the creation of a "eutectic" mixture.

Materials suitable for display purposes must include the following anisotropic properties:

(1) The refractive index must be different when the material is viewed from different aspects, i.e., the light is bent more as it passes through the material in one direction than another.

(2) The molecule must possess a dipole. This is an uneven distribution of charge on the molecule, which causes it to align in an electric field — Fig. 1.

Many organic molecules possess such dipoles. The dipole on the materials used in liquid crystalline displays has two components, one along the long axis and one perpendicular to it.

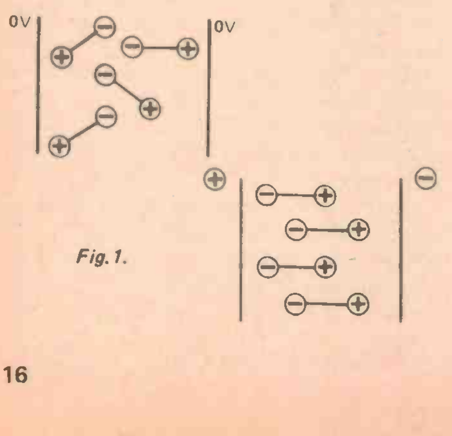

Fig. 1.

If the dipole along the long axis is greater than the dipole perpendicular to it, it is said to possess *positive* dielectric anisotropy. If the dipole is greater on the perpendicular axis it is said to possess *negative* dielectric anisotropy.

(3) The material also must possess anisotropic conductivity (as graphite does). The conductivity in nematic liquid crystals is greater along the long axis than perpendicular to it.

(4) The material should have a resistivity of the order of 10^9 Ω/cm.

Display construction

Liquid crystal displays work in two different ways, but the construction of the cells are similar. The differences are mainly in the filters on the back and faces of the display and in the type of background.

The cell consists of a very thin layer (about 12 μm) of the liquid crystalline material between two sheets of glass which have a conductive coating on their inside. One glass plate (a) has the actual seven-segment display etched on

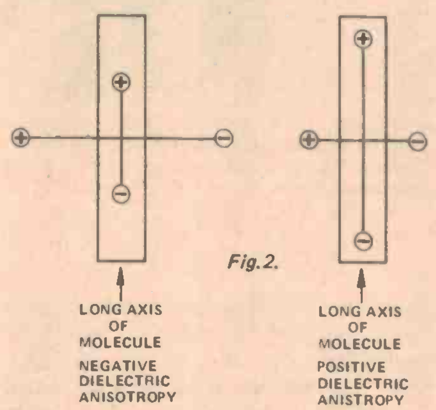

Fig. 2.

it. The other plate (b) has a common electrode etched on it. This conductive coating is either tin oxide or a mixture of tin and indium oxides. This provides an electrode with about 90% transmission of light.

This conductive coat is further treated so that the molecules align themselves with the surface while an electric field is not applied, resulting in a more or less translucent display. When an electric field is applied, the molecules move so as to align their dipoles with the electric field. This causes changes in the optical properties of the liquid crystal material which appears as the display.

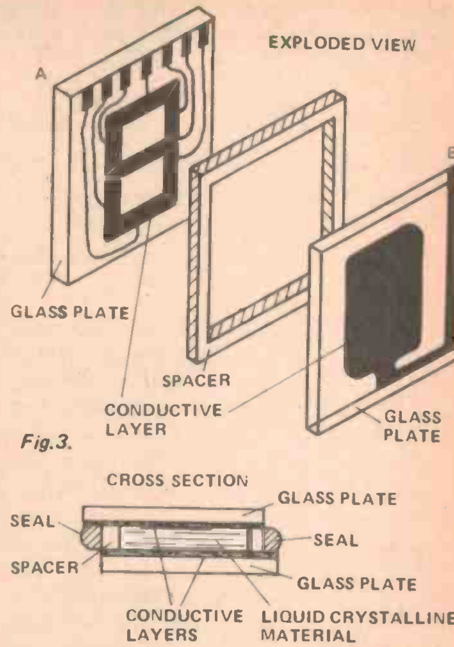

Fig. 3.

Two principle techniques are used, dynamic scattering and polarization.

Dynamic scattering

In this mode, the liquid crystalline material has *negative* dielectric anisotropy, with the greater electrical conductivity along its long axis. The molecules are normally perpendicular to the surface. When an ac field is applied, the molecules (in clusters) move to realign their dipoles with the field. The realignment of the dipole is in opposition to the conductivity and the liquid becomes turbulent. This turbulence is seen as milkiness in the display.

Since no light is emitted the display must be used to modify the passage of incident light. This may be done by passing light through the display, or, more usually, by reflecting light from a mirror behind the display.

The transmissive cell (Fig. 5) will appear to glow where the segments are

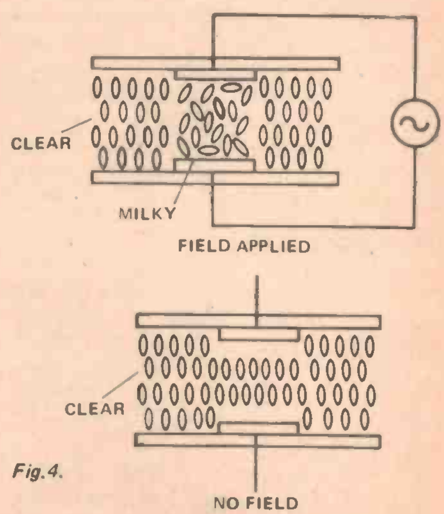

Fig. 4.

switched on. The reflective cell (Fig. 6) will appear misty where the segments are switched on. These displays have the shortcoming of a rather low "contrast ratio". That is, the apparent difference between the switched on and switched off display is not very great.

Polarization modes

This type of display is constructed in basically the same way as the dynamic scattering cell described above. The difference lies in the type of liquid crystalline material. The material used is one which has a twisted nematic structure (twisting light that passes through it), and has *positive* dielectric anisotropy (the major component of its dipole along its long axis).

The inside faces of the cell are coated so that the molecules are parallel to them and aligned in a particular direction when no electric field is applied.

The cell thickness is designed so that there is a complete 90° turn of molecules between the top and bottom. The twisted nematic has the property that it twists light that passes through it. Polaroid filters are fitted above and below the cell so that light is polarized as it enters, and is twisted through 90° exiting through a filter opposed at 90° to the first. The light is then reflected off a mirror and returns via the same pathway.

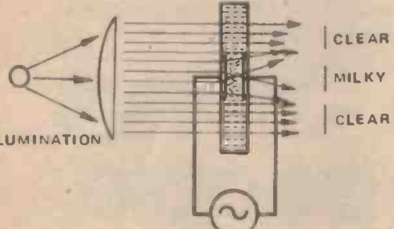

Fig.5.

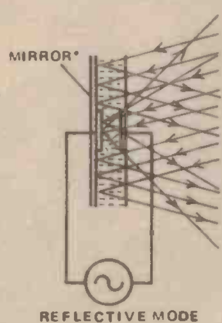

Fig.6.

* THE MIRROR IS OFTEN THE BACK ELECTRODE

In the passive state the cell is clear. When an electric field is applied the molecules re-orientate to lie perpendicular to the faces of the cell and no longer twist the light. The light is now polarized as it enters the cell, and without being twisted, meets the second filter which is at right angles to the first and so does not pass the light. Hence that portion of the display with the field applied appears black (since no light is reflected).

If you have not seen this effect before take two pairs of Polaroid sun glasses, look at a source of light with one in front of the other.

Held in this way, light, although polarized, is free to pass through the second filter since the plane of polarization is the same for both lenses. If one lens is now rotated through 90°, no light passes since the light polarized by the first lens will not pass through the second.

The effect of having the "crossed polaroids" in the cell causes almost total extinction of reflected light and consequently a high contrast ratio an almost completely black and white display.

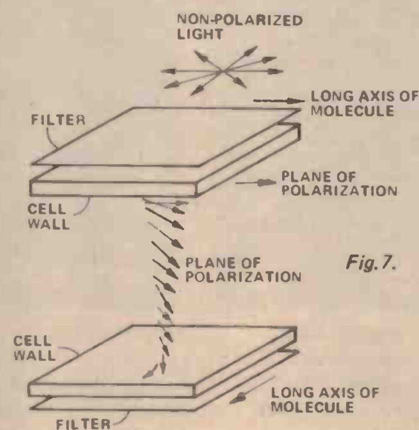

Fig.7.

Addressing technique

The cells are normally driven by ac (although some cholesteric cells may use dc).

The technique commonly used is to have dc pulses of identical amplitude, one applied to the back, the other to the display segment via an exclusive — or gate. In the off state the two signals are in phase. In the on state they are out of phase.

This technique has limitations due to the large number of circuits and connections, however, this has been overcome by putting the circuit on the glass of the display using thick film techniques!

Alternatives to this form of drive are multiplexed addressing, or MOS shift register memory.

Other uses

Certain nematic liquid crystals change colour over the whole range of the spectrum (red to violet) as their temperature changes. Furthermore, the colour change is over a very narrow temperature range, usually 2° or 3° C. The temperature at which this happens, and the range over which the change takes place can be adjusted by use of mixtures of different cholesterics.

A set of 10 or 12 of such cells in a row, the following one starting to show colour at 2° C higher temperature than the previous one, forms a useful thermometer working over a fairly restricted range. They have found application as living room and refrigerator thermometers.

Other liquid crystals have a very narrow range over which they change colour (0.5° C). They have found application in medicine since they can resolve differences of 0.05° C. Assuming the liquid crystal is set to show colour at normal skin temperature any local deviation from the correct temperature will show as a different colour. This has applications in detecting cancers, since they tend to be hotter than normal body heat. They can also be used to show areas of poor blood flow, or where allergic reactions are taking place, since these areas are slightly hotter or colder than the normal body temperature.

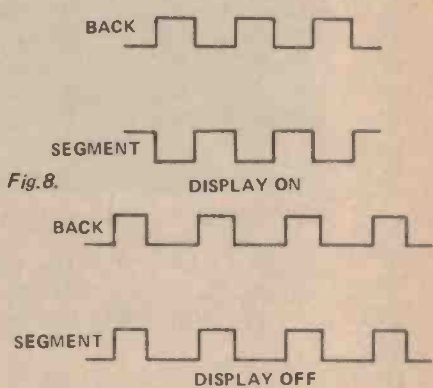

Fig.8.

Cells with extremely low temperature resolution can even detect field intensity patterns of microwaves and ultrasonic sound fields due to local heating effects.

As might be expected there are also cells which change colour with applied electric field. This would appear to have interesting prospects for the future.

Other interesting possibilities which occur include the "memory effect". Certain cholesterics take hours, or some cases weeks, to return to their clear liquid crystalline state after they have been scattered by an applied electric field. The clear state can be restored by applying a different electric field.

Clearly liquid crystal technology has an enormous amount to offer a wide variety of fields — electronics, medicine and others. We are likely to see further interesting developments in the next few years as this technology takes over, and improves on, existing display techniques. How about an alpha numeric display with independently variable colour segments?

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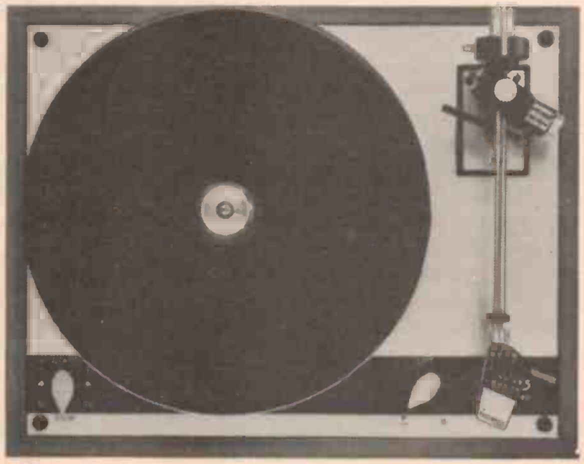

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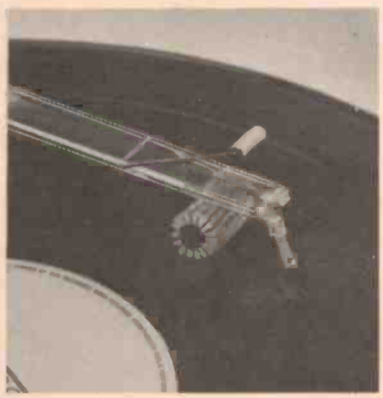

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7405	Hex inverter (Open collector)	32c
7406	Hex inverter driver 30V	36c
7407	Hex driver 30V	48c
7408	Quad 2-input and	32c
7409	Quad 2-input and (Open collector)	32c
7410	Triple 3-input nand	32c
7411	Triple 3-input and	48c
7412	Triple 3-input nand (Open collector)	32c
7413	Dual 4-input nand schmitt	56c
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7425	Dual 4-input nor with strobe	44c
7426	Quad 2-input nand driver 15V	44c
7427	Triple 3-input nor	44c
7428	Quad 2-input nor buffer	72c
7430	Single 8-input nand	32c
7432	Quad 2-input or	44c
7433	Quad 2-input nor (Open collector)	80c
7437	Quad 2-input nand buffer	48c
7438	Quad 2-input nand buffer (Open)	48c
7439	Quad 2-input nand buffer (Open)	48c
7440	Dual 4-input nand buffer	32c
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7442	BCD to Decimal decoder	88c
7443	Excess 3 to Decimal decoder	$1.56
7444	Excess 3 gray to Decimal decoder	$1.56
7445	BCD to Decimal driver 30V	$1.32
7446	BCD to 7 segment driver 30V	$1.24
7447	BCD to 7 segment driver 15V	$1.24
7448	BCD to 7 segment driver	$1.24
7450	Dual 2x2 and or invert expand	32c
7451	Dual 2x2 and or invert	32c
7453	Single 2x2x2x2 and or invert expand	32c
7454	Single 2x2x2x2 and or invert	32c
7460	Dual 4-input expander	32c
7464	Single 4x2x3x2 and or invert	32c
7465	Single 4x2x3x2 and or invert (Open)	76c
7470	Edge trigger JK flip flop	48c
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7473	Dual JK Master slave flip flop	68c
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7475	Quad latch	88c
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7496	5 bit parallel shift register	$1.32
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74C14	Hex inverter schmitt	$2.16
74C20	Dual 4-input nand	72c
74C30	Single 8-input nand	72c
74C48	BCD to 7 segment decoder	$3.32
74C73	Dual JK flip flop	$1.12
74C74	Dual D flip flop	$1.12
74C75	4 bit latch	$1.12
74C76	Dual JK flip flop	$2.36
74C85	4 bit magnitude comparator	$2.96
74C90	Decade counter	$2.36
74C93	4 bit binary counter	$2.36
74C107	Dual JK flip flop	$2.84
74C160	Decade counter asynchronous clear	$3.12
74C161	Binary counter asynchronous clear	$3.12
74C162	Decade counter synchronous clear	$3.12
74C163	Binary counter synchronous clear	$3.12
74C174	Hex D flip flop	$3.12
74C175	Quad D flip flop	$2.60
74C192	Up down decade counter	$3.12
74C193	Up down binary counter	$3.12
74C194	4 bit right left shift register	$3.12
74C195	4 bit register parallel in	$3.12
74C221	Dual monostable multivibrator	$2.35

TTL-low schottky

74LS00	Quad 2-input nand	45c
74LS01	Quad 2-input nand (Open collector)	45c
74LS02	Quad 2-input nor	45c
74LS03	Quad 2-input nand (Open collector)	45c
74LS04	Hex inverter	45c
74LS05	Hex inverter (Open collector)	45c
74LS08	Quad 2-input and	45c
74LS09	Quad 2-input and (Open collector)	45c
74LS10	Triple 3-input nand	45c
74LS11	Triple 3-input and	45c
74LS12	Triple 3-input nand (Open collector)	45c
74LS13	Dual 4-input nand schmitt	$1.75
74LS14	Hex inverter schmitt	$2.35
74LS15	Triple 3-input and (Open collector)	64c
74LS20	Dual 4-input nand	45c
74LS21	Dual 4-input and	45c
74LS22	Dual 4-input nand (Open collector)	64c
74LS26	Quad 2-input nand driver 15V	96c
74LS27	Triple 3-input nor	52c
74LS28	Quad 2-input nor buffer	52c
74LS30	Single 8-input nand	45c
74LS32	Quad 2-input or	52c
74LS33	Quad 2-input nor (Open collector)	96c
74LS37	Quad 2-input nand buffer	52c
74LS38	Quad 2-input nor buffer	52c
74LS40	Dual 4-input nand buffer	52c
74LS42	BCD to decimal decoder	$1.85
74LS47	BCD to 7 segment driver 15V	$2.75
74LS48	BCD to 7 segment driver	$2.75
74LS49	BCD to 7 segment (Open collector)	$2.75
74LS51	3 + 3 and 2 + 2 and or invert	64c
74LS54	2 + 2 + 3 + 2 and or invert	64c
74LS55	4 + 4 and or invert	64c
74LS73	Dual JK edge trigger flip flop	60c
74LS74	Dual D edge trigger flip flop	64c
74LS75	4 bit latch	$1.00
74LS76	Dual JK edge trigger flip flop	$1.24
74LS78	Dual JK edge trigger flip flop	65c
74LS83	4 bit binary full adder	$3.72
74LS85	4 bit magnitude comparator	$2.64
74LS86	Quad 2-input exclusive or	72c
74LS90	Decade counter	$1.64
74LS91	8 bit shift register	$2.84
74LS92	Divide by 12 counter	$1.64
74LS93	4 bit binary counter	$1.64
74LS95	4 bit right left shift register	$3.96
74LS107	Dual JK edge trigger flip flop	$1.24
74LS109	Dual JK edge trigger flip flop	76c
74LS112	Dual JK edge trigger flip flop	$1.24
74LS113	Dual JK edge trigger flip flop	72c
74LS114	Dual JK edge trigger flip flop	72c
74LS122	Monostable multivibrator	$2.24
74LS123	Dual monostable multivibrator	$2.72
74LS124	Dual voltage control oscillators	$1.88
74LS125	Quad tristate buffer invert control	$1.88
74LS132	Quad 2-input nand schmitt	$2.24
74LS136	Quad exclusive or (Open collector)	$1.36
74LS138	3 line to 8 line demultiplexer	$2.16
74LS139	Dual 2 line to 4 line demultiplexer	$2.28
74LS145	BCD to decimal driver 15V	$3.16
74LS151	8 channel digital multiplexer	$2.00
74LS153	Dual 4 line to 1 line multiplexer	$3.16
74LS155	Dual 2 line to 4 line demultiplexer	$2.64
74LS156	Dual 2 line to 4 line demultiplexer	$3.64
74LS157	Quad 2 line to 1 line multiplexer	$2.20
74LS158	Quad 2 line to 1 line multiplexer	$2.96
74LS162	Decade counter asynchronous clear	$3.48
74LS163	Binary counter asynchronous clear	$2.72
74LS164	8 bit parallel out shift register	$2.32
74LS174	Hex D flip flop with clear	$2.32
74LS175	Quad D flip flop with clear	$2.32
74LS181	Arithmetic logic unit	$2.32
74LS192	Up down decade counter	$2.96
74LS193	Up down binary counter	$2.96
74LS194	4 bit left right shift register	$2.40
74LS195	4 bit parallel in shift register	$2.40
74LS196	40MHz decade counter	$2.40
74LS197	40MHz binary counter	$3.64
74LS221	Dual monostable schmitt input	$2.20
74LS247	BCD to 7 segment driver 15V	$3.24
74LS248	BCD to 7 segment driver	$3.24
74LS249	BCD to 7 segment driver	$3.24
74LS251	Tristate 8 line to 1 line multiplexer	$3.88
74LS253	Tristate 4 line to 1 line multiplexer	$2.20
74LS257	Tristate quad 2 line to 1 line	$3.96
74LS258	Tristate quad 2 line to 1 line	$2.76
74LS260	Dual 5-input nor	$1.40
74LS266	Quad exclusive or (Open collector)	$1.48
74LS279	Quad RS latches	$1.88
74LS283	4 bit binary full adder	$3.48
74LS290	Decade counter	$3.40
74LS293	4 bit binary counter	$3.40
74LS365	Tristate hex driver	$1.88
74LS366	Tristate hex invert driver	$1.88
74LS367	Tristate hex 4 driver	$1.76
74LS368	Tristate 2 + 4 invert driver	$1.76
74LS386	Quad 2-input exclusive or	$1.48

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TIL211	Small green led with mount	48c
TIL220	Large red led with mount	24c
TIL222	Large green led with mount	48c
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FND500	.5" common cathode readout	$1.95
FND507	.5" common anode readout	$1.95
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This is the three I.C. SQ decoder kit as featured in EA February 1977. Complete with board, rotary pots and IC's. No case or power supply. This is a very popular kit. See below for conversion kit.

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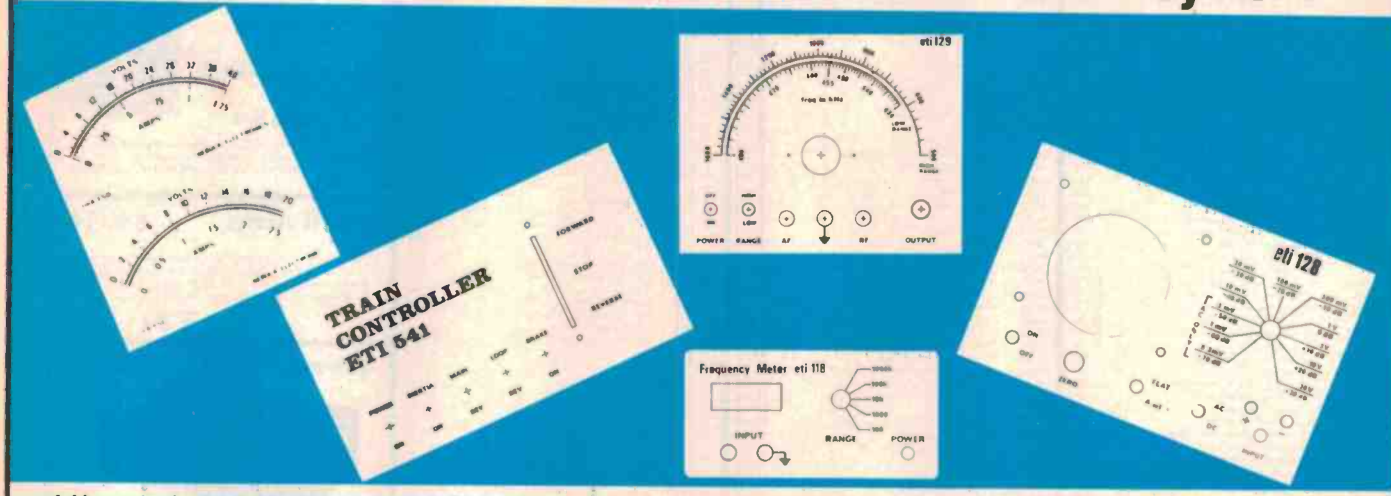

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CONSUMER ELECTRONICS SHOW SUCCESS

THE FIRST CES (Consumer Electronics Show) held last year in Sydney had originally been intended as a trade show, but later it was decided to open to the public for certain periods. The second CES, held in August at the Sydney Hilton, was more than twice as large as the 1976 show, and apart from a lift failure during one of the busy weekend period (meaning a climb by stairway of 20 floors between the lower and upper exhibition areas) the record number of visitors was able to see and, (by some definitions!) hear a wide range of new and established products from the world's audio manufacturers.

Entry to the show was free. An added bonus was a competition for three prizes, donated by Pioneer, entered simply by filling in a form at the exhibition entrance.

The lower exhibition area, on floors 8 and 9, was extremely busy at all times. Floor 9 was predominantly a static' display with an open format, mainly for the browsers who might perhaps have too much of an earful upstairs and downstairs! The eighth floor function area, consisting of several large rooms including the ballrooms, was the focus of the show, with exhibits by Australian Musical Industries, Convoy, Haco, Hagemeyer, Harman, Philips, Pioneer, Rampec, Rank and Sonab.

A major attraction on the Philips stand was a new range of cartridges based on the company's earlier 400 'Super M' series. The original 412 cartridge is one of our long-term favourites, and any improvement on this (as promised by the 412-11 and new 422 with SST (Super-Sonic Tracing) stylus is good news indeed. Philips' new Motional Feedback Speakers were reproducing remarkably deep sounds and we're making arrangements to have a closer look at these in the near future.

Sonab was showing for the first time a range of amplifiers by Dynavector, complementing the already highly-regarded high-output MC cartridges. Dynavector's fascinating high-mass/low mass aim was exhibited together with a custom-built turntable carrying no less than three arms making cartridge comparison a breeze! The amplifiers are all-valve designs and though extremely expensive (how about $4,000-odd for 50 watts per channel) seem to have a very fine performance indeed. An interesting feature of the valve power amplifier is toroidal output transformers, which are more efficient and smaller than conventional types. Nevertheless, the power amplifier is extremely heavy — too heavy to be carried comfortably by one person!

The Haco display included a dazzling range of Technics equipment, with that company's version of the Elcaset format being shown for the first time. Technics should be congrtulated for putting on one of the most dramatic demonstrations of hi-fi sound ever heard at an audio show.

The demonstration was introduced by a taped speech and then attention was switched to a live drummer using hands and brushes. After a few moments the drummer changed over to sticks and then fairly went at it! Then, just as the audience wondered how on earth he could keep up the pressure he stood up and walked away — but the (now taped) sound continued — with little apparent difference in level or quality. A most convincing demonstration of the ability of the new Technics RS-1500US open reel tape deck and the company's top range amplifiers and speakers.

TEAC's new Elcaset recorder was on demonstration at the Show, and another machine of note was the DBX-

Haco's dramatic 'live/recording' demonstration featured Techics audio equipment.

TECHNICS PRESENTS ITS CREDENTIALS.

Technics Model SL-2000

Technics invented the world's first direct-drive turntable. The concept was elegantly simple, because the platter was an extension of the DC servo motor which revolved at precisely record-playing speed. This eliminated the need for belts, gears and idlers – the sources of vibrations, wow and flutter.

Our first sensational direct-drive turntable has since been succeeded by a whole family of them, including a thoroughly professional model with quartz-crystal speed control, so accurate that 'drift' over a 30-minute LP side is less than 0.036 of a second. Its great speed accuracy, plus enormous torque and super fast start/stop action makes it the choice of top broadcasting stations and discos both in Australia and throughout the world. Naturally we are proud of this, but the real sense of 'mission accomplished' comes from the fact that creative use of automation has brought direct-drive turntables within the reach of millions of discerning music-lovers.

The Technics range includes more models than anyone else – in manual, semi-automatic or fully automatic. But there's a lot more to Technics direct-drive than just more models of turntables. There's more precision, better performance and greater reliability.

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National Technics hi-fi

T77.14

National Semiconductor showed this remarkable calculator/watch which apart from impressive time-keeping functions incorporates a full scientific calculator!

equipped A860 cassette unit. Tascam, Silver and Blaupunkt products were also on display.

All the exciting new Nakamichi products, including improved versions of the TT1000 and TT700 cassette recorders and a new model, the N500 (based on the designed previously made for Thorn and Sonab) were seen in the Convoy room together with the latest TDK tapes, B & W loudspeakers and very elegant Bang & Olufsen products.

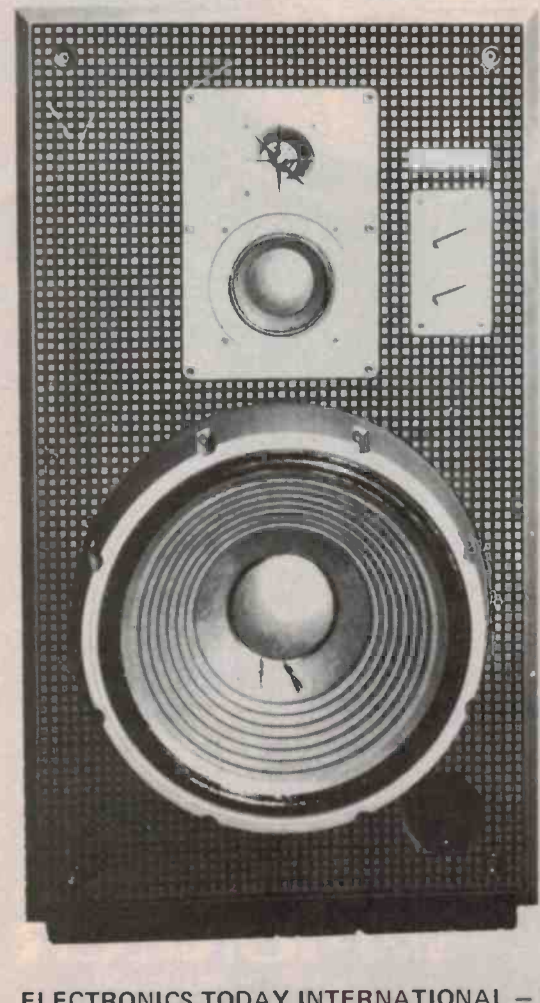
JBL's three-piece L212 speaker system and Harman Kardon's new Citation 17 preamp and revised Citation 16 power amp were featured impressively in Harman's exhibit together with the excellent ST-7 Rabco turntable and more conventional turntables from CEC, these, incidentally, offering very good performance at reasonable prices.

Rank displayed a number of products including new speakers from Altec, amplifiers and speakers from Leak and Wharfedale, turntables by Thorens including the fine new 126ABC, a wide range from Sansui and Ortofon cartridges. Rampec showed speakers by Avid and Ultralinear, amplifiers and tuner-amps from NAD, turntables from Dual and Perpetuum-Ebner, tapes from Capitol and cartridges from Pickering.

Pioneer's huge range was also impressively displayed with a new rack-mounting system, and new tape, amplifier and speaker components. Particularly interesting were the new high-polymer tweeters which showed enormous potential.

As if all this were not enough, the upper exhibition floors of the Sydney Hilton were crammed to overflowing with exciting new products. Tremendous interest was aroused with Phase-Linear's new Phase III speaker system, using a pair of upper-frequency panel radiators and a common, separate bass-bin — similar in concept to the JBL L121. Excellent sounds were delivered in the Megasound room via the Win Labs. SDT-10611 cartridge. Phase Linear amplification and the Phase III and ESS Heil loudspeakers. Surprisingly, the Heil bass unit, first seen in public at last year's CES, was not in evidence this year.

AMW Acoustic Labs, whose fine range of speakers has been highly acclaimed in the past couple of years, sprung an interesting surprise. Most visitors to the AMW exhibit had expected to find a new speaker system, but the sound of a new hybrid valve/transistor power amplifier more than made up for the disappointment. Designed and made in Australia, the new amplifier will be available at around the $1900 mark later this year. A most interesting feature is a bias voltage adjustment system using LED indicators, which enables the output valves to be optimally biased giving a far longer service life.



◀ *Sony's big G7 speaker attracted a great deal of attention—especially from representatives of competing brands.*

▼ *Beautifully made one-off turntable is used by Sonab to demonstrate differences between tone arms.*

Blow the lid off your super-highs.

HPM-150

Pioneer's new HPM-150 is guaranteed to take your music listening enjoyment higher than any other maker. Up to 40,000Hz to be exact.

Four speakers laid out four ways, the HPM-150 features Pioneer's exclusive HPM (High Polymer Membrane) super-tweeter in its own glass-topped enclosure. The cylindrical diaphragm covers a wider 270° range, thereby putting an end to narrow beam tweeter directionality. Arranged on a system of five vertical horns, the ultra-thin high polymer membrane responds in a more natural "breathing motion" over its entire surface. And efficiency is increased by as much as 6dB in the horizontal plane. But, forget the numbers, you can hear a difference like that.

At the low end, the HPM-150 offers a fantastic 40cm (15¾-inch) woofer with a carbon fiber blended cone. Possessing a high modulus of elasticity, yet having high mechanical strength, this cone material reduces internal loss of power and eliminates audible distortion. Again, Pioneer continues to give you more bass for your bucks.

In between, a 10cm (4-inch) cone midrange and lightweight cone tweeter round out the all-important middle of the sound spectrum with excellent transient characteristics plus wide dynamic margin.

And Pioneer's HPM-150 is built tough to handle every percussive note without missing a beat. Nominal input power is 125 watts. But, this system is so versatile, it can be driven successfully with amps ranging from 50 to 300 watts per channel (RMS).

Pioneer's new HPM-150 speaker system. New meaning to the word super-high. Both in quality of reproduction and listening satisfaction.

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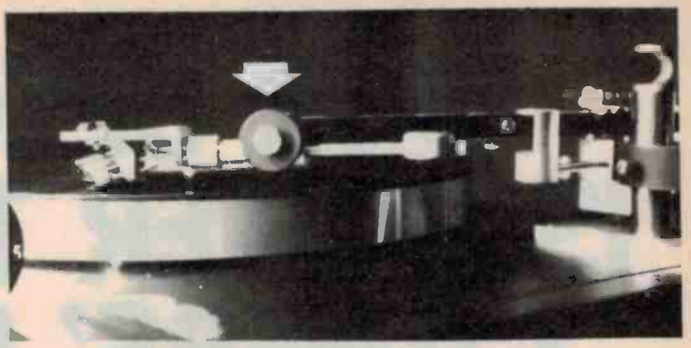


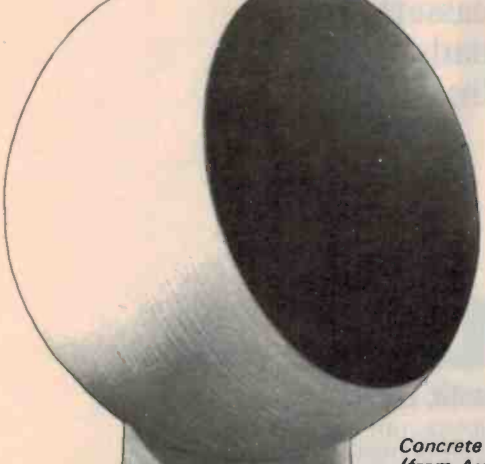
Dynavector arm—displayed by Sonab, is articulated at the point arrowed.

AWA was attracting large crowds with such established brands as Denon, Revox and AKG. The company also presented a fine new range by Mitsubishi, including a super-power amplifier and matching preamp. Leroya demonstrated the SAE impulse noise reduction system and a turntable from Stanton employing a novel magnetic centre-bearing/suspension system.

Two Australian manufacturing enterprises were Phase Sound, with an interesting and soon-to-be-investigated range of loudspeakers, and Audiosphere, whose ball-shaped speakers were emitting expectedly uncoloured sounds.

Sony, with two suites on the 29th floor, displayed the most comprehensive array of tape recording equipment at the show, representing open reel, cassette and Elcaset. Videotape equipment was also featured on a number of exhibits, and it seems likely that high quality video equipment will soon be a financially feasible proposition for those wanting such facilities as TV projectors and colour recording hardware for use, perhaps, as an adjunct to the hi-fi audio system.

A highlight of the show was Arena Distributor's room, with a selection of top British, American and Japanese equipment. The oriental contribution was Accuphase and Fidelity Research; the USA's was Audio Research and Mark Levinson — all regarded as products within the 'state-of-the-art' bracket. From England were Gale speakers, claimed to have been much improved since a not totally favourable report, appeared in our companion magazine Hi-Fi Review. Also from the United Kingdom, this time from Scotland, was the Linn-Sondek LP12 turntable, informing everybody in absolute silence that all turntables are *not* equal, and last but not least from the wilds of Wiltshire, some twenty minutes' drive from Stonehenge, was the superb series of Naim amplifiers. We've already lent ears to the Naim 250 and have placed it well within our short list of top amplifiers; it happens to be very close to the top of that list.



Concrete sphere speakers (from Audiosphere) are based on work originally published by Harry F. Olsen in 1950. Response is remarkably clean.

EDS displayed and demonstrated a sophisticated range of speakers by Electro-Voice, models in the Interface series showing great audible promise, particularly for their prodigious bass performance.

The Accutrac turntable was also on display and gave many of us our first opportunity to see this computerised device. Made by Audio Dynamics Corporation — the manufacturers of the ADC pickup cartridges — this turntable employs a complete logic system which allows the user to programme the tracks on a record in an order which omits any tracks not wanted, but which will also repeat any favourite tracks.

The unit has a built-in infra red beam generator which is directed onto the record. The normal grooves on the record scatter the beam, but the unmodulated space between grooves reflects the beam back to a detector on the tone arm, so that the turntable can, in fact, sense the tracks.

To do complete justice to this year's CES, we would need the entire magazine. The audio gluttons amongst us had a feast, although as usual serious listening was well-nigh impossible, at least during the crowded periods when the show was open to the public. Despite this, the show makes a very valuable contribution by enabling listeners to see the extent of the range available at all price levels, to evaluate the potential of the hi-fi medium, and to discover where and when products on display are available.

We understand the Sydney CES will be held again next year and that accommodation is already being booked for the event. Those who missed this year's show can look forward to next year; it will be a show worth visiting if it's only half as good as this year's!

Valve Sound

A substantial number of ETI readers have asked us if we could run something on valve amplifiers — or 'valve sound' generally.

So far we have a couple of quite fascinating articles which purport to explain *why* valve amps sound different from transistor amps (although we're not convinced yet that the best of both do!) — and we've made some subjective comparisons between a couple of top quality valve amps and their transistor equivalents.

At this stage we would very much appreciate hearing from readers with special knowledge of valve amplifiers — and also from manufacturers (or their representatives) of valve amplifiers.

OUR SECOND BEST IS BETTER THAN MOST OTHERS' FIRST BEST.

TDK's AD (Acoustic Dynamic) is one of the world's finest cassette tapes but not the best cassette tape made by TDK.

Our SA (Super Avilyn) has the edge but that's only if you're using the special bias/equalisation setting on your tapedeck.

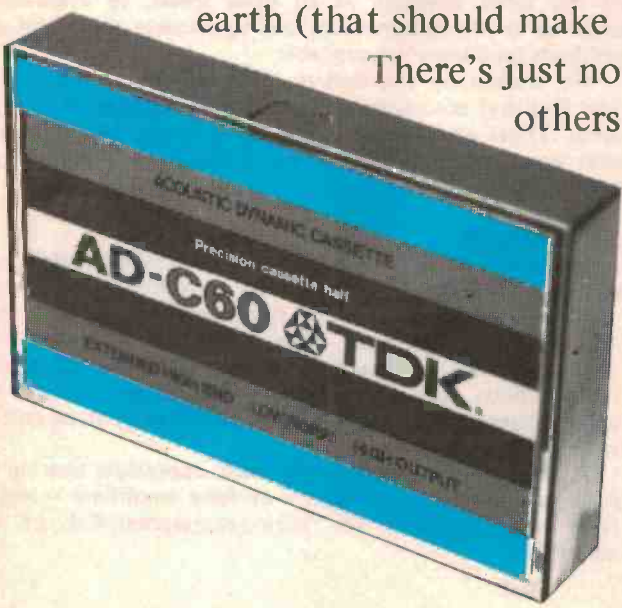
However, if you're using the normal or standard setting, you'll have to settle for AD – second best.

Chances are you won't find anything better or with more consistent sound quality for decks with normal tape selector settings (or no selector switch at all). In other words, even if you don't own extravagant equipment, with AD you can still hear extravagant sound reproduction.

You see, because of AD's superior dynamic range at the critical high end, you'll hear any music that features exciting "highs", with amazing brilliance and clarity you won't get from any other tape.

But there is something else you should hear before you try TDK's AD. The price.

Unlike other so-called "super premium" cassettes, AD's price is down-to-earth (that should make AD sound even better).



There's just no comparison between ours and what others consider to be their best. So try the second best cassette we've ever made – AD.

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SOUND BRIEFS

MORE AND LESS WEIGHT FROM SME

Having recently announced a new viscous damping attachment for 3009/11 Improved series pickup arms, SME now offers three new counterweights, extending the already available cartridge weight range of 4–9 gm to 1¼ – 22¼ gm.

AGS CASSETTE UNIT

AGS (who made one of the first-ever Dolby-B equipped cassette units, best remembered in its Wharfedale DC–9 guise) has now introduced a superb **low-price front loader.** This is model DC–22, Dolby-B equipped, of course, and with a ±3 dB response of 28 Hz – 16 kHz at –20 dB level (our measurement, not their claim). Looks like bargain cassette units are definitely on the way.

AMW VALVE AMP

Seen at the Sydney CES, and described in our special report, the prototype power amplifier from AMW Acoustic Labs uses a valve output stage and transistor drivers. Power output of this interesting hybrid design is claimed to be 100 watts RMS per channel.

DUAL DIVERSION

For those wishing to **play records upside down,** Dual can supply the answer. One of the new 1249 belt-drive turntables was seen at London's recent Heathrow audio show playing a record while dangling from a chain attached to its front left corner. Wonder how they stopped the record from falling off?

NEW NAIM

NAP 250 is Naim's **new power amplifier,** soon to be available in Australia together with a new preamp and revisions to the existing preamp – these to meet the complaint from certain quarters that no tape monitoring facility four source/recording comparison was available on the early versions of the NAC-22 preamp.

FOR TURNTABLE CONNOISSEURS

A new turntable from Connoisseur has recently made its debut in Australia. This is the BD3, a three-speed **belt-drive design.** Expected retail price is around the $200 mark, arm extra, but if the new model reflects the excellent price/performance ratio of earlier Connoisseur designs, it should be a winner.

You like music loud, right? But you don't like distortion. Right. That's why there's JBL.

Most loudspeakers aren't nearly as efficient as JBL. Most loudspeakers require up to 4 times the amplifier power to play as loud as JBL. Four times!

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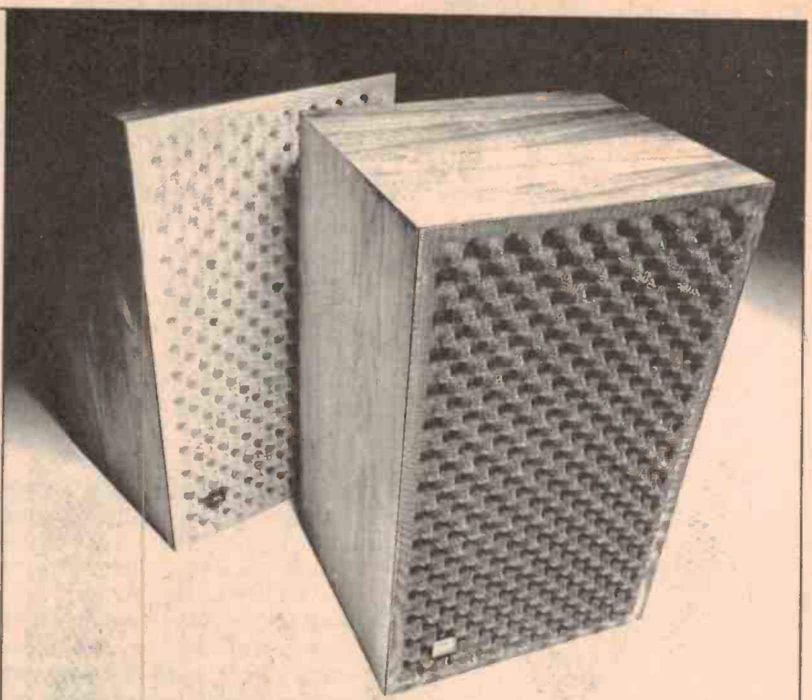
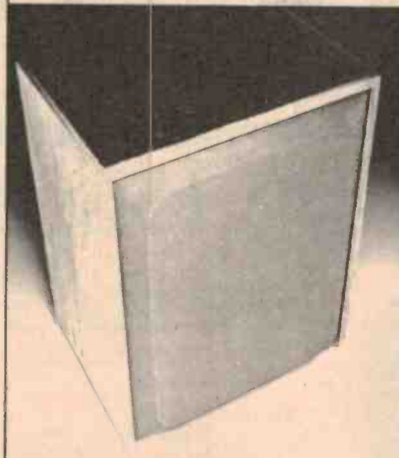
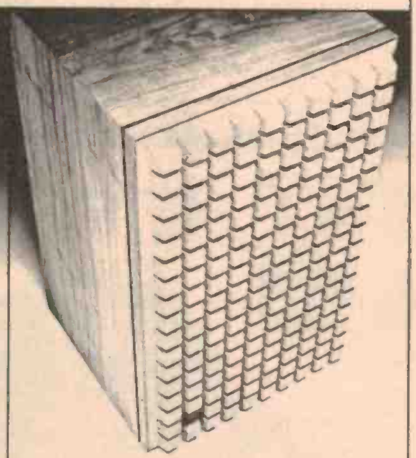


L166 — the most accurate bookshelf loudspeaker JBL has ever made. Oiled walnut finish with the most acoustically transparent grille ever created.



L65 — the smallest floor system JBL makes. Oiled walnut finish with smoked glass top. Cloth grilles in Midnight Blue, Rust Red or Earth Brown.



L100 — The three-way twin of a JBL professional studio monitor. Oiled walnut finish with blue, orange or brown air foam grille.

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V-15 Type III . . . critics called the Type III the finest cartridge ever when it was introduced. The ultimate test, however, has been time. The V-15's engineering innovations, the uniform quality, and superb performance remain unsurpassed by any other cartridge on the market today. 3/4 to 1-1/4 gram tracking force.

M24H . . . the cartridge that does not compromise stereo reproduction to add four-channel capability. Superb stereo trackability and quadriphonic carrier signal retrieval. New hyperbolic stylus tip, high energy magnet, and low-loss laminated electromagnetic structure. 1 to 1-1/2 gram tracking force.

M95ED . . . second only to the V-15 Type III in stereo reproduction. A thinner, uninterrupted pole piece minimizes magnetic losses. Its 20 to 20,000 Hz response remains essentially flat across the entire frequency range for excellent sound quality. 3/4 to 1-1/2 gram tracking force.

M91ED . . . excellent trackability at a lesser price. Shure Hi-Track has a smooth 20-20,000 Hz frequency response, ¾ to 1½ grams tracking force and an output voltage of 5.0mv per channel. Nude mounted diamond stylus tip.

M70EJ . . . the easiest way to upgrade your hi-fi stereo system without straining your budget. Basically flat response is comparable to other brand cartridges costing twice as much. 1-1/2 to 3 gram tracking force.

SC35C . . . Shure professional studio phono cartridge actually improves on-the-air playback quality of all recorded material. Cutaway stylus grip design and 'band alignment point'. Frequency response 20 to 20,000 Hz.

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AE124/FP

ADD-ON FM TUNER

This 'add-on' FM tuner may be incorporated into an existing AM radio or hi-fi system. It may be assembled in many different forms.
Design by Dr. B. R. Lewis of the University of Adelaide's Department of Physics.

THIS TUNER has a minimum of initial adjustments and few operating controls, it can draw its power from any widely varying available dc voltage source (for example, a power amplifier supply rail). Thus it is not intended primarily to compete with the 'free standing' designs published by ourselves and others. ref[1,2] Although it has somewhat similar IC complements, it is nevertheless capable of equally excellent performance. Distortion of 0.1% and signal to noise of 70dB (unweighted mono) was exhibited by the prototype using an HP spectrum analyzer.

Many options are available, – in one extreme case the tuning could be preset by a trimpot, with no meters or switches at all: the board being built into an existing amplifier as an extra programme source using no additional panel space. In another extreme case a line operated power supply could be provided, a 10 turn helipot used as a tuning control, tuning, carrier strength and frequency meters provided, AFC, mute defeat and mono/stereo switches provided, with the whole unit built into a wooden box whose front panel could be graced by the above controls plus a stereo indicator LED. The cost in the above two cases is estimated to be about $40 and about $80 respectively.

Practical Considerations

The tuner is constructed on a small, single sided printed circuit board, the pattern for which is shown in Fig. 4. The components layout is shown in Fig. 2. The in/out connections have a 0.2" spacing and are designed to be compatible with the McMurdo do-it-yourself plugs/sockets.

Piher trimpots are used throughout, all resistors are 0.5 W except R42, bypass capacitors are disc ceramic or TAG tantalum, and filter frequency determining capacitors should be mica, styroseal, or polyester for the larger values surrounding IC3. The external components shown in Fig. 2 are all optional except the tuning potentiometer RV6. No special constructional difficulties should be encountered.

Adjustments

Connect an antenna as shown in Fig. 2. Tune into the local stereo station by monitoring the stereo outputs with headphones or amplifier, ensuring that the mute defeat switch is on (closed) and that the AFC switch is off (connected to R36). Adjust RV4 until the oscillator signal at the test point (TP) reads 19.00 kHz or set RV4 halfway between the points at which the stereo LED comes on (anticlockwise and clockwise). Adjust RV5 until pins 6 of IC4,5 read about 6 V as read by a multimeter.

Observe pin 1 of IC2 with a high frequency oscilloscope and tune across the station, observing the rise and fall of the 10.7 MHz IF signal. Set the tuning so that this signal is maximized, thus ensuring that we are sitting centrally in the ceramic filter bandpass range. (If an oscilloscope is not available M2 may be used as an indicator of IF signal strength). Leave the tuning set and remove the secondary slug from L1. Adjust the primary slug so that the tuning meter is centred. Insert the secondary slug and adjust until maximum swing away from centre is observed on M3. Readjust the primary slug so that M3 is centred again. L1 is now adjusted.

Now detune the station slightly and turn the AFC on via SW3. Note that M3 swings towards centre from either side, confirming that tuning errors and thus distortion are decreased due to the action of the AFC.

Tune off the station, open SW1, and adjust the mute level control RV3, for reasonably quiet interstation noise. Verify that the station output is not muted on this setting.

The following section applies only if the frequency readout capability is required. Connect the output of a VHF signal generator into the aerial terminals and set to 98 MHz (assumed accurate). Adjust RV1 until M1 is centred. Set the generator to 88 MHz and adjust RV2 to give maximum negative deflection on M1. Set the generator to 108 MHz and verify maximum positive deflection on M1. (Some interaction occurs here and successive adjustments are necessary). The exact frequency scale can now be calibrated on to the meter. If no instruments are available the following may be used as a rough guide:

Frequency (MHz)	Tuning Voltage
88	2
98	6
108	18

The tuner is now fully adjusted and operation of all the controls may be rechecked.

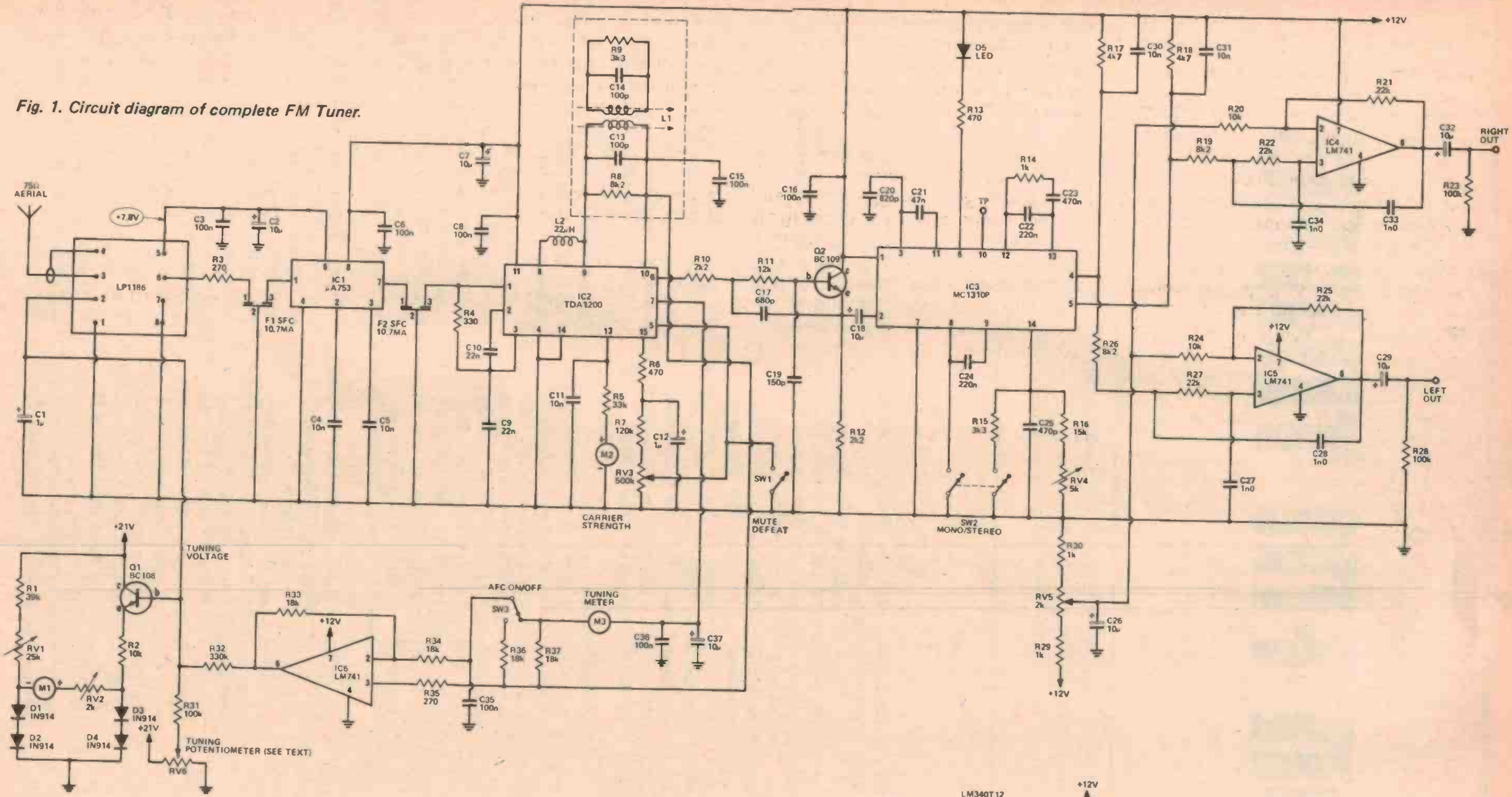


Fig. 1. Circuit diagram of complete FM Tuner.

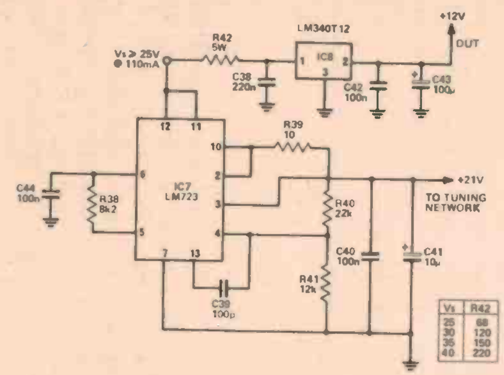


TABLE 1

Preferred design values for VCVS filters formed by IC4, IC5.

GAIN	R21,25	R19,26	R22,27
2.0	10k	12k	12k
3.2	22k	8k2	22k
4.3	33k	6k8	27k
5.7	47k	5k6	33k
6.6	56k	4k7	39k

Circuit Description

The full circuit for the tuner is shown in Fig. 1. The front end consists of the well known Mullard LP 1186 varicap tuned FM tuner module. At the time of writing this is still readily available. This module requires an 8V, 6 mA power supply (pin 5) and covers the frequency range 87.4 – 108 MHz with a diode tuning voltage range of 2-17V. Aerial (pins 3,4) and output (pin 6) impedances are 75Ω unbalanced and of course.

The IF signal from the LP1186 passes through the Murata ceramic resonator F1 to the IF amplifier IC1, R3 providing the correct input impedance match to F1. The output impedance of F1 and the input impedance of F2 are correctly matched by IC1 which has two separate outputs providing two choices of gain. In this circuit the lower gain is used (output the IF output centre frequency is 10.70± .05 MHz. Provision is made for an AFC input voltage, but in this circuit it was found more convenient to supply AFC as an additive correction on the tuning voltage (pin 2). The module has three stages, a tuned aerial and RF stage, giving good image and IF rejection, a separate oscillator stage for good signal handling, and a mixer stage with a double-tuned IF output circuit. Note that none of the adjustments on the LP 1186 should be tampered with.

The tuning voltage is derived from the rough supply voltage (V_s) via IC7, an LM 723 precision regulator connected to provide an output voltage of 20-21V at pin 3, current limited by R39. This voltage is filtered and applied across the tuning potentiometer (RV6) whose wiper provides the tuning voltage for the LP 1186 via R31. For general purpose use it is recommended that RV6 be a 10-100 k, 10 turn helipot since extremely fine control is needed over the tuning voltage for minimum distortion of the received programme. If it is not desired to have the AFC facility, the extreme stability requirement on the varicap voltage is satisfied by the choice of a precision regulator and a high quality helipot, but the inclusion of AFC is a strong recommendation. Other tuning potentiometer systems could of course be used. For example, a push-button tuning control using a set of voltage dividers and narrow range trimpots is quite feasible.

Since the dependence of tuned frequency on the varicap supply voltage follows a pseudo-logarithmic law, some form of compensation is required to produce a linearly scaled frequency readout. Q1 and associated components form a crude logarithmic converter, and it happens that the out of balance current passing through the centre zero meter M1 is nearly linearly related to the tuned frequency.[3] If a frequency readout is not required Q1 and associated components may be omitted pin 7), sufficient for city use, but if a higher sensitivity is desired it is quite easy to take the higher gain output (pin 5) instead. IC1 also includes a regulated power supply of 7.8V (pin 6) which is very convenient for powering the LP1186 module.

The amplified output from IC1 passes through the passband matched (same colour code as F1) filter F2, correctly loaded by R4, to the detector chip IC2, an SGS TDA1200 which performs the functions of FM amplification and detection, interchannel controlled muting, AFC output and carrier strength output. The TDA1200 is functionally identical to the TCA CA3089, but in the author's experience is better performed and much cheaper to obtain.

The carrier strength output (pin 13) may be used, if desired, to drive meter M2 via R5. The mute input (pin 5) takes the form of a dc volume control, and in this circuit, rather than the normal mute output (pin 12), the AGC output (pin 15) was used to control muting as a more sensible characteristic was observed. The mute level control RV3 can easily be set to receive a desired station strongly while largely eliminating interstation noise. The mute defeat switch SW1 is self explanatory.

The external components involved with the quadrature detection of the FM signal are the RFC L2 and the double tuned 10.7 MHz tank L1. Constructional details for L1 are given in Fig. 3 and adjustment procedures follow later. Note that the can of L1 forms an integral part of the circuit continuity if the author's printed circuit board layout is adopted, and that the circuit will not work without it.

The AFC output (pin 7) of IC2, relative to the reference bias (pin 10) is inverted by IC6 and added via R32 to the voltage provided by the tuning potentiometer is such a proportion and phase as to hold the captured station over a reasonable range of tuning voltage. In the future, when closely adjacent stations may exist in this country, less holding power will be desirable and R32 should be increased, or indeed the holding range limited to a maximum of less than the interstation spacing by back to back diodes across R33 or some such technique. At present the holding range is largely a matter of personal taste and it is fascinating to lower the value of R32 and watch the tuning control have virtually no effect as it is rotated through one turn or so.

The AFC output current is measured by the centre-zero meter M3 which acts as a tuning meter. The AFC may be switched out by SW3 without affecting the basic tuning voltage or the tuning meter action. Note that R35 is not strictly necessary but is used instead of a jumper for aesthetic reasons.

The detected output appears at pin 6 of IC2 and passes through the two pole VCVS active filter [4] formed by the network around Q2. This network has a response which is optimally flat to about 100 kHz and then rolls off sharply at 12 dB/octave above this, eliminating the undesirable effects of wideband noise[3]. Since the wanted components of the stereo signal extend only up to 53 kHz, these are unaffected by the filter.

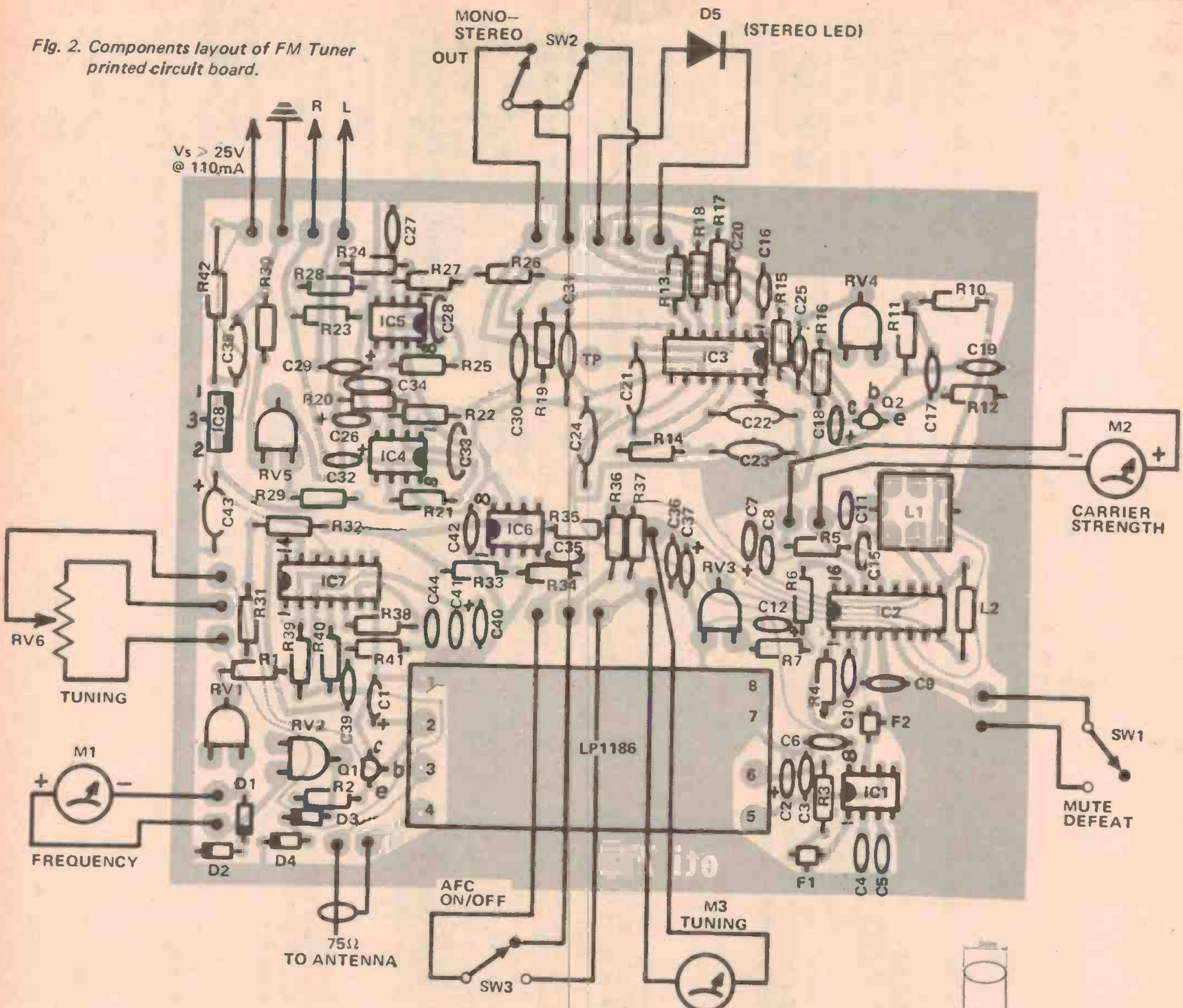
The multiplex signal now passes to the input of IC3, an MC1310P FM stereo demodulator connected in a standard circuit as recommended by the manufacturers.[5] No inductors are required for this phase locked loop chip which provides an output (pin 6) to directly drive the stereo indicator LED (D5) when a 19 kHz pilot tone of greater than 20 mV RMS is received at pin 2. Full details of the operation of IC3 may be obtained from the manufacturer.[5]

The 19 kHz output of the internal divided down oscillator is brought out from pin 10 to a test point to allow ready frequency adjustment. The frequency is determined by the external network C25, R16, RV4, and these components should be selected high stability, tight tolerance types. (C25 mica or styroseal, R16 metal film). Mono operation of the circuit is accomplised by closing SW2 which disables the oscillator to prevent interference, and disables the stereo switch to prevent false lamp triggering.

The demodulated left and right channel outputs appear at pins 4 and 5 respectively, and pass to identical VCVS two pole active filters[4] centred around IC4,5. These provide a basic gain of 3.2 and have a response which is optimally flat to 12 kHz and rolls off at 12dB/octave thereafter. This adds to the internal rejection of the MC1310P of 19 kHz and 38 kHz switching frequencies. All frequency determining components surrounding IC4,5 should once again be of accurate values and high stability. It should be noted that the gain of these output filter/amplifiers can of course be changed to suit individual purposes by changing R21,25 but this changes the shape of the frequency response (for example increasing R21, 25 will produce a large peak at the cut-off frequency). Thus if it is desired to change R21,25, then R19, 22 and R26,27 will have to be changed as well according to the values given in Table 1. With the circuit values shown outputs of about 3 V peak to peak are obtained on the maximum excursions of typical programme material. RV5 sets the dc operating conditions of IC4, 5 to ensure that their outputs (pins 6) sit at half rail voltage.

Most of the tuner runs from a 12 V rail obtained from the raw supply (V_s) via a standard three terminal regulator IC8. The circuit draws about 110 mA and excess power due to having an input voltage substantially greater than 12 V, is largely dissipated in R42, a 5 W wire wound resistor chosen according to the table on Fig. 1. IC8 does not require a heatsink.

Fig. 2. Components layout of FM Tuner printed circuit board.



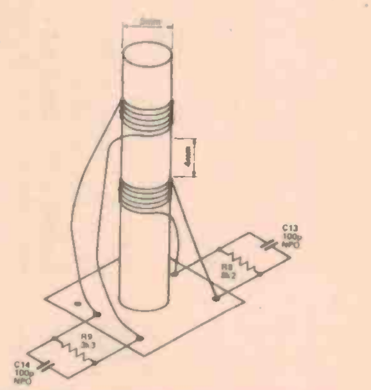


Fig. 3. Constructional details for quadrature coil L1.

Performance

The aerial sensitivity of the tuner has not been extensively studied, but is quite adequate for the normal metropolitan situation. IC1 has a choice of two gain options and wideband preamplification could be provided before the front end if fringe area reception were desired.

An HP spectrum analyzer was used to measure noise and distortion. Ultimate unweighted mono signal to noise ratio was found to be 70 dB while a distortion figure of 0.1% at 3V peak to peak output (mainly second harmonic) was obtainable if L1 was finely adjusted while observing the spectrum analyzer. For adjustment of L1 using the technique described earlier distortions of 0.2–0.3% (second and third harmonic) were obtained. These figures of course assume accurate tuning. Typical maximum output voltage was about 3 V peak to peak as stated earlier.

Specifications relating to RF performance are obtainable from the LP1186 data sheet.

References

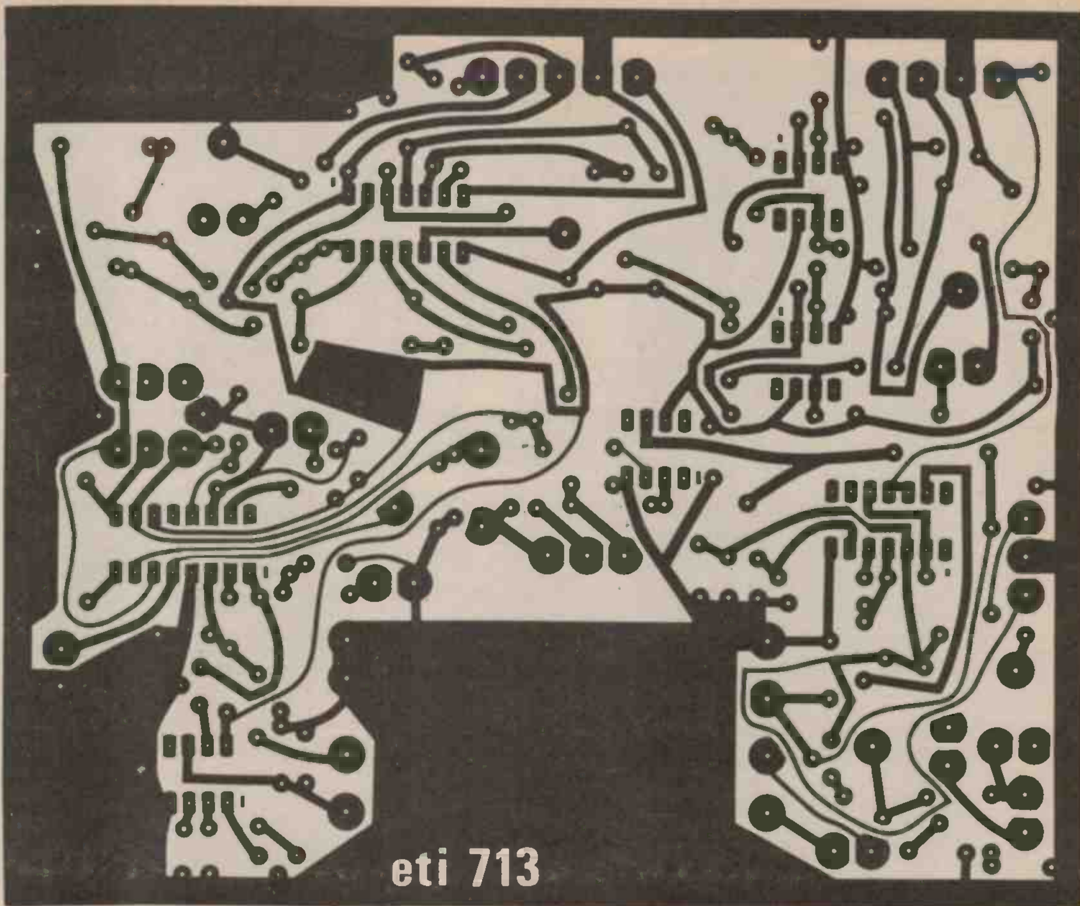
1. "ETI 740 FM Tuner" ETI, P. 27, March 1976.
2. "Playmaster 146 AM-FM Tuner" EA, p. 48, September 1975.
3. "Novel Stereo F.M. Tuner" (part 2) J.A. Skingley and N.C. Thompson, Wireless World, p. 124, May 1974.
4. "Operational Amplifiers – Design and Applications" J. Graeme, G. Tobey, L. Huelsman McGraw-Hill p. 297, 1971. (The well known Burr-Brown handbook)
5. Motorola Semiconductor Data Library. Vol 6, Series A "Linear Integrated Circuits" p. 8-19, 1975.

PRIMARY AND SECONDARY

22 turns 34 B & S close wound on Neosid long 5 mm former and separated by 4 mm.
2 Neosid F16 slugs.

R8,R9; C13,C14 are all connected to pins as shown and contained inside can.

Fig. 4. Printed circuit pattern for FM Tuner. Full size 142 x 118 mm.

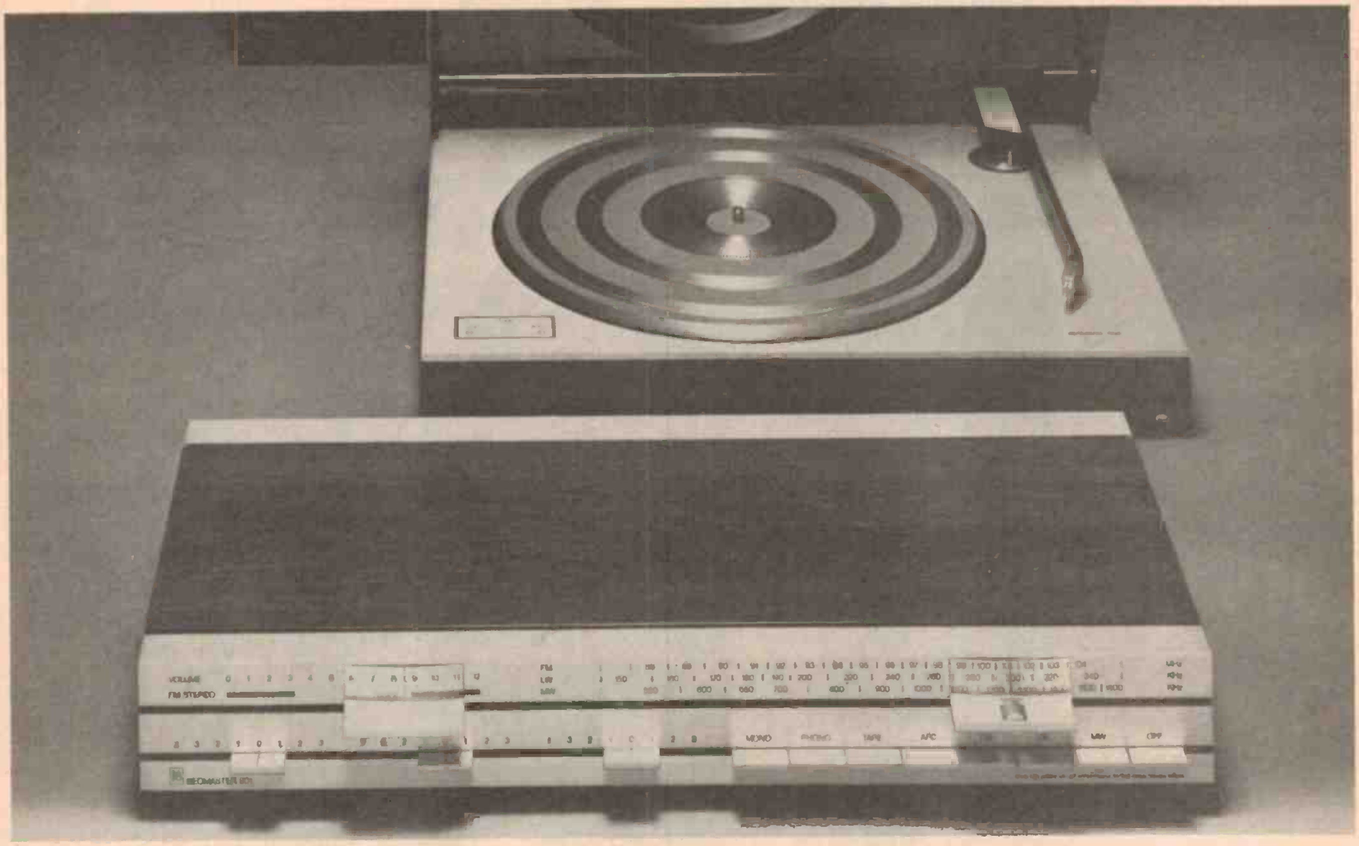


PARTS LIST – ETI 713

Resistors	all ½W 5%
R1	39k
R2	10k
R3	270
R4	330
R5	33k
R6	470
R7	120k
R8	8k2
R9	3k3
R10	2k2
R11	12k
R12	2k2
R13	470
R14	1k
R15	3k3
R16	15k
R17,18	4k7
R19	8k2
R20	10k
R21,22	22k
R23	100k
R24	10k
R25	22k
R26	8k2
R27	22k
R28	100k
R29,30	1k
R31	100k
R32	330k
R33	18k
R34	18k
R35	270
R36,37	18k
R38	8k2
R39	10
R40	22k
R41	12k
R42	see text
Potentiometers	
RV1	25k trim
RV2	2k "
RV3	500k "
RV4	5k "
RV5	2k "
RV6	10k–100k 10 turn rotary
Capacitors	
C1	1µ0 25V tantalum
C2	10µ 16V "
C3	100n disc ceramic
C4,5	10n polyester
C6	100n disc ceramic
C7	10µ 16V tantalum
C8	100n disc ceramic
C9,10	22n polyester
C11	10n "
C12	1µ0 25V tantalum
C13,14	100p ceramic
C15,16	100n disc ceramic
C17	680p *
C18	10µ 16V tantalum
C19	150p *
C20	820p ceramic
C21	47n polyester
C22	220n "
C23	470n "
C24	220n "
C25	470p ceramic
C26	10µ 16V tantalum
C27,28	1n0 *
C29	10µ 16V tantalum
C30,31	10n polyester
C32	10µ 16V tantalum
C33,34	1n0 *
C35,36	100n disc ceramic
C37	10µ 16V tantalum
C38	220n polyester
C39	100p ceramic
C40	100n disc ceramic
C41	10µ 16V tantalum
C42	100n disc ceramic
C43	100µ 16V electro
C44	100n disc ceramic

*low tolerance mica or stroseal

Inductors	
L1	see text
L2	22µ H RFC
Semiconductors	
IC1	µA 753
IC2	TDA 1200
IC3	MC 1310P
IC4–IC6	LM741
IC7	LM723
IC8	LM340T12
Q1	BC108
Q2	BC109
D1–D4	1N914
D5	LED
Miscellaneous	
PC board ETI 713	
SW1	SPDT toggle
SW2	DPDT toggle
SW3	SPDT toggle
M1	±100µ A centre zero
M2	200µ A
M3	±100µ A centre zero
F1,2	10.7 MHz filter SFC10.7MA
Tuner module LP1186	



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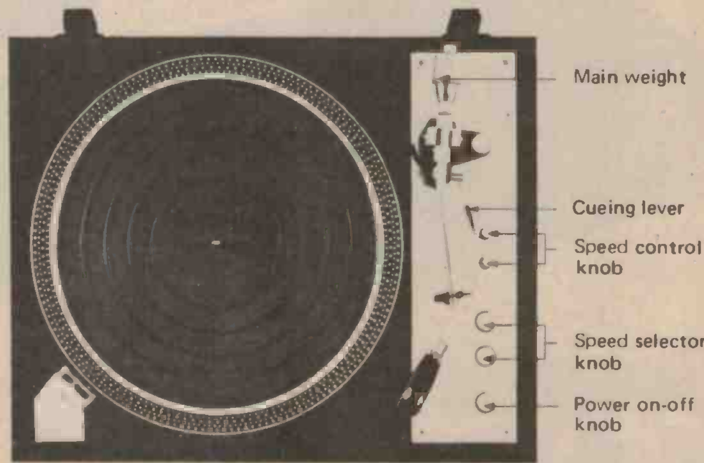

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DL-107

Output voltage: 2.0 mV (1 kHz 50 mm/sec)
Frequency response: 20 ~ 30,000 Hz
Tracking force: 2.0 ± 0.3 gr
Compliance: 8×10^{-6} cm/dyne
Weight: 8 gr

INTEGRATED STEREO AMPLIFIER

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- Wide power band (5Hz-55kHz/-3 dB at rated output).
- Audio muting switch.

Rated output 30W 30W
Dimensions 390 (W) x 145 (H) x 258 (D) mm.

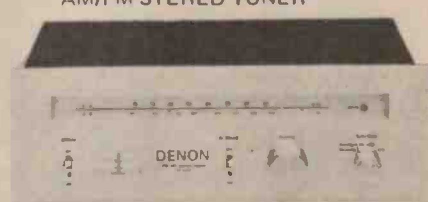
MOVING MAGNET CARTRIDGE

DL-109D

Output voltage: 3 mV (1 kHz 50 mm/sec)
Frequency response: 20 ~ 50,000 Hz
Tracking force: 1.8 ± 0.3 gr
Compliance: 9×10^{-6} cm/dyne
Weight: 7.5 gr

AM/FM STEREO TUNER

ST-3300



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SPECIFICATION — ETI 604

Rate	1 / sec. to 15 / sec.
Beat	Off, 1—1 to 1—9
Output power 9 volt supply	8 watts peak
Output frequency	800 Hz, 2500 Hz
Power supply	6 — 15 volts dc

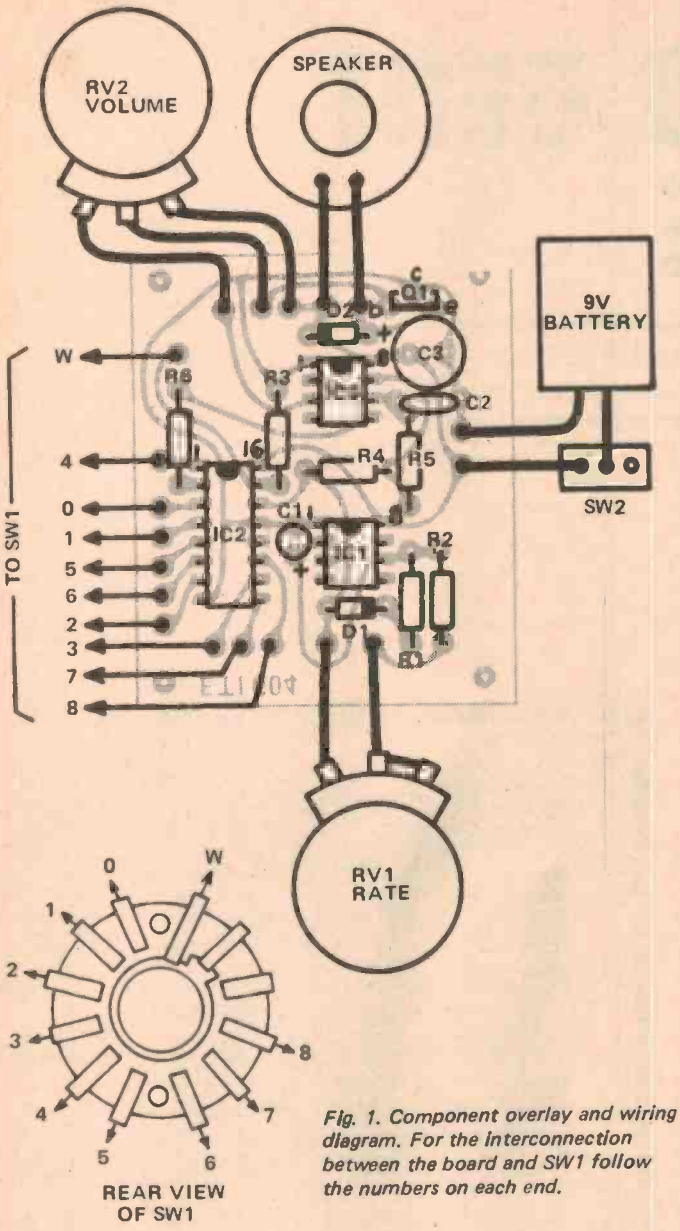


Fig. 1. Component overlay and wiring diagram. For the interconnection between the board and SW1 follow the numbers on each end.

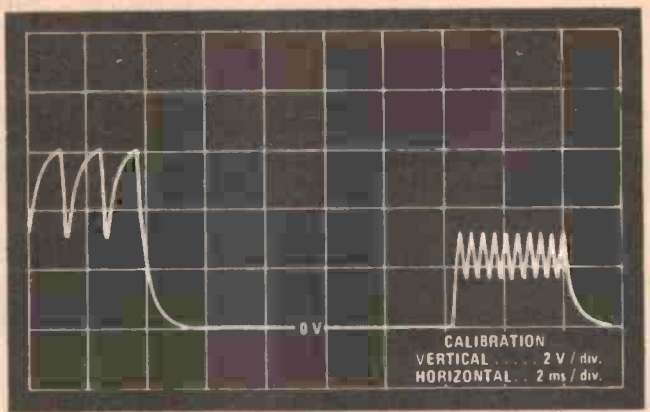


Fig. 2a. Waveform on pins 2 and 6 of IC3.

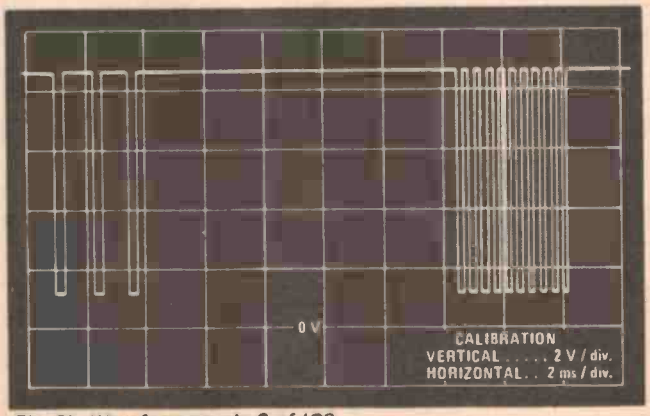


Fig. 2b. Waveform on pin 3 of IC3.

Fig. 2c. Waveform on pin 3 of IC1.
On these waveform diagrams the beat rate has been increased to show the two different outputs available.

PARTS LIST – ETI 604

Resistor	all ½ W, 5 %	**Semiconductors**	
R1	2k2	IC1	NE555 timer
R2	47k	IC2	4017 decade counter
R3	15k	IC3	NE555 timer
R4	1k	Q1	BD140 transistor
R5	15k	D1, 2	1N4004 diode
R6	4k7		
Potentiometers		**Miscellaneous**	
RV1	1M lin rotary	PC board ETI 604	
RV2	500 ohm lin rotary	Speaker	
		Plastic box	
Capacitors		6 way AA size battery holder	
C1	1µ0 16V	6 AA size batteries	
C2	22n polyester	3 knobs	
C3	100µ electro	SW1 single pole 11 position switch	
		SW2 single pole toggle switch	

Design Features

The metronome designs published so far simply use a dc pulse to drive the loudspeaker. The only way to change the sound of this type of output to give the accentuation required and to maintain an even beat is to change the amplitude. As this is not very satisfactory we decided to use a tone burst method instead.

Initially we tried a pulsed LC network which produced a very good sound but was a little complex and expensive so we finally decided on a pair of 555 timers. With this system we alter the tone frequency simply by

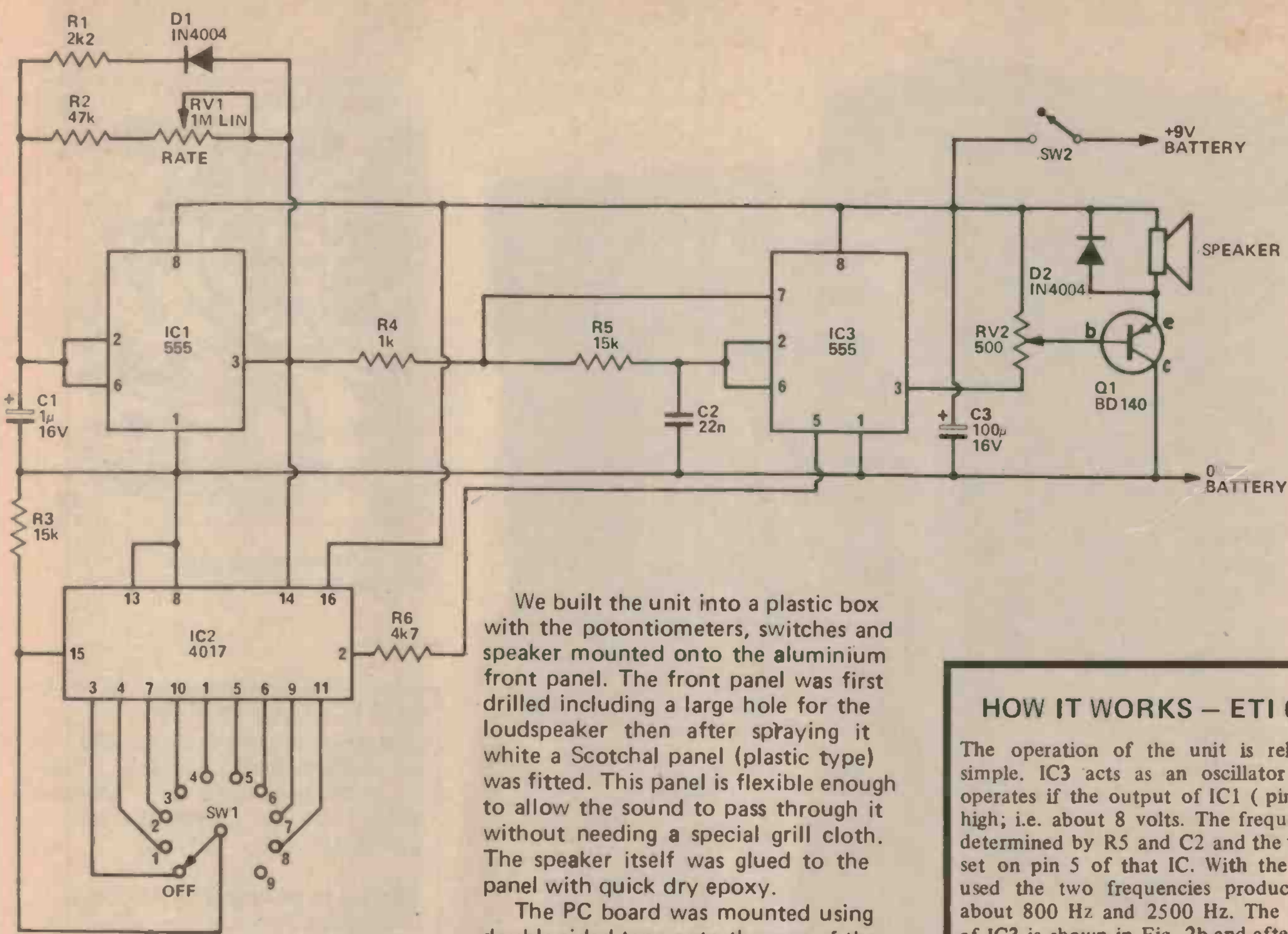


Fig. 3. Circuit diagram of the metronome.

varing the control voltage on the 555 driving the speaker. The other 555 timer is used to give the time between beats and the duration of the burst. A 4017 is used to count the beats and at the required time changes the control voltage of IC3.

When designing the PC board we considered mounting it on the rear of the wafer switch. However due to the number of different switches available we used wires to interconnect the switch to the PC board. The switch we used in the prototype was the OAK type as it was more readily available and also Australian made.

Construction

The unit is simple to build if the PC board is used. Assemble the board with the aid of the overlay diagram taking care to insert the transistor, ICs, diodes and the capacitors the correct way round. Some care should be taken in handling the 4017 IC; the pins should not be touched more than necessary and as well as it being the last component installed, pins 8 and 16 should be soldered first.

We built the unit into a plastic box with the potontiometers, switches and speaker mounted onto the aluminium front panel. The front panel was first drilled including a large hole for the loudspeaker then after spraying it white a Scotchal panel (plastic type) was fitted. This panel is flexible enough to allow the sound to pass through it without needing a special grill cloth. The speaker itself was glued to the panel with quick dry epoxy.

The PC board was mounted using double sided tape onto the rear of the speaker although it can be mounted in the rear of the box. The potentiometers, switches and speaker can be connected with hookup wire as shown in the overlay-wiring diagram. When connecting the battery ensure the polarity is correct as the unit will be damaged if it is reversed.

Late News

In our prototype we used nicad batteries which have a low internal resistance. Later we discovered when using standard dry cells that a slight irregularity occurred on the accentuated beat due to battery voltage fluctuations. If this is a problem with your unit it can be cured as follows:

1. Cut the PC board track between pin 8 of IC 1 and the point where the wire from SW 2 is joined and fit a diode (1N914 etc.), cathode to IC8, across the break.
2. Add a 100 μF 16 V capacitor across pins 1 and 8 of IC 1 (+ve to pin 8).
3. Add a 10 μF 16 V capacitor across pins 1 and 5 of IC 1 (+ve to pin 5).

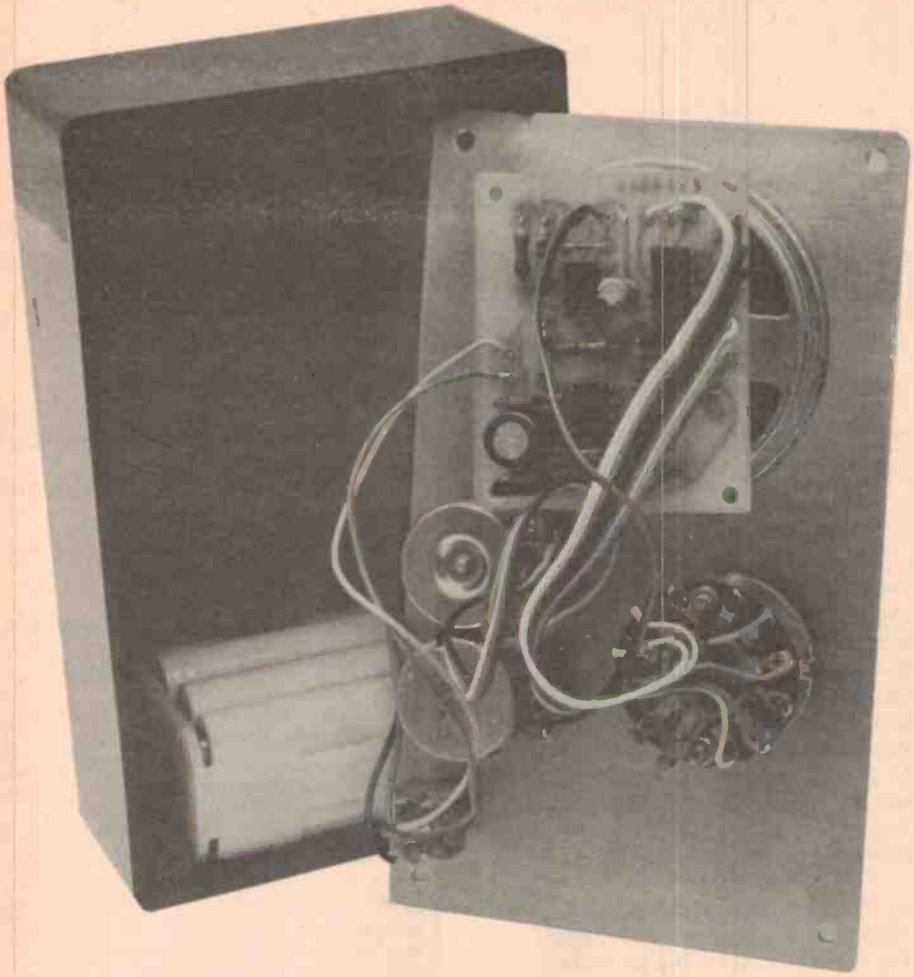
Alternatively, buy some nicads!

HOW IT WORKS – ETI 604

The operation of the unit is relatively simple. IC3 acts as an oscillator which operates if the output of IC1 (pin 3) is high; i.e. about 8 volts. The frequency is determined by R5 and C2 and the voltage set on pin 5 of that IC. With the values used the two frequencies produced are about 800 Hz and 2500 Hz. The output of IC3 is shown in Fig. 2b and after being attenuated (if required) by RV2, is buffered by Q1 which drives the speaker. The diode D2 is used to prevent reverse voltage from the speaker damaging Q1.

The first IC is used to generate the tone duration (about 4 ms.) and the time interval between beats. The interval is adjustable by RV1 while the tone duration is set by R1. Diode D1 isolates R1 in the interval period. The output of IC1 is shown in Fig. 2c.

The output of IC1 also clocks IC2 which is a decade counter with ten decoded outputs. Each of these outputs go high in sequence on each clock pulse. The second output of IC2 is connected to the control input of IC3 and is used to change the frequency. Therefore the first tone will be high frequency, the second low and the third to tenth will be high again. This gives the 9–1 beat. If the reset input is taken high the counter reverts back to the first state. We use this to limit the sequence length to less than ten by taking the appropriate output back to the reset input. If for example the 5th output is connected to the reset, the first tone will be high, the second low, the third and fourth high, then when the 5th output goes to a '1' it resets it back to the first which is a high tone. We then have 3 high and one low tone or a 3–1 beat. Actually the 5th output goes high only for about 100 ns. while the counter resets.



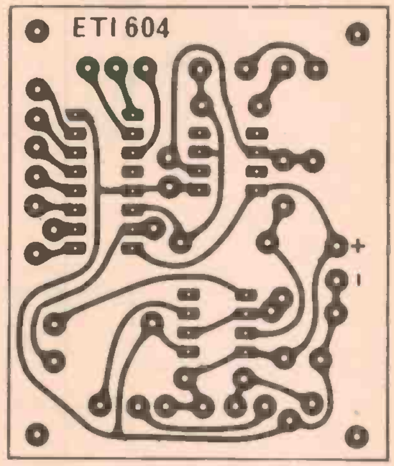


Fig. 4. Printed circuit layout. Full size 60 x 50 mm.

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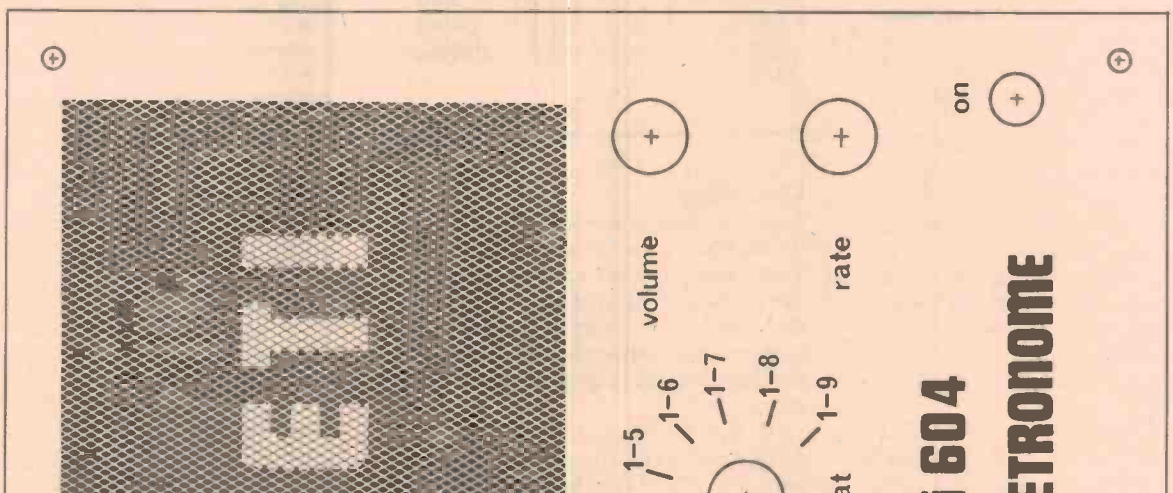
Fig. 5. Artwork for the front panel shown full size.



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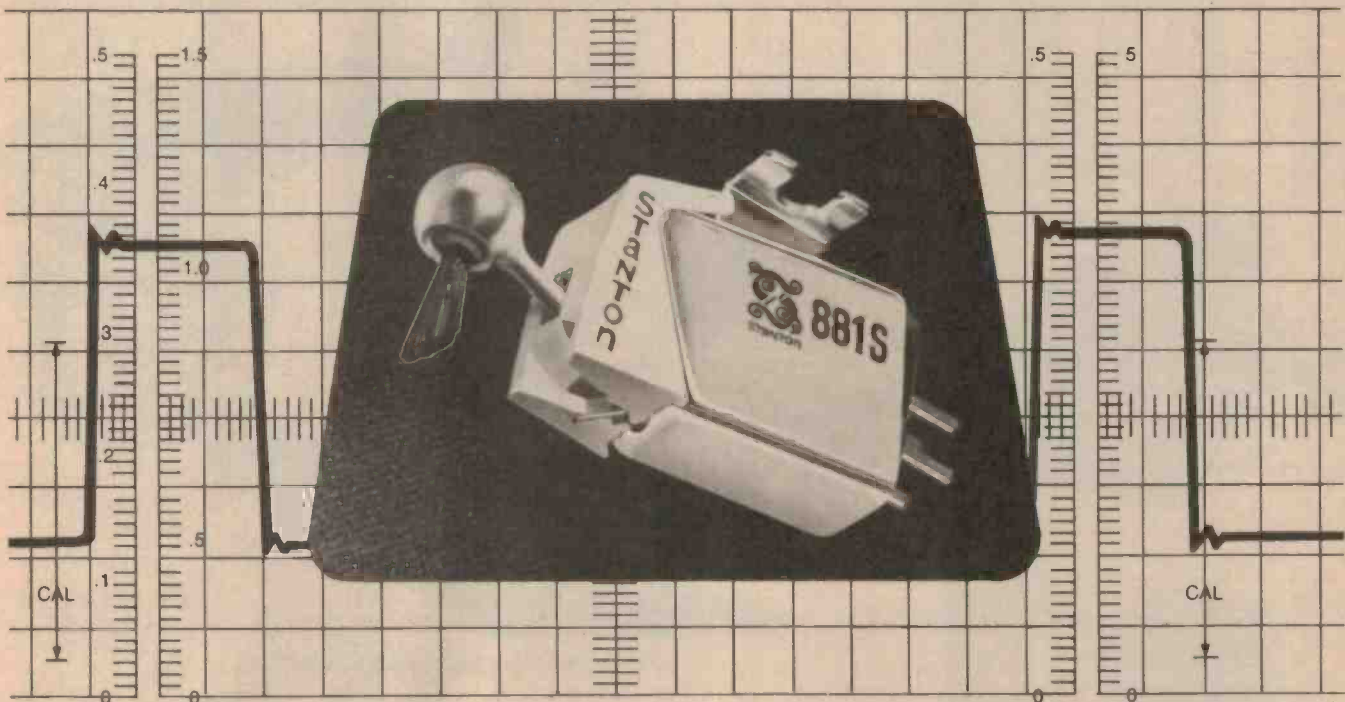

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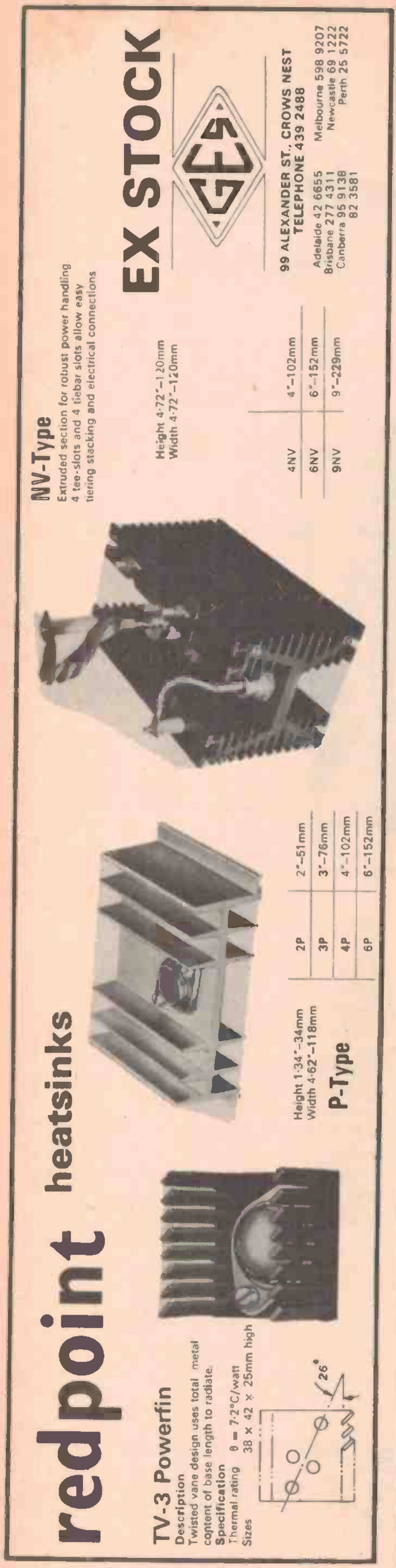

Met. Research

The Australian Bureau of Meterology and CSIRO have collaborated in the design of a buoy which will tell us of the meterology of the Indian Ocean.

Fig. 1. Met Officers launch a buoy for testing.

THE AUSTRALIAN bureau of Meteorology, which is part of the Federal Government Department of Science, is spending $350,000 on a drifting buoy programme as part of Australia's contribution to a world wide meteorological experiment aimed at improving the quality of weather forecasting. Australian industry is already involved in this programme following the letting of a contract for the manufacture of 50 buoy hulls. It is expected that tenders will be called soon for the fabrication and calibration of the electronic instrumentation system and the subsequent assembly of the complete buoys. The Bureau is already procuring the necessary electronic parts for supply to the successful contractor.

The buoys, which are to report sea surface temperature and atmospheric data, are to be produced by September 1978 to enable ocean deployment by December of the same year. They are based on the already proven Bureau/CSIRO design, which, in a pilot drifting buoy programme still in progress, has demonstrated ocean performance in excess of 450 days of reliable service which is a world record. The other countries producing buoys are at an earlier stage of buoy development.

The spar shaped buoys (see Fig. 1), are 5.3m long and weight 105kg. They employ a polyvinyl chloride and fibreglass hull developed by CSIRO Division of Fisheries and Oceanography. The instrumentation electronics is of Bureau of Meteorology design except for several specialised sub units of US manufacture. The energy source is a 70 ampere hour alkaline manganese battery pack.

Drifting Network

These buoys, together with other types now being developed by France, Canada, Norway and the United States, will bring the total number of buoys in the experiment to 300. These are to be deployed to constitute a drifting network, (see Fig. 2), in the southern hemisphere oceans in the band between 20° and 65° south latitude. It is expected that most of the Australian buoys will be deployed in this band

Buoys

between about 70° and 180° east longitude (i.e. mid Indian Ocean through to New Zealand) by Antarctic relief ships and commercial shipping during their regular schedules.

Data from the buoys will be collected by orbiting satellite and used in the First GARP Global Experiment (FGGE) which involves a combined observing system including drifting buoys and balloons, satellites, aircraft, specially deployed ships and ground stations. FGGE will involve national meteorological services and many other scientific organisations around the world in a coordinated effort to obtain meteorological data for the entire globe for a period of one year from December 1978. GARP (Global Atmospheric Research Program) is a joint undertaking by the World Meteorological Organisation (WMO) and the International Council of Scientific Unions (ICSU).

FGGE will mark the culmination of more than 10 years of international planning and will provide the comprehensive data base for subsequent research and development. Australia is a member of the 12 nation intergovernmental panel charged with the coordination, planning and execution of the experiment.

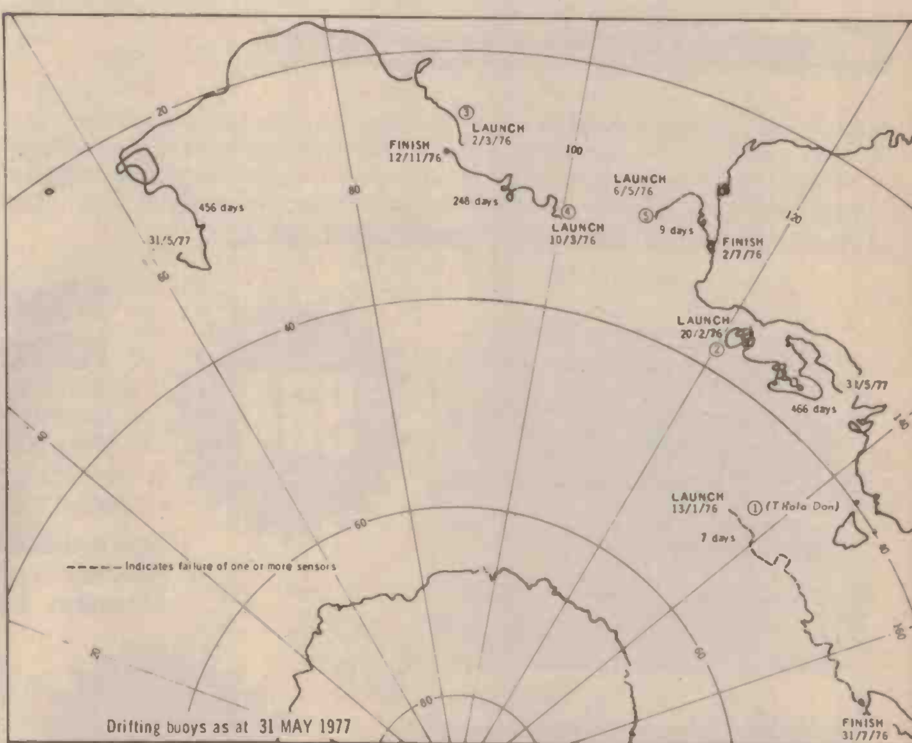

Fig. 2. The paths of previous tests.

Tropical Effort

Much of the data will flow from the existing global meteorological observing network and from geostationary meteorological satellites provided by the US., USSR, Japan and the European Space Agency. Special efforts are however being planned for the tropics and data sparse southern hemisphere. The planned drifting buoy network, including the 50 Australian buoys, will play a critical part in the southern hemisphere.

Buoy data, collected by the orbiting satellites, will be received by a satellite ground receiving station when over North America, from where they will be relayed to a buoy data processing and control centre at Toulouse in France which is being established by France as part of its contribution to FGGE. This processing will include the determination of buoy location to within 5km using the satellite observed doppler shift in buoy radio transmissions.

Better Forecasting

The data output of the Toulouse centre will be recorded on tape for transfer to the FGGE World Data Centres.

There will also be an output linked into the meteorological global telecommunications network, which it is expected will provide valuable buoy observation data in Melbourne in sufficient time for real time forecasting operations.

The satellite based telemetry system used to collect and process data received from the buoys during FGGE is expected to be available for use with drifting buoys through to at least 1985.

Electronics Calibration

The Bureau's contract requirements will include the need to calibrate the temperature measuring electronics over the range −5°C to +35°C, with an accuracy of 0.3°C traceable to the National Association of Testing Authorities (NATA) and barometric pressure measuring electronics is to be calibrated over the range 920 mb to 1048 mb, with an accuracy of 0.3 mb also traceable to NATA standards.

Due to the nature and importance of the application of the completed buoys it will be necessary for all sub-assemblies to be subjected to a "burn-in" phase. This is to include vibration testing in addition to temperature cycling of all circuit assemblies including the transmitter which will be a commercial unit. The Bureau's prototype instrumentation comprises a power regulator, a timing controller, temperature electronics and pressure electronics. Approximately 200 individual components are used in the assembly of these four units.

Tender documentation will be available in August from the Purchasing Office, Department of Administrative Services. Queries of a technical nature should be directed to the Bureau of Meteorology on (03) 6694167.

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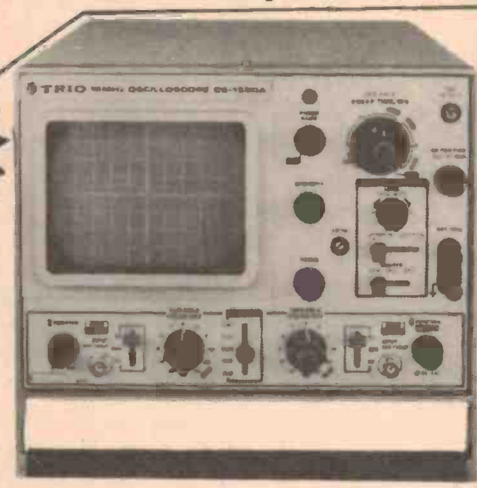

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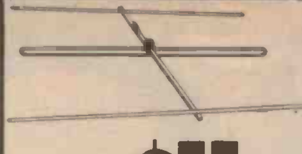

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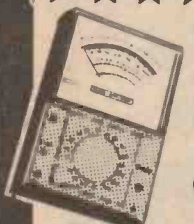

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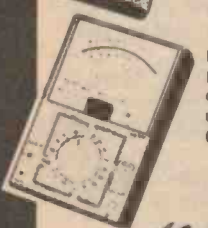

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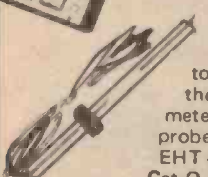

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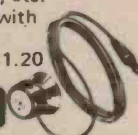

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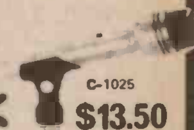

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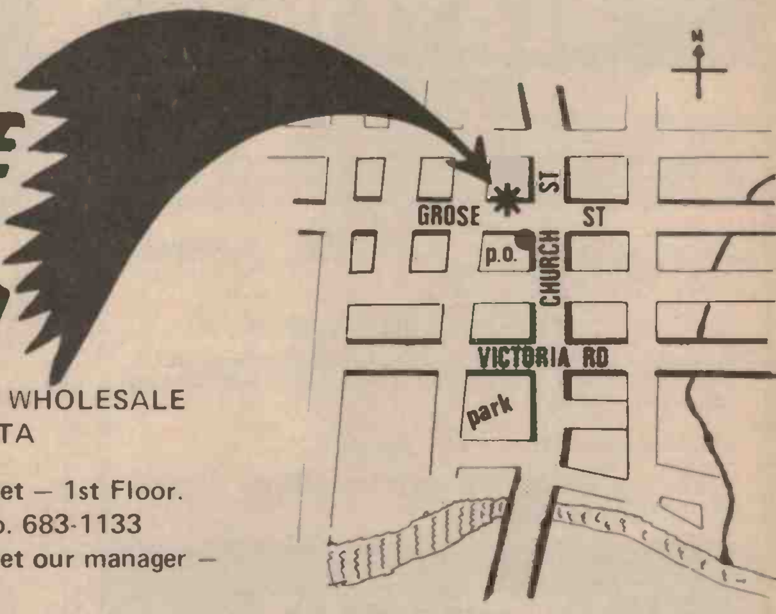

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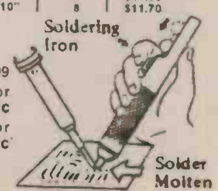

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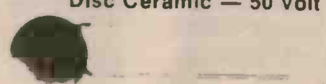

	1-9	10 up
2.2, 3.3, 4.7, 6.8, 8.2, 10, 15, 22, 33, 47, 68, 82, 100, 150, 220, 330, 470, 1K, 2K2, 3K3, 4K7, 10K, 22K, 47K pfd	11c	9c

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TIL211	Green	2.3 at 25mA	50mA	3	12" D	50c	48c	46c
TIL220	Red	1.6 at 20mA	50mA	3	2" D	28c	20c	19c
TIL222	Green	2.5 at 25mA	50mA	3	2" D	39c	30c	28c
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* What it is
* Where to use it
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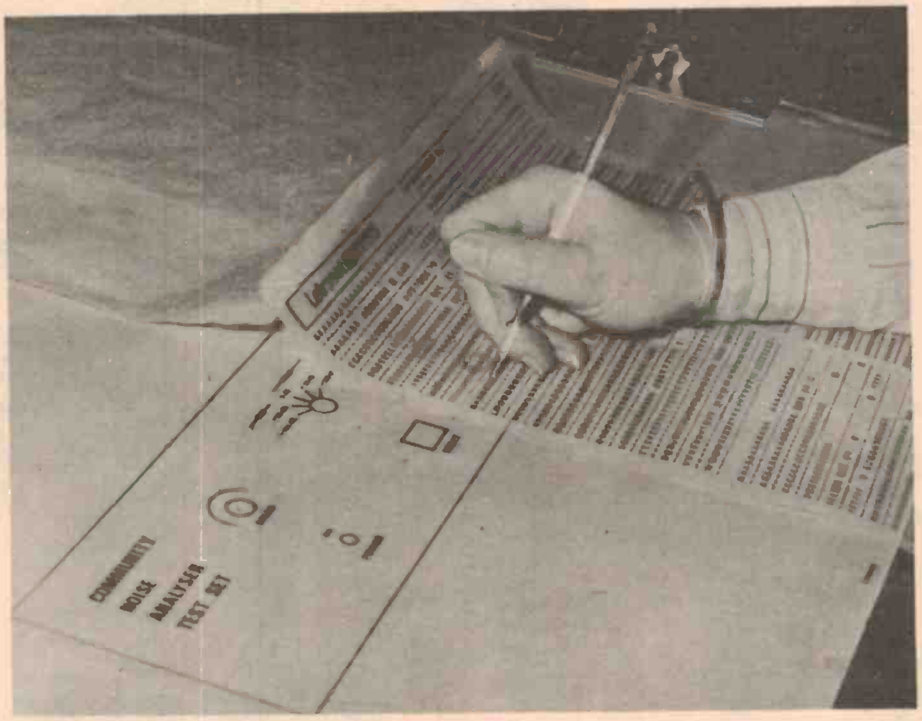


FOR THOSE UNFAMILIAR with Scotchcal, it is a photosensitve material, (like photographic film), which has a base material of either thin plastic or aluminium (0.13 mm thick). The photosensitive material on the surface comes in green, blue, red or black and the plastic base material can be clear, yellow or white (see table). Exposing the material to ultraviolet light through a negative hardens the material, and by developing it the area which is not exposed comes off leaving the base material visible.

Scotchcal has a self-adhesive backing and by peeling off the protective backing paper, it can be fitted to any surface. The plastic label can be fitted around curved surfaces or corners such as cylinders and pyramids but it will not stretch and so double curves such as spheres are out. While the aluminium can be bent around large curves, its springiness may cause problems of adhesion on small radius corners.

While Scotchcal has been around for some time, its cost, due to the box size, made it uneconomical for the hobbyist. It is now avaolable in single sheets at a little over $4 per square foot. It is very useful for making nameplates, meter scales, instrument panels, amplifier panels, logos and similar applications.

Sensitivity to Light

Scotchcal material is sensitive to ultraviolet light and can be safely handled under normal room lighting. When using sunlight as a UV source, it should not be handled in the sun for longer than necessary.

It should, however, always be stored in the lightproof wrapping supplied.

WARNING

The developer and aerosol sprays used have a strong vapour and should be used in a well ventilated area. Hands should be washed after using the developer and if either developer or protective spray gets into the eyes they should be washed out with water and medical attention sought. If the vapour affects the breathing get plenty of fresh air.

The Master

Before making a label a 'master' of the desired pattern is is needed. Unless photographic equipment is available, this master must be full size and on a transparent or translucent material. The easiest material to obtain is simply tracing paper. Lines can be drawn in black ink using a drawing pen while for lettering 'Letraset', 'Rapidtype' or a similar dry transfer is recommended. Large areas can be filled in with ink or some of the red tape used for PCB masters.

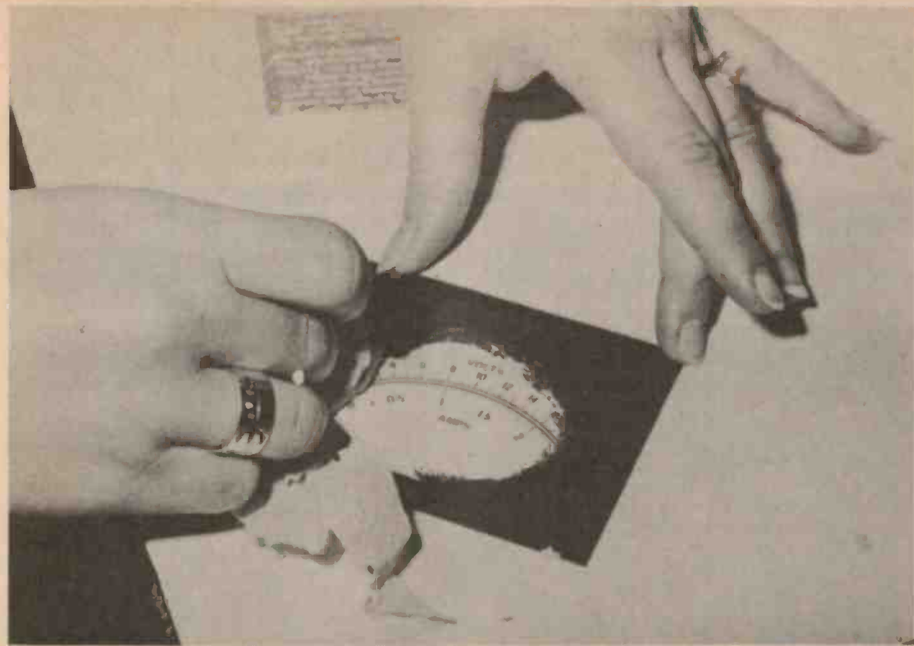
If photographic equipment is available the master can be made any size which is convenient and can be on an opaque (preferably white) backing. It can then be photographed and enlarged to give a *film* negative of what is required.

Making the Label

Exposure

The Scotchcal material is negative acting, i.e. what is clear on the master will be black (or the appropriate colour) on the label. If it is required that the clear areas on the master be the base colour on the panel then a negative is needed first.

Depending on the physical arrangement of your exposure equipment, a negative of the required panel should be held in contact with the active side of the Scotchcal (so that the writing can be read) and then exposed to a source of UV light. The exposure time depends on the light source, distance and the colour of the Scotchcal. Experiment with some small pieces first to get the right time. If the negative is good, over-exposing will not normally do any harm.



The Negative

If it is necessary to make a negative from the original master it is recommended that Scotchcal 8007 be used. This is a clear plastic (no adhesive) with an orange-yellow coating on the surface. This coating while apparently transparent is opaque to UV light.

This film is exposed similarly to the label material with one exception. This is that it is exposed on the non-emulsion surface unlike normal photographic films. The emulsion surface can be detected by its lack of gloss or by the fact that, if it is picked up by one corner, it will curl towards the emulsion surface. Exposure to the emulsion side will not result in a bad image — it will result in no image at all!

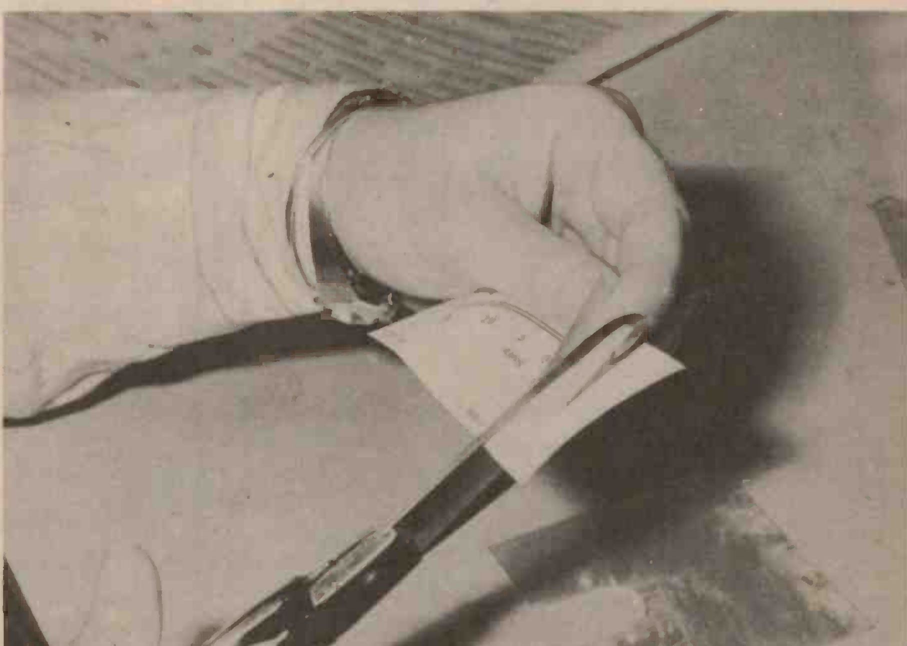
Developing

Place the label face up on a table and pour some developer on the surface, spreading it to give a liberal coating over the entire surface using a piece of cotton wool, tissue or soft paper. Allow it to settle for 5–10 seconds then, with a light rubbing action, remove the exposed material to leave the desired image. Wipe off the excess developer and allow to dry. It is not recommended that developer be skimped on as it is cheap compared to the labels (we find that 1 litre is enough for about 3 boxes or 15 large sheets of Scotchcal.

If excessive rubbing is necessary to remove the unwanted material the exposure was too long or the negative not opaque enough to UV light. If the image is not fast then try again with increased exposure time.

PHOTOSENSITIVE LABEL

Type No.	Colour	Backing
8001	Red	Aluminium
8005	Black	Aluminium
8009	Blue	Aluminium
8011	Red	White plastic
8012	Black	Clear plastic
8013	Black	Yellow plastic
8015	Black	White plastic
8016	Blue	White plastic
8018	Green	White plastic
8007	Exposure film	



Protective Coating

While the Scotchcal image won't change once developed, it consists of a coating on the surface and can be scratched or rubbed off if subjected to physical abuse. Two aerosol sprays, one matt, one gloss, have been specially developed for Scotchcal to extend the life of the label. The matt coating can only be used on metal labels.

The label should be placed in a dust-free area and wiped with a lint-free cloth. The surface should be sprayed to give a uniform coating and left to dry on a flat surface (it may run otherwise).

Exposure Equipment and Timing

These can be as elaborate or as simple as you like (or can afford) as long as the negative is held in contact with the Scotchcal while a source of UV is shone at it. For many years we simply used a sun lamp (for suntanning) hung over the edge of a table with the Scotchcal and negative sitting on a piece of foam plastic with a sheet of glass holding them down. With this method an exposure of about 15 minutes was needed.

We now use three Philips Actinic Blue (TLA20W/05) 20 W fluorescent lamps (standard 20 W fittings) at about 100 mm apart and 75 mm away from the Scotchcal and negative. With this setup the time required is about six minutes.

Machines used for making 'dyelines' normally use a UV source and will work by adjusting the speed. Whatever source of UV you use (remember as a last resort the sun can be used) experiment with small pieces first to get the best results.

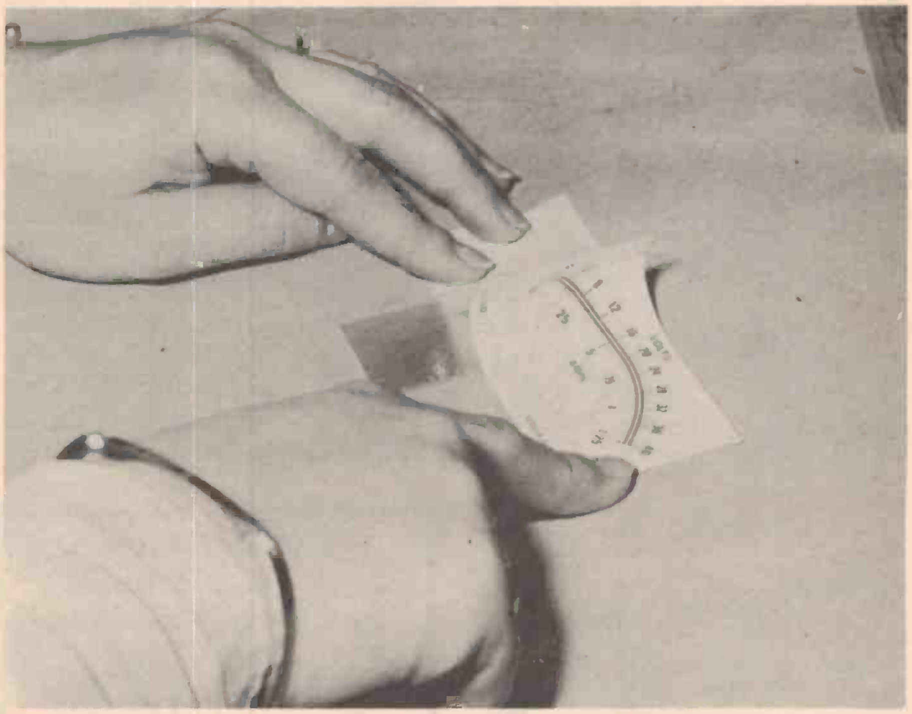
Scotchcal

The times quoted are for all colours except blue which needs only about half the time and the exposure film which needs about a quarter of the time specified. Remember if the negative is good, over-exposure will do no harm.

Application

As we said earlier, Scotchcal has a self-adhesive surface protected by a paper backing. With the aluminium panel, remove this backing, carefully line the label up and then bring the surfaces into contact. Smooth it down with a soft cloth. If the panel has to be drilled it is preferable to do this before the protective spray is used.

With the plastic label the surface to which it is to be applied must be smooth as any imperfection will show up through the thin material. Also, due to the thinness it is slightly translucent and it is preferable to spray the surface the same colour as the base colour of the Scotchcal before fixing the label. Also with the plastic label if a small section of the backing paper is cut off on one edge it can be lined up easily, this edge pressed down to locate the panel and then the backing peeled off while pressing down the label (see photo).



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4008	2.75	4023A	45c
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4.7	,,	10	,,	8c
4.7	,,	25	,,	8c
22	,,	10	,,	8c
22	,,	50	,,	15c
25	,,	25	,,	8c
33	,,	6.3	,,	9c
33	,,	16	,,	10c
47	,,	10	,,	12c
47	,,	25	,,	14c
47	,,	50	,,	15c
100	,,	10	,,	13c
100	,,	25	,,	15c
220	,,	6.3	,,	17c
220	,,	16	,,	17c
220	,,	35	,,	22c
470	,,	25	,,	22c
1000	,,	10	,,	35c
1000	,,	16	,,	36c
1000	,,	25	,,	47c
1000	,,	50	,,	80c

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SSB phasing rigs

Most people view phasing SSB as a technique belonging to the past. However, in this article Roger Harrison hopes to phase reverse your thinking by presenting some circuit ideas that are rare or non-existent in the amateur literature.

THE CLASSIC PHASING METHOD of SSB generation is shown in Fig. 1. Traditionally, the audio phase-shift network used passive techniques usually employing R-C components (see references 3 and 4), although active 90° audio phase difference circuits were sometimes used (references 5 and 6). Audio PSN's using L-C or R-L-C components are rare in literature, but a good circuit is described in reference 7. A modern active quadrature phase difference network was recently described by Dickey that used op-amps and R-C networks — see reference 8. We shall return to that one too.

These networks are all designed to provide a phase difference, between two output terminals, of 90° within ± 1° or so across the speech band from 300 Hz to 3 kHz or thereabouts. The text books will tell you that this sort of performance results in an opposite sideband suppression of −40 dB, which is generally regarded as a respectable figure. At the same time the amplitudes of the outputs must remain within 2% of each other to maintain the same performance. It is probably not worth striving for much better than this as the intermodulation distortion of any amplifiers succeeding the SSB generator will be greater than the level quoted.

The RF quadrature phase difference networks were traditionally designed for single-frequency operation or operation over a very narrow band. A wide variety of techniques have been employed over the years, ranging from simple R-C circuits to coupled coils. Thus, the SSB was generated on one frequency and then heterodyned to the desired output frequency. Specifications for the RF PSN are similar to that for the audio PSN.

One of the drawbacks of phasing SSB, that accounted for much of the subsequent popularity of the filter method, was the alignment and the long-term stability problems of the phasing technique. I now think that a phase-reversal on that view is possible, also.

To digress a little, let us consider for a moment direct-conversion techniques for SSB reception and perhaps generation. In 'Single Sideband for the Radio Amateur' (reference 9), Richard Taylor W1DAX describes a direct-conversion SSB receiver. A block diagram is shown in Fig. 2. The RF PSN covered the 20 m amateur band allowing the use of a variable local oscillator. If this technique is applied to Fig. 1 then we have direct-generation of SSB by the phasing method. Aha!

In one stroke we get rid of all those mixers and their nasty multiple-outputs-on-all-sorts-of-frequencies-including-the-

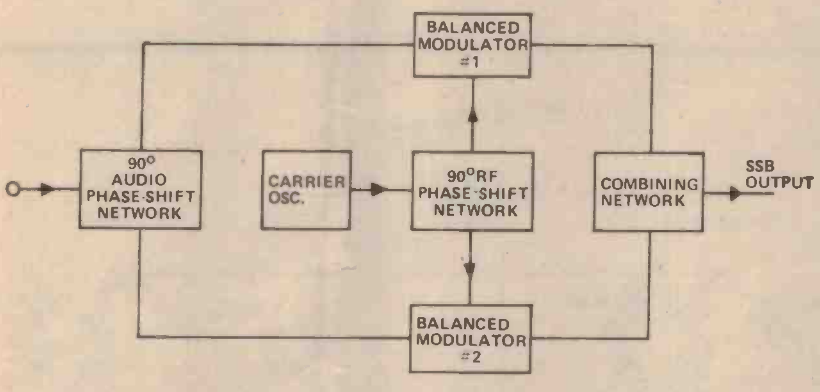

Fig. 1. Phasing method of SSB generation.

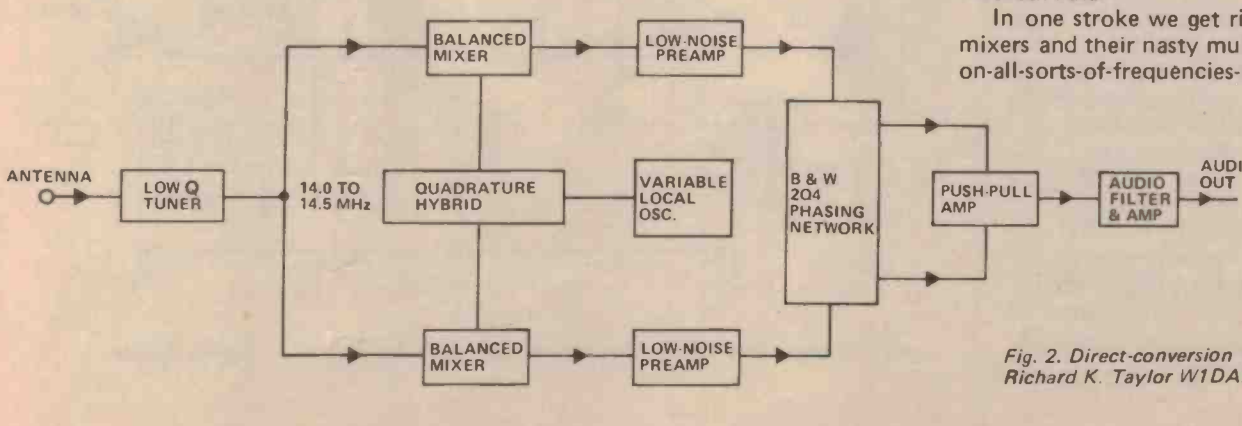

Fig. 2. Direct-conversion SSB receiver by Richard K. Taylor W1DAX (reference 9).

SSB phasing rigs

* All inductors for this network wound-on Philips toroids type 020-01010.

1.05 μH use 5 turns, 26 B&S enamel, close wound.
4.36 μH use 12 turns, 26 B&S enamel, spread around circumference of toroid.
15.4 μH use 24 turns, 26 B&S enamel around whole of circumference.
64.2 μH use 48 turns, 30 B&S enamel around whole of circumference.
26.3 pF use 27 pF, 5% NPO ceramic or silver mica.
110 pF use 110 pF, 5%, NPO ceramic or s.m.
386 pF use 390 pF, 5%, NPO ceramic or s.m.
1605 pF use 2700 pF, 5% and 3900 pF, 5% polyfilm capacitors in series.

Each arm in each bridge network is adjusted to resonate at the frequency shown.

T1,T2,T3 – see text.

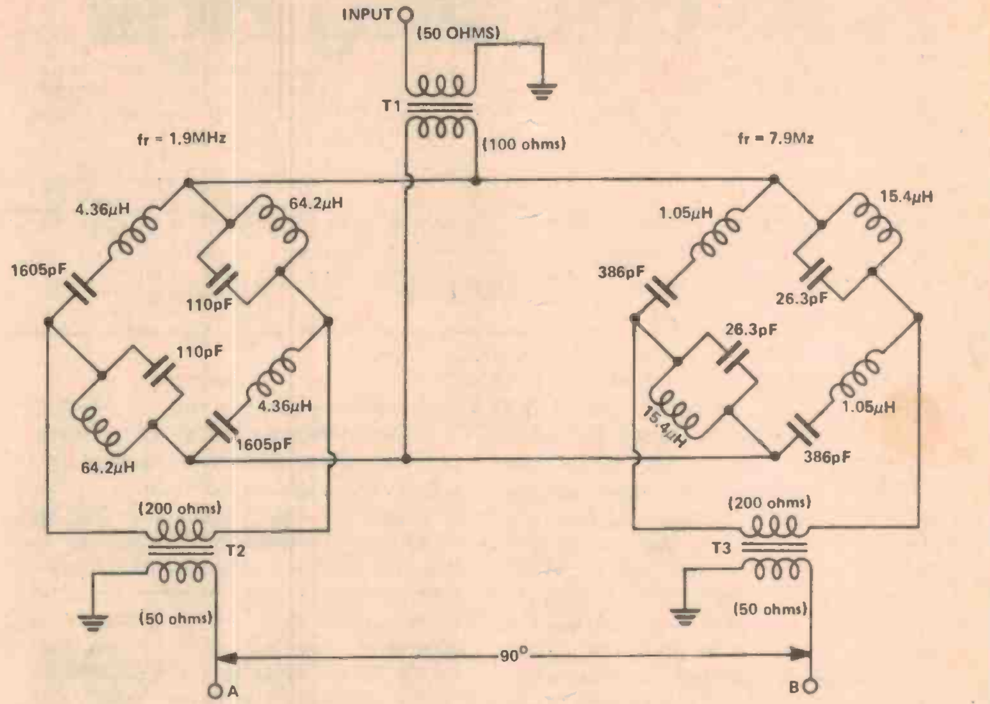

Fig. 3. Wideband RF quadrature phase difference network covering the range 1 MHz to 15 MHz designed by Jim Koehler, VE5FP. This network maintains a 90° phase difference between A and B within less than 1° across the range, and output amplitudes within 0.5 dB.

0.465 μH use 6 turns, 22 B&S enamel on 579x250x312/900 neosid toroid; spread around circumference.
1.84 μH use 6 turns, 30 B&S enamel, close wound on Philips toroid type 020-91010.
6.13 μH use 12 turns, 26 B&S enamel spread around 2/3 of Philips toroid 020-91010.
24.2 μH use 27 turns, 30 B&S enamel on Philips toroid 020-91010, spread around circumference.
12 pF use 12 pF, 5%, NPO ceramic or silver mica.
46pF use 47 pF, 5%, NPO ceramic or s.m.
153 pF use 150 pF, 5%, NPO ceramic or s.m.
604 pF use 680 pF, 5%, NPO ceramic or s.m. in series with a 5600 pF, 5% polyfilm capacitor.

Each arm in each bridge network is adjusted to resonate at the frequency shown.

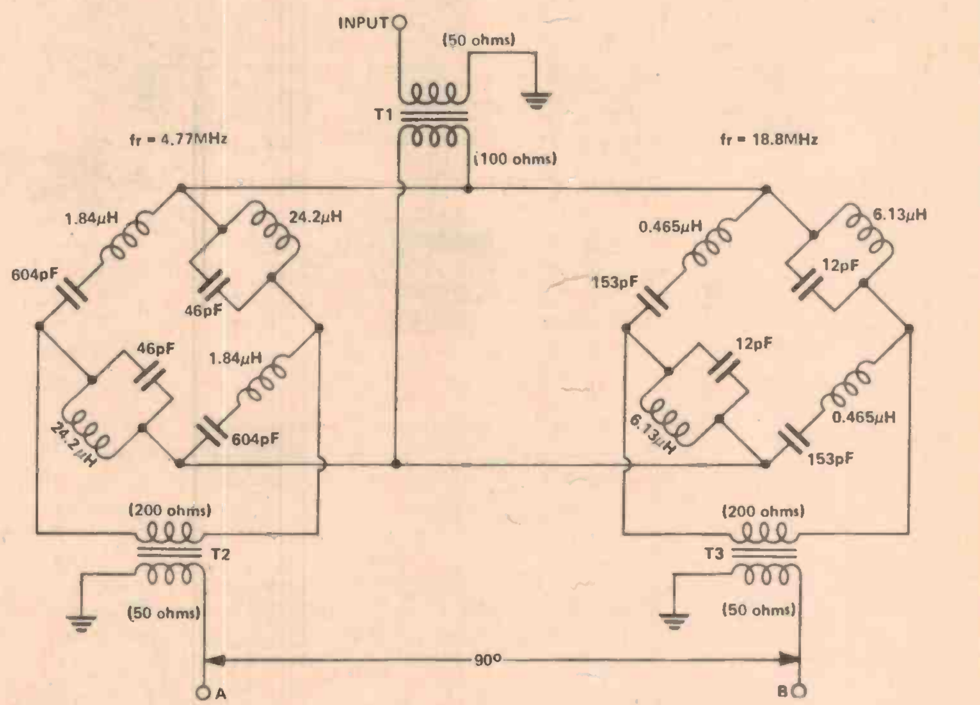

Fig 4. Wideband RF quadrature phase network similar to Fig. 3. but covering 3-30 MHz.

one-we-want that is necessary when SSB is generated on one frequency and then heterodyned to the output frequency – usually including a VFO and band-switching arrangement along the way.

But. . . I can hear you all saying, that's (Fig. 2) only in a single band. What we need is a passive, wideband RF quadrature phase difference network. Right on!

PASSIVE, WIDEBAND RF QUADRATURE PHASE DIFFERENCE NETWORKS

Now this is where the story really starts. Peruse Fig. 3. This network is courtesy of Jim Koehler VE5FP/ VK2BOV who designed it for a circularly polarised ionospheric antenna system during his sabbatical leave in Australia during 1974-75. Two bridge networks provide a 90° phase difference over the range 1 MHz to 15 MHz with a phase error of less than 1° and amplitude differences between the outputs less than 0.5 dB across the range. A similar network covering the decade from 3 MHz to 30 MHz is shown in Fig. 4. It has similar characteristics.

The input and output port impedances are 200 ohms for each bridge in the networks. The transformers T2 and T3 are wideband 4:1 RF transformers. These are available from commercial sources or you can make one yourself. A small toroid of F14 or similar material may be used or a dual-hole balun core such as the Neosid 1050/1/F14 would be suitable. To construct a suitable transformer using the latter, take three 180 mm lengths of number 26 or 30 B & S enamelled copper wire and twist them together to obtain about two twists per 10 mm. Wind three turns of this through the two holes of the balun core (i.e three turns around the centre leg of the core). Separate and identify the wires and connect the start of one to the finish of another so that the two windings are connected in series. This is then the 200 ohm winding. The third wire then becomes the 50 ohm winding (a more detailed description of a 4:1 transformer is given in ETI, June 1976, page 30).

If desired, the output windings of T2 and T3 may drive the input ports of diode-ring double balanced mixers directly.

Although the inputs of each bridge in the network are in parallel, resulting in an input impedance to the network of 100 ohms, T1 may be the same as T2 and T3 as the mismatch has no serious effect on the performance of the network.

The Q of each inductor in the network must be above 50 or 60, preferably higher, and the coupling between each arm of a bridge, other than the direct connection, must be kept to a minimum. Toroids are therefore recommended and have proved quite successful. As an alternative, standard coil formers and screened-can assemblies have been used but the Q must be adequate. Ferrite cup-cores used in conjunction with these assemblies are pretty well a must for this job. The data for the inductors specifies the use of some small toroids which result in quite high Q inductors of very small size.

Each arm (one L and one C) is constructed individually and the inductor is adjusted to resonate at the frequency indicated by squeezing or spreading the turns around the core of the toroid until resonance is achieved. A GDO was used to indicate resonance. A monitoring receiver is used to indicate how close to the frequency the GDO is. An accuracy of 10-20 kHz is sufficient. This operation should be carried out with the components in situ before they are finally connected as per the circuit.

The required capacitors may be selected by measuring a batch and using those of appropriate value. Where several are used in parallel or series to make up a value, they may be temporarily tacked together and measured, one of them being changed as necessary to arrive at or very near the required value. Values within ± 5% of the specified value are near enough.

Continued overleaf...

SSB phasing rigs

L1 = 176 turns of 26 B&S enamel wound-on single bobbin of VINKOR LA2330 pot core assembly.

L2 = 2090 turns of 42 swg enamel wound-on single bobbin of VINKOR LA2330 pot core assembly.

T1 = Two windings, one on each half of double bobbin, each 176 turns of 34 B&S enamel; VINKOR LA2330 pot core assembly.

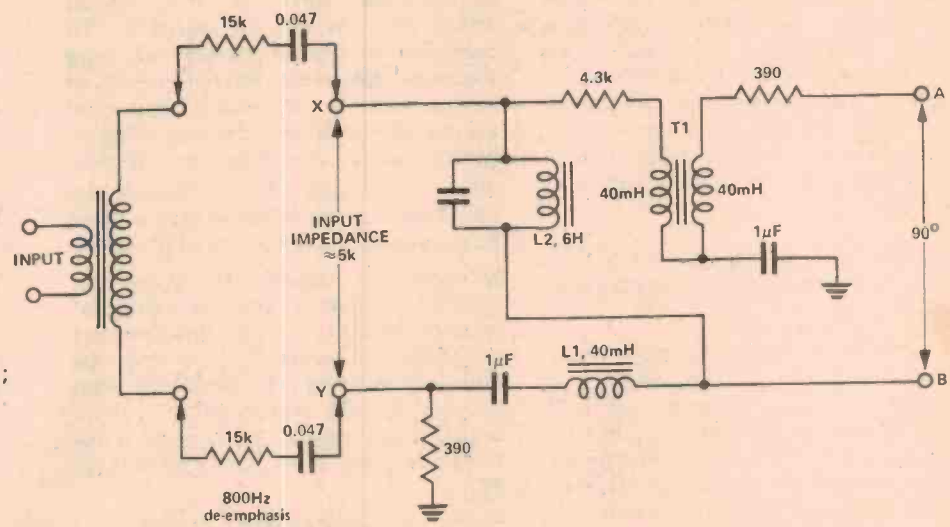

Fig. 5. Audio quadrature PSN using RLC components. This circuit was developed by Westinghouse in 1944 and described subsequently by Robert Cheek (W3LOE) in Nov. 1948 CQ.

Keep the layout symmetrical and uncluttered. Avoid long leads to the transformers.

Active wideband RF quadrature phase difference circuits have been described (reference 2 and 10). These use digital techniques which I won't go into here. The non-sinusoidal output waveforms of these circuits causes problems with spurii, and, although harmonics may be removed with low-pass filters following the generator, circuit simplicity is lost and the extra spurii are a factor that has to be taken into consideration. See reference 2.

AN UNUSUAL PASSIVE AUDIO PSN

The circuit in Fig. 5 is from reference 7. The network was designed by Westinghouse in 1944 and subsequently described by Cheek (W3LOE) in 1948 as part of a phasing-type SSB exciter. In contrast to most R-C PSN's, which call for component values within 1%, the components in this network are relatively non-critical. The resistors and capacitors may be standard 5% or 10% tolerance types. Composition resistors and paper capacitors were used in the circuit described by Cheek. The main requirement is that each 40 mH inductor must resonate with the 1 μF capacitor at 800 Hz. The exact values appear to be uncritical so long as components of the nominal value specified are used. The 6 H inductor and the 6.2 nF capacitor must resonate at 800 Hz also. In the original description, Cheek used re-wound audio transformers for L1 and T1 and two 3 H low current power supply chokes in series for L2.

The 40 mH inductors may be made from 88 mH toroids, which are popular with RTTY enthusiasts. These consist of two 44 mH coils wound on a toroid and connected in series. They can be obtained from local sources or from overseas suppliers. Turns may be removed from the 44 mH winding until resonance is achieved, using a 1 μF capacitor to tune the winding. For this operation, a CRO or VTVM and an audio oscillator are necessary. The oscillator could be coupled to the toroid by means of an added temporary link. Resonance should occur close to 800 Hz. The exact frequency has no magic about it, 800 Hz is simply the geometric mean between 160 Hz and 4000 Hz which adequately covers the speech band. What is important is that each LC pair of the network resonates to the same frequency. This could just as easily be 750 Hz (geometric mean between 200 Hz and 2800 Hz) or 900 Hz (geometric mean between 270 Hz and 3000 Hz).

The transformer, T1, consists of two windings having equal numbers of turns wound on the same core resonated at 800 Hz (or whatever) with the 1 μF capacitor. The two windings are connected in series, the dots on the circuit in Fig. 5 indicating the start of each winding.

Alternatively, each inductor may be wound on a standard pot-core assembly or a suitable low frequency toroid. The author wound a set of inductors on VINKOR pot-core assemblies. These make quite a compact package. Ordinary polyfilm capacitors were used.

The two quadrature outputs can drive into a low impedance, the characteristics of the PSN being largely unaffected by the actual load impedance, which may be as low as 400 ohms. Input impedance is about 5 k and should be floating with respect to ground — which necessitates a transformer or differential amplifier.

The speech amplifier preceding the PSN must include de-emphasis below 800 Hz. If the network is transformer driven a de-emphasis network consisting of two 15 k resistors and two 47 nF capacitors, connected in series with each input terminal, serves this purpose. The input impedance is then about 40 k and the input transformer should be suitable to drive this impedance. This is suggested by Cheek in reference 7.

This network maintains the 90° phase shift within ± 1° or better between 300 Hz and 3.5 kHz. The amplitude balance between the quadrature outputs is within 2% or better between 200 Hz and 4 kHz. Thus, an opposite sideband suppression of −40 dB is readily maintained across the speech band and beyond. This together with the low input and output impedances and the relatively non-critical nature of the components gives this circuit some advantages over the more common RC audio quadrature phase-shift networks. The overall loss is about 12-14 dB (excluding the de-emphasis circuit). Naturally, the audio stages preceding the network must have a sharp cutoff above 3 kHz apart from the required de-emphasis.

A SUGGESTED PHASING SSB GENERATOR/DETECTOR

Figure 6 shows a suggested circuit of a phasing SSB generator/detector using the RF and audio quadrature phase-shift networks discussed.

Providing the loss in the audio PSN does not prove to be a handicap, the circuit could be bilateral — that is it may be used directly either as a generator or as a demodulator. What's more, it is all-passive. However, the circuit may be adapted to use active mixers such as the Plessey SL640 or SL641 or the MC1596 made by National and Motorola etc or perhaps the Fairchild 796. Preamplifiers may need to be inserted in each quadrature channel input in the demodulator mode, if necessary, as was done by Taylor in his receiver (reference 9). The 7 dB pad in the local RF input may be omitted and a wideband transformer inserted as in Figs. 3 and 4. However, some isolation for the local RF source is desirable. The pad provides 50 ohms impedance to the source and presents 100 ohms to the RF PSN input.

The two 1 k trimpots are for balancing the diode mixers. T1,2,3,4 are 4:1 wideband transformers as per Figs. 3 and 4.

REFERENCES

(1) "Phasing-Type SSB Generator", W. Doyle W7CMJ, Ham Radio, April 1973, pp. 22-25.

(2) "Phasing-Type Single-Sideband Transmitter", G. K. Shubert WAOJYK, Ham Radio, June 1975, pp. 8-22.

(3) "Design Criteria for SSB Phase-Shift Networks", A.I.H. Wade G3RNW, Ham Radio, June 1970, p. 34.

(4) "Wideband Phase-Shift Networks", R.B. Dome W2WAM, Electronics, December 1946, p. 112.

(5) "Versatile Single Sideband Exciter", Donald E. Norgaard W2KNJ, CQ, March 1949, p. 34.

(6) "Wideband Audio Phase-Shift Networks", N. Southwell UK2ZF, Amateur Radio (WIA journal), June 1955, p. 2 and July 1955, p. 2.

(7) "Single-Sideband for Everyone", Robert C. Cheek W3LOE, CQ, November 1948, p. 17.

(8) "Outputs of Op-amp Networks Have Fixed Phase Difference", Richard K. Dickey, Electronics, August 21st, 1975.

(9) "A Direct-Conversion SSB Richard K. Taylor WIDAX, page 180. 'Single Sideband for the Radio Amateur' fifth edition 1970; reprinted from QST, September 1969.

(10) "Single Sideband Suppressed Carrier Generation", A.J. Turner G3UFP, Wireless World, September 1973, pp. 453-455.

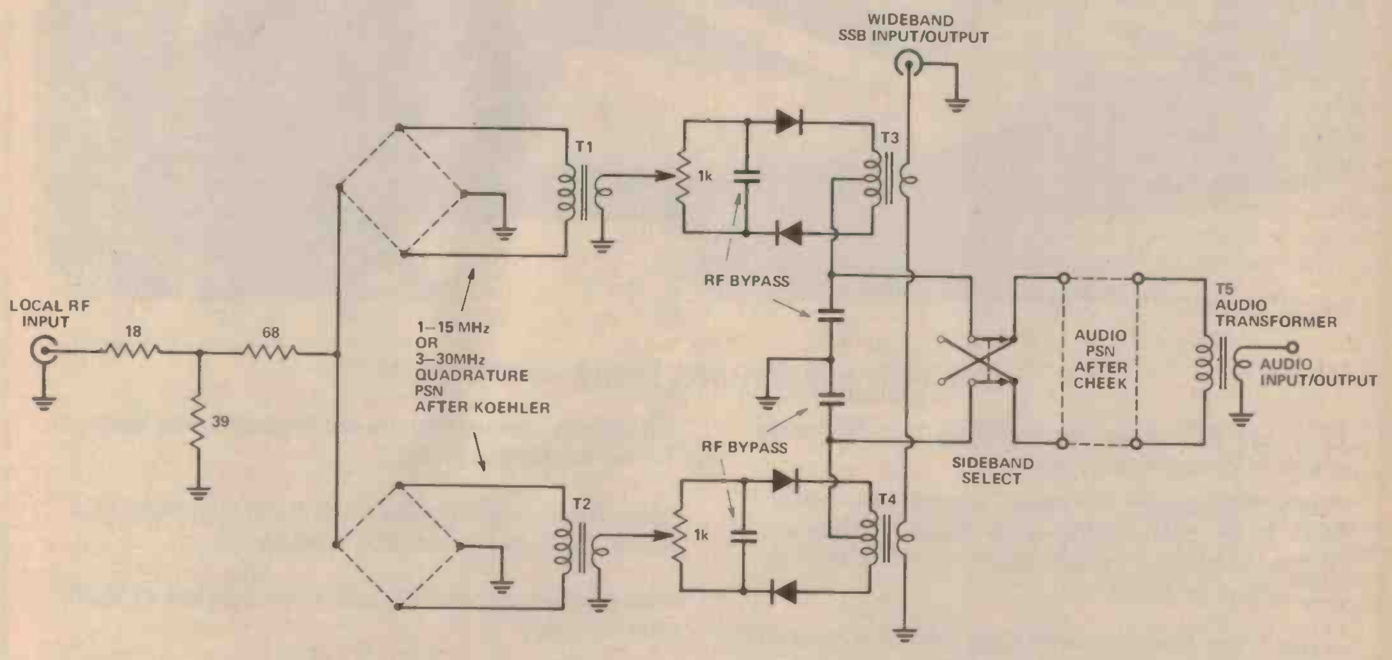

Fig. 6. Suggest passive bilateral wideband, phasing type SSB generator/demodulator.

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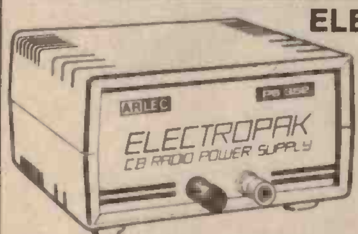

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MICROCOMPUTER POWER SUPPLY

This supply has been specifically designed to power S100 (Altair and IMSAI type) computer systems.

ALTAIR/IMSAI TYPE microcomputers which use the Altair, or S100, bus (such as the Morrow front panel reviewed last month) use separate cards for the CPU, memory, I/O and special functions. These 250 x 130 mm (approx.) cards each have on-board regulators to reduce cost by not requiring expensive high current regulation and b) avoid the damage which would be caused by catastrophic failure of such a regulator. With the on-board regulator scheme, if a regulator fails, damage is limited to one board.

S100 cards require three supply voltages; 8 V which provides the 5 V supply, +16 V which is regulated to 12 V to supply some MOS and linear IC's and −16 V for a −12 V supply to accomodate MOS substrate bias and op-amps. Although early Altairs had problems with an 8 V 8 A supply, the power consumption of memory has dropped considerably since then, and the 28 A supply of the IMSAI may be viewed as a slight over-reaction.

If the 16 V secondaries are not loaded, this supply can give up to 10 A at 7 V, though the transformer must be adequately ventilated — this is sailing rather close to the wind. We have used a pre-regulator to avoid problems with the output voltage rising too high on light loads. A side benefit of the SCR regulator is the provision of a 100 Hz sync pulse which can be used as a Real Time Clock.

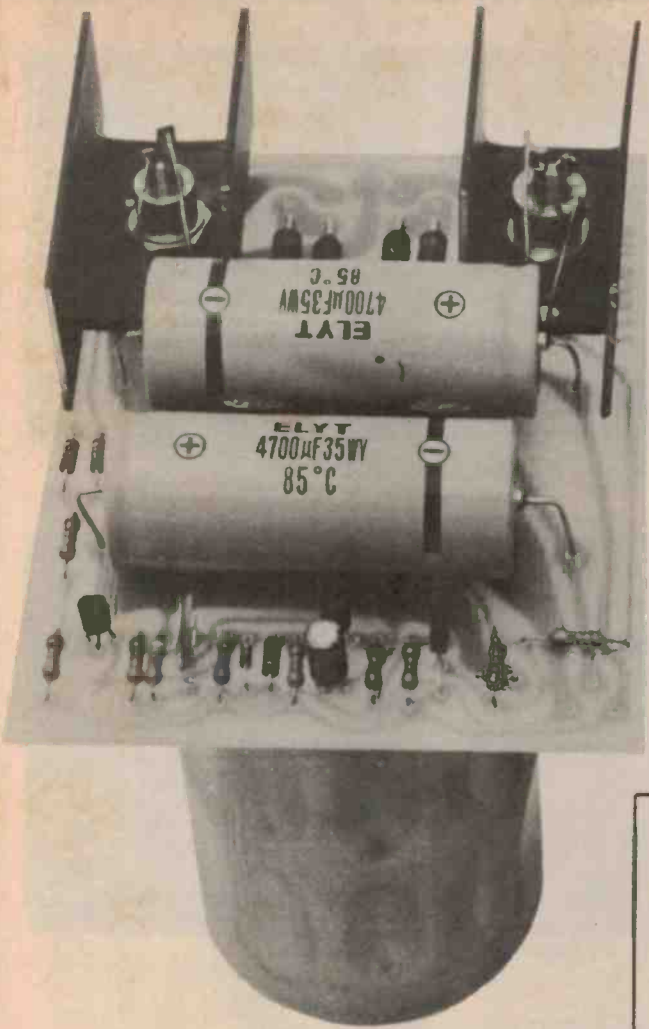
SPECIFICATION – ETI 635

Nominal outputs	+8 V @ 7.5 A
	+16 V @ 750 mA
	−16 V @ 750 mA
Actual output voltages	+7.5 V
@ full load, 240 V input	+15.3 V
	−16.2 V
Regulation	
+8 V output, 0 – 7.5 A	100 mV
+16 V output, 0 – 750 mA	1.5 V
−16 V output, 0 – 750 mA	1.5 V
Ripple voltage	
@ full load +8 V	0.7 V p - p
+16 V	1.0 V p - p
−16 V	1.0 V p - p

Design Features

We initially had the transformer designed to give the required output voltage at full load but the moment we removed the load we knew that either a pre-regulator was needed or a much larger transformer to keep the voltage between the limits. Cost ruled out the larger transformer so that left the regulator.

We first designed a series regulator but due to the additional losses involved (a total of about 20 watts at 10A output) this was ruled out. The SCR (silicon controlled rectifier) regulator was chosen as it has very little extra power loss compared to a straight rectified supply. As high regulation is not



needed we used a simple circuit without the usual choke associated with this type of regulator. Even so the output is maintained to approximately ½ volt over the load range.

Construction

Mount all the components except the transformer onto the printed circuit board. Due to the size of the main filter capacitor, the PC board is mounted directly to it. The capacitor is then bolted to the chassis by its clamp. When mounting the capacitor ensure that the tracks on the PC board are clean or tinned, preferably use the star tvpe lock washers between the board and the capacitor.

The SCRs must have heatsinks fitted, the ones shown are the minium recommended. Alternatively a separate heatsink could be used. Remember that the currents are fairly high(peak currents around 40A in SCRs) and the cables used should be an appropiate size(40/0076 min).

If the unit is to be used continuously at full load in an enclosure adequate ventilation must be provided.

Fig. 1. Printed circuit layout. Full size 130 x 100 mm.

Fig. 2a. Ripple voltage on 8 volt output at 7.5 amps.

Fig. 2c. Waveform on the base of Q2.

Fig. 2b. Sync pulse output.

Fig. 2d. Waveform on the base of Q3.

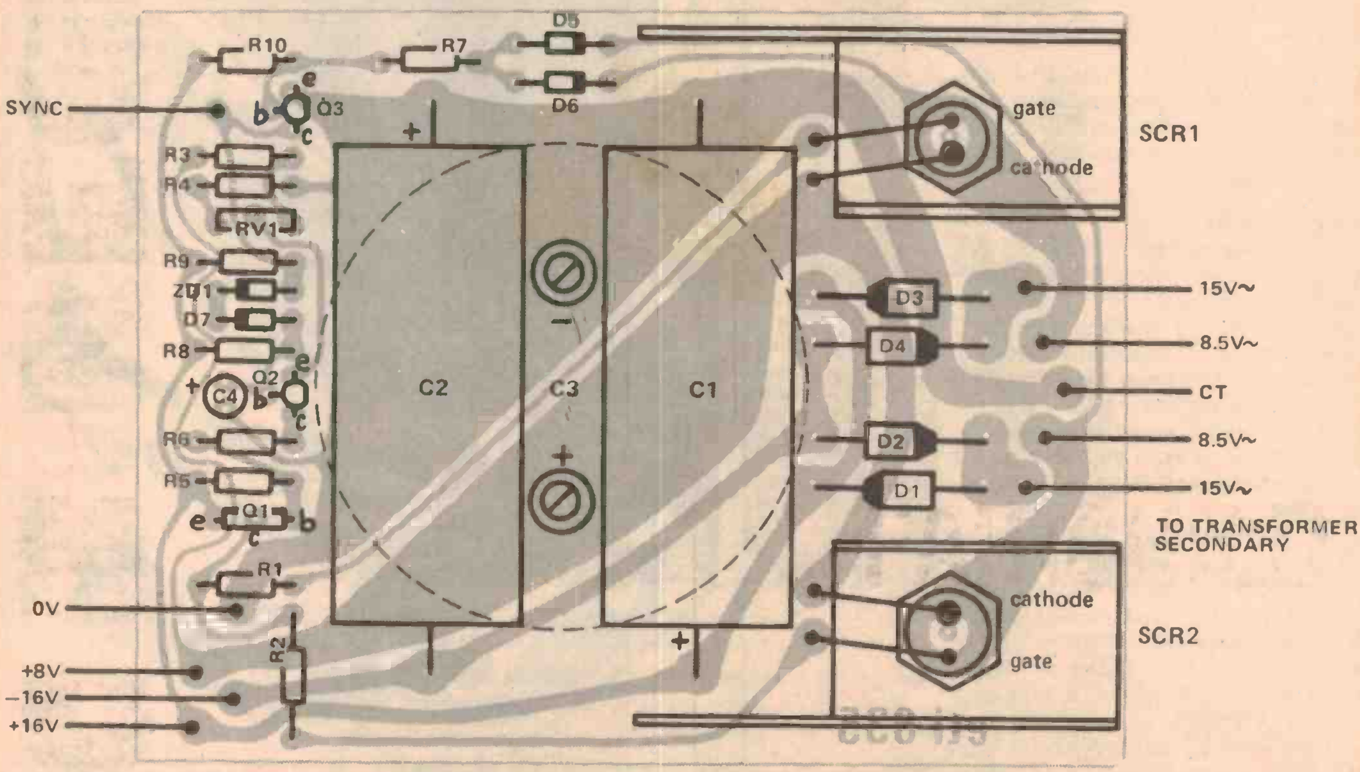


Fig. 3. Component overlay of the power supply. Note that capacitor C3 is bolted onto the copper side of the board.

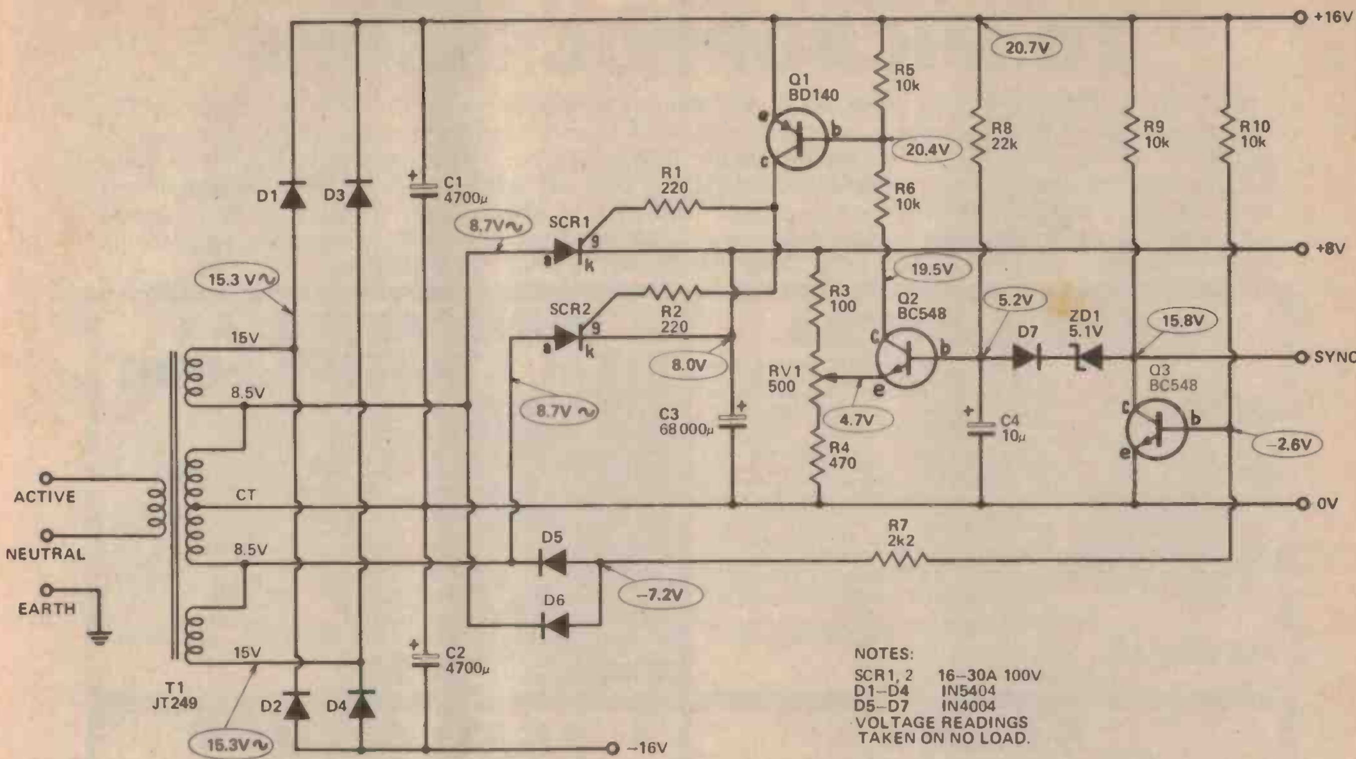


Fig. 4. The circuit diagram of the power supply.

PARTS LIST – ETI 635

Resistors all ½W 5%

R1, 2	220
R3	100
R4	470
R5, 6	10k
R7	2k2
R8	22k
R9,10	10k

Potentiometer

RV1	500 trim

Capacitors

C1, 2	4700μ35V electro
C3	68000μ 16V electro Philips 2222 106 15683
C4	10μ 25V electro

Semiconductors

Q1	BD140
Q2, 3	BC548
ZDI	5.1V Zener 300mW
DI-D4	1N5404
D5, 6	1N4004
D7	1N914
SCRI,2	20A SCR

Miscellaneous

PC board ETI 635
Transformer
240 V Primary
8.5 V–0–8.5 V @ 7.5 A
15 V–0–15 V @ 750 mA
(Jones Transformer JT249)

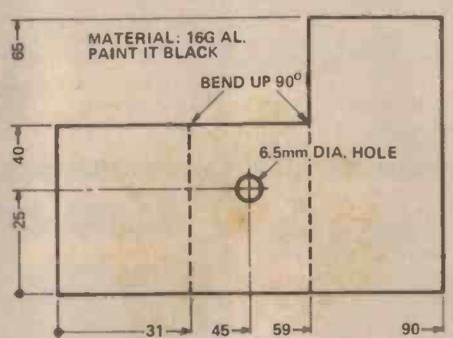
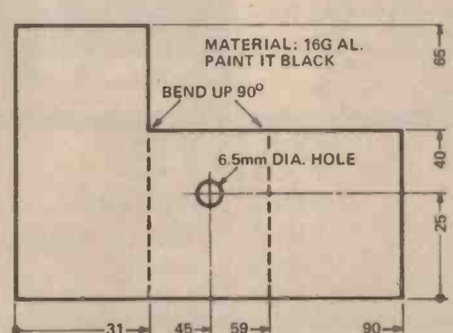


Fig. 5. Details of the heatsinks used on SCR 1 and SCR 2. Heatsinks of similar or larger area may be used if required.



HOW IT WORKS – ETI 635

The ± 16 volt supplies are simply fullwave rectified and filtered, this giving adequate regulation and ripple rejection. The 8V supply however needs regulation. With this the normal rectifier diodes are replaced by SCRs (silicon controlled rectifiers) where the turn on point can be varied. The control of the SCRs is as follows.

Transistor Q3 is used to synchronise the triggering of the SCRs to the line frequency. It is normally biased "off" by the negative voltage generated by D5 and D6. However when the voltage approaches zero this transistor turns on for about 3ms. During this period capacitor C4 is discharged to about 5.6 volts and then it is allowed to charge up again via R7. The voltage rises only about 1V before it is again discharged by Q1.

This generates a sawtooth waveform at 100 Hz rate, transistor Q2 compares the voltage to that on RV1 which is proportional to the output voltage. The comparator transistor, Q2, controls the SCRs via Q1. Because the reference waveform is a sawtooth, as the output voltage falls the firing angle of the SCR moves forward in the cycle until the SCRs are on permanently and control is then lost. This point occurs at about 10A in this unit.

Due to the lack of a choke which is normally employed in this type of regulator, the relative fast charging of C3 causes the unit to move into a type of halfwave rectified output under light loads. The ripple still remains well within the 1Vp.p. limit specified.

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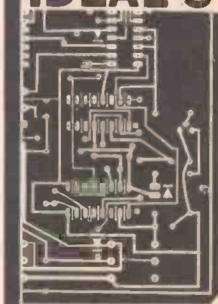

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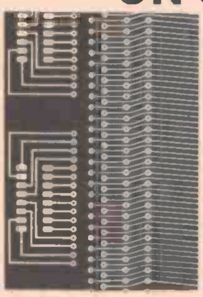

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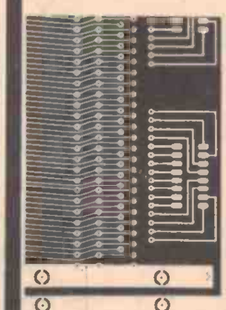

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Variwiper — adjustable windscreen wiper control ... $10.00
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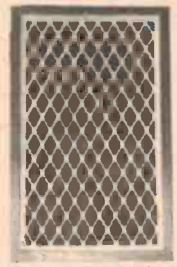
Mag. Pre-Amp — stereo, for mag cart, 300mV out ... $9.00
30V 2A Reg Supply — for amps, experiments, etc C/W trans. ... $10.00
Power Supply ETI 111 — 1.5 to 15V DC at 1.5A variable ... $19.50
Temperature Meter ETI 113 — 0 to 200°C in 3 ranges ... $49.00
Kemstar Tuner — Wideband hi-fi AM tuner ... $45.00
Musicolour II — Popular colour organ 3KW ... $55.00
4 Input Mixer — General purpose mixer ... $18.00
Stereo Pre-Amp — Switch — 3 inputs, 2 indep. switches ... $4.50
Digital Stopwatch ETI 520 — Versatile, accurate ... $70.00
Experimenters Workshop ETI — tools, parts, ICs, etc. ... $115.00

SPEAKER KITS



Partly assembled universal speaker box kits, below normal price, beautifully made by our cabinet factory. With "continental-look" WOOD GRILLE FRONTS, you mount speakers, front, back and wire up etc — it's so easy to DO IT YOURSELF. You'll have a really professional job and you'll save $$$. Walnut finish.

SPK-15 $22 EA.
SIZE 570 x 330 x 230 mm. Suits all 10" and smaller speakers

SPK-10 $20 EA.
Suits all 8" and smaller speakers

SPK-5 $16 EA.
Size 435 x 275 x 230 mm. Suits all 8" and smaller speakers.

FANTASTIC BOOK REDUCTIONS!

Japanese Transistor Manual. Over 30,000 transistor specifications and base connections on 167 pages, lists all the transistors registered with the Electronic Industries Association of Japan. **Was $3.95, now only $3 ea.**

World Transistor Cross-Reference Guide. Extensive listings (over 50,000) of European-American-Japanese transistors with specifications and equivalents. Every serviceman should have one. **Reduced from $7.50 to only $6.00.**

STOCK-TAKING ☆ ☆ ☆ ☆ SPECIALS ☆ ☆ ☆ ☆

500 ½w resistors $3.00; 100 1w resistors $1.00; 40 5w, 10w resistors $3.00; 50 hi-stab ½ per cent, 1 per cent, 2 per cent asst. resistors $1.50; 100 asst capacitors, cer, poly, mica 100-630V $2.00; 20 new, quality asst potentiometers $2.00; 50 asst tagstrips $2.00; 10 asst switches, toggle, DPDT, rotary, slide etc $2.00; 200 asst nuts, bolts etc $100' 25 TTL asst, ICs, new $4.50; 50 asst RTLIC's, new $5.00; 100 asst RTLIC's, new $9.00; 30 PVC insulated mains terminal blocks $1.00; 10 alligator clip jumper leads asst colours $2.00; 30 lengths 6" x asst sizes and colours spaghetti $1.50; 80 way PC edge connector, you cut to own size $1.00; Heat sensor cut-out switch, for transformers, heatsinks etc 50c; 10 pces PCB offcuts, some fibreglass, 2-sided etc $2.00.

INTEGRATED CIRCUITS TTL

7400 ... 45c
7401 ... 45c
7402 ... 45c
7403 ... 45c
7404 ... 45c
7406 ... $1.20
7407 ... $1.20
7408 ... 50
7409 ... 50
7410 ... 50
7411 ... 50
7412 ... 80
7413 ... $1.30
7416 ... $1.00
7420 ... 50
7427 ... $1.00
7430 ... 45
7432 ... 80c
7440 ... 50c
7441 ... $1.50
7442 ... $1.30

7447 ... $1.95
7450 ... 50
7453 ... 50
7460 ... 50
7473 ... $1.00
7476 ... $1.10
7483 ... $1.80
7490 ... $1.00
7491 ... $1.40
7493 ... $1.10
74100 ... $1.00
74107 ... $1.00
74141 ... $3.20
74145 ... $1.00
74151 ... $1.00
74154 ... $3.45
74164 ... $3.50
74181 ... $1.00
74182 ... $1.00

Also CMOS, linear, etc.

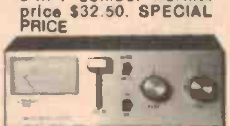
TEST EQUIPMENT SALE! SALE!

A large variety of good, used test gear for sale at bargain prices to personal shoppers only — mostly laboratory equipment e.g. Fluke 332 Voltage Standard, HP 140 Oscilloscope, Fairchild PULSE Generators, Beckmann Function Generators etc.

CB RADIO at best prices

SWR METER ANTENNA MATCHER JD-175

Tune your aerial for really low SWR and maximum power output with this 3-in-1 combo. Normal price $32.50. SPECIAL PRICE



SWR, POWER, FIELD STRENGTH METER 110

Comprehensive, multi-purpose test set and in-line SWR BRIDGE, 52 ohms, 1:1 to 1:3, power 0-10, 0-100w. Normal price $27.50

CB ANTENNAE

5' Helical Whip, roof or boot mount ... $22.00
Base-loaded whip ... $19.00
As above, magnet mtg ... $19.95
CB/AM/FM combo centre-loaded whip ... $30.00
Twin Truckers dual mirror mtg. aerials ... $37.70
SWR meter, in-line ... $19.50
PL-259 plugs ... $1 ea.
RG58/V Cable, per mtr. ... 45c

Large range of CB accessories ex stock.

"HARD-TO-GET" AND MISCELLANEOUS ITEMS

PCB etch resist pens ... $1.50
NIXIE tubes, 0-9, GR111 ... $1.00 ea
NE-2 neons 60V oper. ... 10c
TO-3 mtg ins. bushes ... 50 for 50c
1.5uF 35V tantalums ... 15c
PVC-2 tuning gangs ... 50c
3.5mm earphone plugs ... 10c
3.5mm sockets ... 10c
Fuseholders, in-line 3AG ... 15c
5K Trans vol. controls ... 35c
Knobs to suit, 33mm diam. ... 10c
Mag. earpieces, 3.5mm plug ... 30c
Cigar lighter plugs ... 30c
240 neon bezels ... 50c
Car aerial sockets ... 5c
Alligator clips ... 10c
TK-64 white knobs ... 15c
TK-55 brown knobs ... 15c
TK-29 black knobs ... 15c
TK-816 alum. knobs ... 30c
70 x 45mm oval spkr 8 ohm ... $1.55
58mm diam. spkr 25 ohm ... $1.20
8 track cartridges ... $1.20

75-300 ohm balun ... $2.00
300-75 ohm balun ... $2.00
4XUM-3 batt holder ... 30c
3/8" ferrite rods ... 25c
Car aerials ... $2.50
ON-OFF toggle switch ... 40c
DPDT toggle switch ... 55c
DPDT rotary switch ... 65c
DPDT slide switch ... 30c
3PDT rocker switch ... 60c
HT suppressors 15K ... 35c
MA1002B NS clock ... $12.00
Transformer to suit ... $6.00
5 pin din plug ... 30c
9 lug tagstrips ... 10 for 30c
16 way plug/socket ... $1.00
50 ohm 2W WW pots ... 50c
Permeability tuners ... $1.00
Mono cartridges ... $1.00
Stereo cartridges C-1 ... $3.00
6" x 4" speakers ... $2.00
UM-3 Ni-cad batts ... $1.65

Originals or equivalents supplied.

SPEAKERS, ETC.

Coral
Complete kits with Xovers, etc.
85A1 15W RMS ... $49
10SA1 25W RMS ... $75
12SA1 30W RMS ... $109
Cabinets available to suit

Car Speakers — dual imp.
5" diam. 4.8 ohm ... $5.50
7" x 5" 4.8 ohm ... $5.95
8" x 4" 4.8 ohm ... $6.95
9" x 6" 4.8 ohm ... $7.50

Crossovers
2 WAY 30W ... $3.50
3 WAY 40W ... $6.95

Hi-Fi Woofers
12" 30W 8 ohm ... $29.90
10" 25W 8 ohm ... $21.75
8" 15W 8 ohm ... $10.50
8" Twin cone ... $11.90

Mid-Range
5" 30W 8 ohm ... $5.45
51/4" 20W 8 ohm ... $3.50

Tweeters
Dome 20W 8 ohm ... $8.95
Dome 50W 8 ohm ... $11.00
Cone 21/2" 8 ohm ... $1.95
Cone 3" 8 ohm ... $4.80
Horn ... $9.95

HV POWER SUPPLIES

0-500V at up to 250mA, used but good working order, also 0-250V 50mA neg. output for bias control plus 6.3V 10A AC output. To clear to bargain prices, personal shoppers only, $30 ea.

PRE-PAK electronics

Head Office — 718 Parramatta Rd., Croydon NSW 2132
Mail Orders — P.O. Box 43 CROYDON NSW 2132

OPEN 7 DAYS Mon-Sun: 9.00am — 5.30pm
Telephone (02) 797 6144

Please send my order ASAP to —

Name.. Date....................

Address..

.... Code..........

TEAR OUT THIS PAGE AND SEND WITH REMITTANCE TO OUR MAIL ORDER DEPT. – POST FREE!

KITS FOR ETI PROJECTS

We get many enquiries from readers wanting to know where they can get kits for the projects we publish. The list below indicates the suppliers we know about and the kits they do.

Any companies who want to be included in this list should phone LES BELL on 33-4282.

Key to companies:

- **A** Applied Technology Pty. Ltd. 109 - 111 Hunter St, Hornsby. 2077. NSW.
- **C** Amateur Communications Advancements, PO Box 57, Rozelle, NSW.
- **D** Dick Smith Pty. Ltd. of Crows Nest, NSW. (see Ads. for address).
- **E** E.D. & E. Sales, Victoria.
- **J** Jaycar Pty. Ltd. 405 Sussex St., Sydney 2000.
- **L** Delsound Pty. Queensland.
- **N** Nebula Electronics Pty. Ltd. 15 – 19 Boundary St., Rushcutters Bay 2011. NSW.
- **O** Appollo Video Games of Hornsby, NSW.
- **P** Pre-Pac Electronics. 718 Parramatta Rd., Croydon NSW 2132.
- **S** BKX Electronics Supply Service. 179 Victoria St., Kings Cross. NSW 2011.

ETI 043	Heads or Tails	A
ETI 044	Two-Tone Doorbell	A
ETI 061	Simple Amplifier	A
ETI 064	Intercom	A
ETI 066	Temperature Alarm	A
ETI 068	LED Dice	A

TEST EQUIPMENT

ETI 101	Logic Power Supply	E
ETI 102	Audio Signal Generator	E,D
ETI 103	Logic Probe	E
ETI 107	Widerange Voltmeter	E
ETI 108	Decade Resistance Box	E
ETI 109	Digital Frequency Meter	E
ETI 111	IC Power Supply	E
ETI 112	Audio Attenuator	E
ETI 113	7-Input Thermocouple Meter	P,E
ETI 116	Impedance Meter	E
ETI 117	Digital Voltmeter	E,A
ETI 118	Simple Frequency Counter	E,A
ETI 119	5 V Switching Regulator supply	E
ETI 120	Logic Probe	L,E
ETI 121	Logic Pulser	L,E
ETI 122	Logic Tester	E
ETI 123	CMOS Tester	E
ETI 124	Tone Burst Generator	E
ETI 128	Audio Millivoltmeter	L,E
ETI 129	RF Signal Generator	L,E
ETI 131	General Purpose power supply	E,N
ETI 132	Power Supply	N

SIMPLE PROJECTS

ETI 206	Metronome	E
ETI 218	Monophonic Organ	E,D
ETI 219	Siren	E
ETI 220	Siren	E
ETI 222	Transistor Tester	E
ETI 232	Courtesy Light Extender	E
ETI 234	Simple Intercom	E
ETI 236	Code Practice Oscillator	E
ETI 239	Breakdown Beacon	E

MOTORISTS' PROJECTS

ETI 301	Vari-Wiper	E
ETI 302	Tacho Dwell	E
ETI 303	Brake-light Warning	E
ETI 309	Battery Charger	P,E
ETI 312	CDI Electronic Ignition	P,E
ETI 313	Car Alarm	E,D

AUDIO PROJECTS

ETI 401	Audio Mixer FET Four Input	E
ETI 403	Guitar Sound Unit	E
ETI 406	One Transistor Receiver	E
ETI 407	Bass A.p	E
ETI 408	Spring Reverb. Unit	E
ETI 410	Supor Stereo	E
ETI 413	100 Watt Guitar Amp	P,L,E,J,D
ETI 413	x 200 Watt Bridge Amp	S E
ETI 414	Master Mixer	E,J
ETI 414	Stage Mixer	E
ETI 416	25 Watt Amplifier	E
ETI 417	Amp Overload Indicator	E
ETI 419	Guitar Amp Pre-Amp	P,E,D
ETI 420	Four-channel Amplifier	L,E
ETI 420E	SQ Decoder	E
ETI 422	International Stereo Amp	S L,E,D
ETI 422B	Booster Amp	E
ETI 422	50 Watt Power Module	E
ETI 423	Add-on Decoder Amp	E
ETI 424	Spring Reverberation Unit	S L,E
ETI 425	Integrated Audio System	E
ETI 426	Rumble Filter	E
ETI 427	Graphic Equaliser	S L,E,J
ETI 430	Microphone Line Amp	E
ETI 433	Active Crossover	E,J
ETI 435	Crossover Amp	E,J
ETI 438	Audio Level Meter	L,E
ETI 440	Simple 25 Watt Amp	L,E
ETI 441	Audio Noise Generator	L,E
ETI 443	Compressor-Expander	E,J
ETI 444	Five Watt Stereo	E
ETI 445	Preamp	J,E,D
ETI 446	Audio Limiter	J,E
ETI 447	Phaser	E,J
ETI 449	Balanced Mic Preamp	J
ETI 480	50 W, 100 W Power Amp	A
ETI 480P	Power Supply	A
ETI 482A	Preamp Module	A
ETI 482B	Tone Controller	A
ETI 485	Graphic Equalizer	J

MISCELLANEOUS

ETI 502	Emergency Flasher	E
ETI 503	Burglar Alarm	E
ETI 505	Strobe	L,E,D
ETI 506	Infra-Red Alarm	E
ETI 509	50-Day Timer	E
ETI 512	Photographic Timer	E
ETI 513	Tape Slide/Synchroniser	E
ETI 514	Flash Unit — Sound Operated	E
ETI 515	Flash Unit — Light operated	E
ETI 518	Light Beam Alarm	E
ETI 525	Drill Speed Controller	E
ETI 526	Printimer	E
ETI 527	Touch Control Light Dimmer	E
ETI 528	Home Burglar Alarm	P,E
ETI 529	Electronic Poker Machine	E
ETI 533	Digital Display	L,E,A
ETI 534	Calculator Stopwatch	A,D
ETI 539	Touch Switch	E
ETI 540	Universal Timer	E
ETI 541	Train Controller	E
ETI 543	Double Dice	A
ETI 544	Heartrate Monitor	A

ELECTRONIC MUSIC

ETI 601 4600	Synthesiser	J
3600	Synthesiser	J
ETI 602	Mini Organ	E,A,D

COMPUTER PROJECTS

ETI 630	Hex Display	A
ETI 631	VDU Keyboard Encoder	A
ETI 632	VDU 1 k x 8 Memory Card	A
ETI 633	VDU Sync Generator	A

RADIO PROJECTS

ETI 701	TV Masthead Amplifier	E,D
ETI 702	Radar Intruder Alarm	D
ETI 703	Antenna Matching Unit	E
ETI 704	Crosshatch/Dot Generator	L,A,D,E
ETI 706	Marker Generator	E
ETI 707	Modern Solid State Converters	C,E
ETI 708	Active Antenna	E
ETI 710	2 metre Booster	C,E
ETI 711B	Single Relay Remote Control	A
ETI 711C	Double Relay Remote Control	A
ETI 711R	Receiver	A
ETI 711AR	Remote Control Transmitter	A
ETI 711DR	Remote Control Decoder	A
ETI 740	FM Tuner	A
ETI 780	Novice Transmitter	E

ELECTRONIC GAMES

ETI 804	Selecta-Game	O,A,D

ETI data sheet

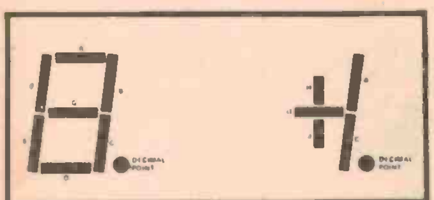
LED DISPLAYS

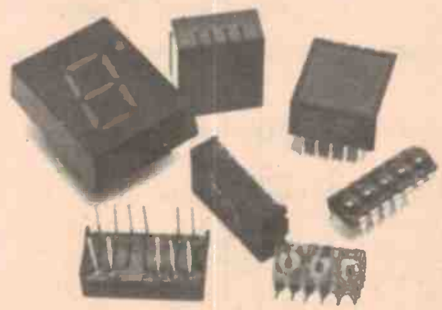
ABOUT THE ONLY feature common to the ranges of displays described in this Data Sheet is the way in which the various manufacturers identify the segments.

The standard method for doing this is shown below. We have deliberately excluded the 'overflow' type of L.E.D. display, in order to provide a better selection of normal types in the space available to us.

Calculated Omission

There is another type of L.E.D. display now becoming more popular in general usage. This is the calculator display, of a type personified by the HP device shown here. We hope to deal with these more fully at a later date. Generally these types use very low power, being, readable at about 100μA and with a varying number of digits, usually eight or ten.





The FND 507 is a common anode version of the FND 500, and as such can be used to replace a TIL 321.

Inclusion

Now that we've told you what isn't in here, perhaps we should explain what we have covered. Each display is described in a standard manner, using the same form of presentation for the relevant technical data. This is to facilitate easy comparison and subsequent selection.

Prices vary enormously from supplier to supplier, so we have not tried to give a definite price, just an indication. Don't be mis-LED, some market segments might well display lower prices!

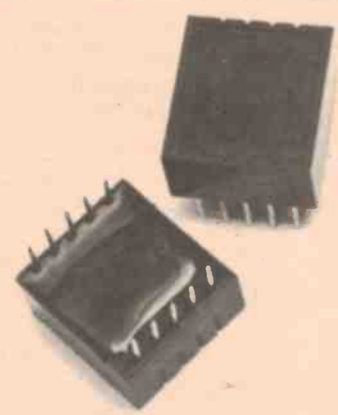
FND 500/507 — FAIRCHILD

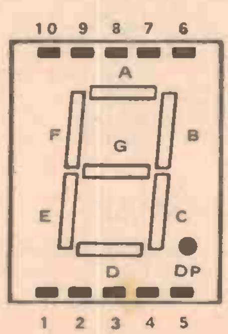
The FND 500 is a common cathode display with an integral red filter. The decimal point is on the right-hand side of the device, which measures 15.3 mm by 16.5 mm high. This device is a pin for pin replacement to the Texas Instrument TIL322 display.

TYPICAL PRICE $2.95

ELECTRICAL CHARACTERISTICS

DIGIT SIZE	0.5 ins
COLOUR	red
AVERAGE FWD CURRENT/SEGMENT	25mA
FORWARD VOLTAGE	1.7V
MIN. REV. BREAKDOWN VOLTAGE	3.0V
MAX. REV. CURRENT	100uA
LIGHT INTENSITY PER SEGMENT	600ucd
MAX. POWER DISSIPATION	400mW





PIN OUT — FND 500/507

1 Segment E	6 Segment B
2 Segment D	7 Segment A
3 Common	8 Common
4 Segment C	9 Segment F
5 Dec. point	10 Segment G

FND 500 . . . . common cathode
FND 507 . . . . common anode

DL 704/707 — MONSANTO

A very common and widely available display, the 707 is the common anode version, with the 707R having a right-hand decimal point, as opposed to the standard left decimal on the 704 and 707. The 704 is thus a common cathode device.

ELECTRICAL CHARACTERISTICS

DIGIT SIZE	0.3 ins
COLOUR	YELLOW/RED/ORANGE
AVERAGE FWD CURRENT/SEGMENT	25mA
FORWARD VOLTAGE	2.5/1.6/1.6V
MIN. REV. BREAKDOWN VOLTAGE	3.0V
MAX. REV. CURRENT	100uA
LIGHT INTENSITY PER SEGMENT	320ucd
MAX. POWER DISSIPATION	500mW

TYPICAL PRICE $2.50

PIN OUT–DL707/707R

1 Segment A	8 Segment D
2 Segment F	9 Anode
3 Anode	10 Segment C
4 NC	11 Segment G
5 NC	12 NC
6 Dec. point	13 Segment B
7 Segment E	14 Anode

PIN OUT–DL 704

1 Segment F	8 Segment C
2 Segment G	9 Dec. point
3 NC	10 NC
4 Cathode	11 NC
5 NC	12 Cathode
6 Segment E	13 Segment B
7 Segment D	14 Segment A

DL 747/750 — MONSANTO

A 'Jumbo version' of the 707 and 704 devices. Widely available. Identify the common anode 747 by the missing pins – 1,9, 10 and 18.

The 750 is in full possession of its pins, and is common cathode. Decimal point is right-handed.

ELECTRICAL CHARACTERISTICS

DIGIT SIZE	0.6 ins
COLOUR	RED
AVERAGE FWD CURRENT/SEGMENT	25mA
FORWARD VOLTAGE	2.4V
MIN. REV. BREAKDOWN VOLTAGE	6.0V
MAX. REV. CURRENT	100uA
LIGHT INTENSITY PER SEGMENT	600ucd
MAX. POWER DISSIPATION	960mW

TYPICAL PRICE $3.50

PIN OUTS–DL747/750

1 NC	10 NC
2 Segment A	11 Segment D
3 Segment F	12 Common
4 Common	13 Segment C
5 Segment E	14 Segment G
6 Common	15 Segment B
7 Dec. point	16 NC
8 NC	17 Common
9 NC	18 NC

DL747 . . . . common anode
DL750 . . . . common cathode
Pins 1, 9, 10, 18, omitted from 747

ETI data sheet

TIL RANGE — TEXAS

A uniform range of large displays, with red, green or amber encapsulation. No filters are needed, and a wide viewing angle is possible. Within defined categories, the devices are matched for luminous intensity. These can also act as direct replacements for the Fairchild FND500/507 duet.

PIN OUTS

TIL321/323/325

As FND 507. Direct replacement.

PIN OUTS—TIL322/324/326
As FND 500. Direct replacement.

ELECTRICAL CHARACTERISTICS

	321/322
DIGIT SIZE	015ins
COLOUR	RED
AVERAGE FWD CURRENT/SEGMENT	20mA
FORWARD VOLTAGE	1.7V
MIN. REV. BREAKDOWN VOLTAGE	3V
MAX. REV. CURRENT	100uA
LIGHT INTENSITY PER SEGMENT	600ucd
MAX. POWER DISSIPATION	300mW

ELECTRICAL CHARACTERISTICS

	323/324
DIGIT SIZE	0.5ins
COLOUR	GREEN
AVERAGE FWD CURRENT/SEGMENT	20mA
FORWARD VOLTAGE	2.5V
MIN. REV. BREAKDOWN VOLTAGE	3V
MAX. REV. CURRENT	100uA
LIGHT INTENSITY PER SEGMENT	320ucd
MAX. POWER DISSIPATION	600mW

ELECTRICAL CHARACTERISTICS

	325/26
DIGIT SIZE	0.5ins
COLOUR	AMBER
AVERAGE FWD CURRENT/SEGMENT	20mA
FORWARD VOLTAGE	2.5V
MIN. REV. BREAKDOWN VOLTAGE	3V
MAX. REV. CURRENT	100uA
LIGHT INTENSITY PER SEGMENT	340ucd
MAX. POWER DISSIPATION	400mW

XAN 352/4 — XCITON

These two come from what is the largest range of displays available. Xciton make big play of having all devices brighter than the competition, and a list of equivalents from their range for most of the others. These two are common cathode (XAN 354) and common anode (352) 0.3" numerics, using high efficiency GaAsP.

Agent: R. & D. Electronics Pty. Ltd., 23 Burwood Road, Burwood, 3125 Vic. Ph. 288 8262.

PIN OUT—XAN 352

1 Segment A	8 Segment D
2 Segment F	9 NC
3 Anode	10 Segment C
4 Omitted	11 Segment G
5 Omitted	12 Omitted
6 Dec. point	13 Segment B
7 Segment E	14 Anode

PIN OUT—XAN 354

1 Segment F	8 Segment C
2 Segment G	9 Dec. point
3 Omitted	10 Omitted
4 Cathode	11 Omitted
5 Omitted	12 Cathode
6 Segment E	13 Segment B
7 Segment D	14 Segment A

ELECTRICAL CHARACTERISTICS

DIGIT SIZE	0.3ins
COLOUR	GREEN
AVERAGE FWD CURRENT/SEGMENT	25mA
FORWARD VOLTAGE	2.0V
MIN. REV. BREAKDOWN VOLTAGE	5V
MAX. REV. CURRENT	100uA
LIGHT INTENSITY PER SEGMENT	450ucd
MAX. POWER DISSAPATION	400mW

Suppliers of LED displays:

Dick Smith Electronics. P.O. Box 747, Crows Nest. NSW 2065. Ph (02) 4395311. (Sydney, Brisbane, Melbourne.)

Electronics Supply Service. 179 Victoria St. Kings Cross, NSW 2011, Ph (02) 3582420.

International Electronics Unlimited. Village Square, P.O. Box 449, Carmel Valley, CA 93924 U.S.A.

Electronic Enthusiasts Emporium (EEE). P.O. Box 33, Pendle Hill, NSW 2145, Ph (02) 6366222.

Applied Technology. P.O. Box 355, Hornsby 2077, Ph (02) 4764755.

WHK Electronics & Scientific Instrumentation. 2 Gum Rd, St. Albans. 3021 VIC. (03) 3963742.

XAN 650 SERIES — XCITON

ELECTRICAL CHARACTERISTICS	82/84
DIGIT SIZE	0.6ins
COLOUR	YELLOW
AVERAGE FWD CURRENT/SEGMENT	25mA
FORWARD VOLTAGE	2.2V
MIN. REV. BREAKDOWN VOLTAGE	3.0V
MAX.REV. CURRENT	100uA
LIGHT INTENSITY PER SEGMENT	700ucd
MAX. POWER DISSIPATION	400mW

PIN OUT XAN 652/654/682/684

1 Segment A	8 Segment D
2 Segment F	9 Common
3 Common	10 Segment C
4 Segment E	11 Segment G
5 Omitted	12 Segment B
6 Dec. point	13 Omitted
7 Omitted	14 Common

XAN 684/654. . . . . . common cathode
XAN 682/652. . . . . . . common anode

ELECTRICAL CHARACTERISTICS	52/54
DIGIT SIZE	0.6ins
COLOUR	GREEN
AVERAGE FWD CURRENT/SEGMENT	25mA
FORWARD VOLTAGE	2.0V
MIN. REV. BREAKDOWN VOLTAGE	3V
MAX. REV. CURRENT	100uA
LIGHT INTENSITY PER SEGMENT	2000ucd
MAX. POWER DISSIPATION	350mW

7400 SERIES — HEWLETT-PACKARD

The 7400 series are 2.79mm GaSP numeric indicators, packaged in end stackable DIL casings. They are readable at 500μA per segment, and constructed for strobed operation in such a way that less lead connections are needed.

A lens magnifier is fitted, with a good viewing angle.

PIN OUT HP7402/7412

1 NC	8 Segment D
2 Segment C	9 Segment F
3 Segment C	10 Cathode
4 Cathode	11 Segment B
5 Dec. point	12 Segment A
6 Cathode	13 Omitted
7 Segment G	14 Omitted

PIN OUT HP7404/7414

1 Cathode	8 Segment D
2 Segment E	9 Segment F
3 Segment C	10 Cathode
4 Cathode	11 Segment B
5 Dec. point	12 Segment A
6 Cathode	13 Omitted
7 Segment G	14 Omitted

PIN OUT HP 7403/7413

1 Cathode	8 Segment D
2 Segment E	9 Segment F
3 Segment C	10 Cathode
4 Cathode	11 Segment B
5 Dec. point	12 Segment A
6 NC	13 Omitted
7 Segment G	14 Omitted

PIN OUT HP7405/7415

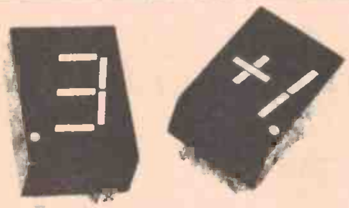
1 Cathode	8 Segment 9
2 Segment E	9 Cathode
3 Segment C	10 Segment F
4 Cathode	11 NC
5 Dec. point	12 Segment B
6 Segment D	13 Cathode
7 Cathode	14 Segment A

ELECTRICAL CHARACTERISTICS	
DIGIT SIZE	(magnifier) 0.11ins
COLOUR	RED
AVERAGE FWD CURRENT/SEGMENT	5mA
FORWARD VOLTAGE	1.6V
MIN. REV. BREAKDOWN VOLTAGE	5V
MAX. REV. CURRENT	100uA
LIGHT INTENSITY PER SEGMENT	20ucd
MAX. POWER DISSIPATION	80mW

Digits per Cluster	Center Decimal Point	Right Decimal Point
3 (right)	5082-7402	5082-7412
3 (left)	5082-7403	5082-7413
4	5082-7404	5082-7414
5	5082-7405	5082-7414

ETI data sheet

7750 SERIES | HEWLETT-PACKARD



A fairly standard range of slightly larger than standard displays. The material is GaSP, and the devices use a standard 14 pin DIL package so that they can be plugged into standard sockets.

PIN OUT HP7750

1 Segment A	8 Segment D
2 Segment F	9 NC
3 Anode	10 Segment C
4 Omitted	11 Segment G
5 Omitted	12 Omitted
6 Dec. point	13 Segment B
7 Segment E	14 Anode

PIN OUT HP7751

1 Segment A	8 Segment D
2 Segment F	9 Dec. point
3 Anode	10 Segment C
4 Omitted	11 Segment G
5 Omitted	12 Omitted
6 NC	13 Segment B
7 Segment E	14 Anode

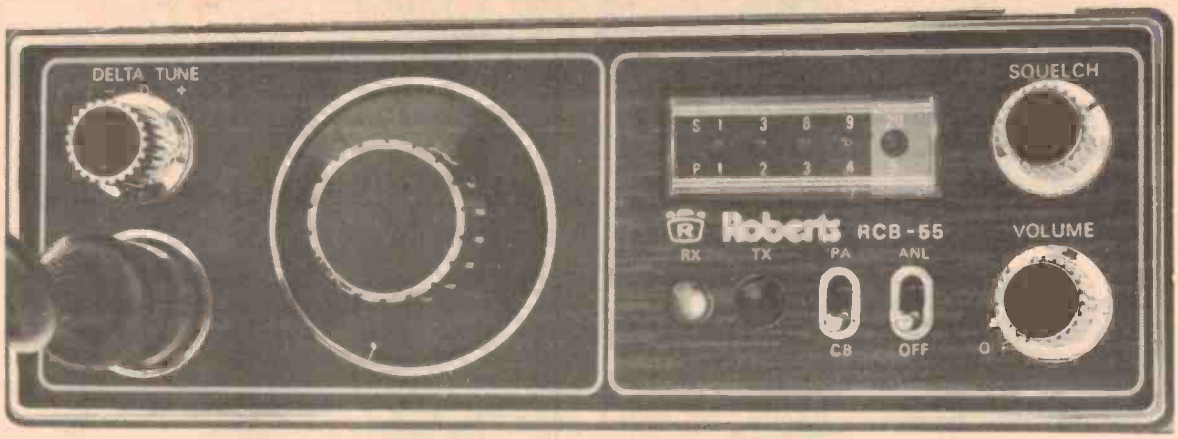
PIN OUT HP7760

1 Segment A	8 Segment D
2 Segment F	9 Dec. point
3 Cathode	10 Segment C
4 Omitted	11 Segment G
5 Omitted	12 Omitted
6 NC	13 Segment B
7 Segment E	14 Cathode

ELECTRICAL CHARACTERISTICS

DIGIT SIZE	0.43ins
COLOUR	RED
AVERAGE FWD CURRENT/SEGMENT	20mA
FORWARD VOLTAGE	1.6V
MIN. REV. BREAKDOWN VOLTAGE	6V
MAX. REV. CURRENT	10uA
LIGHT INTENSITY PER SEGMENT	400ucd
MAX. POWER DISSIPATION	300mW

STOP PRESS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Roberts RCB-55
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RX TX PA ANL
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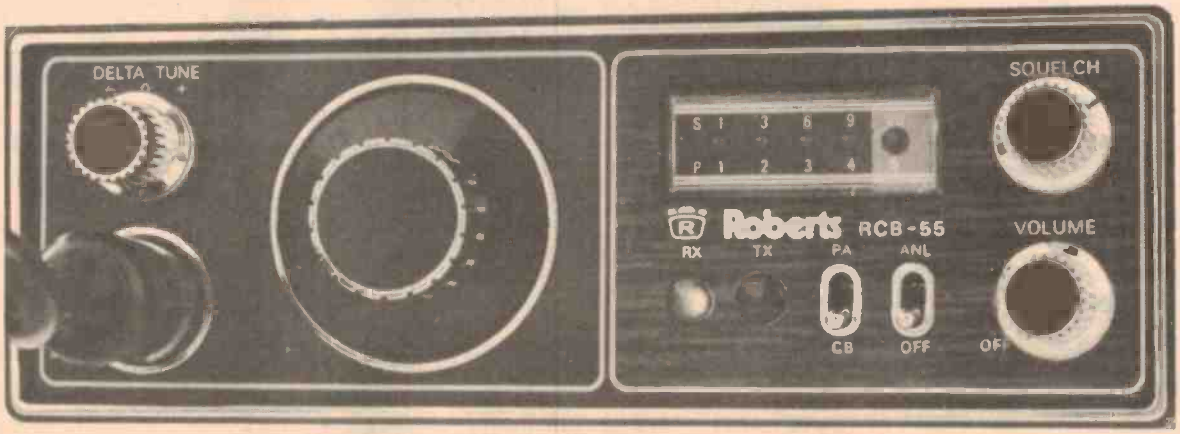
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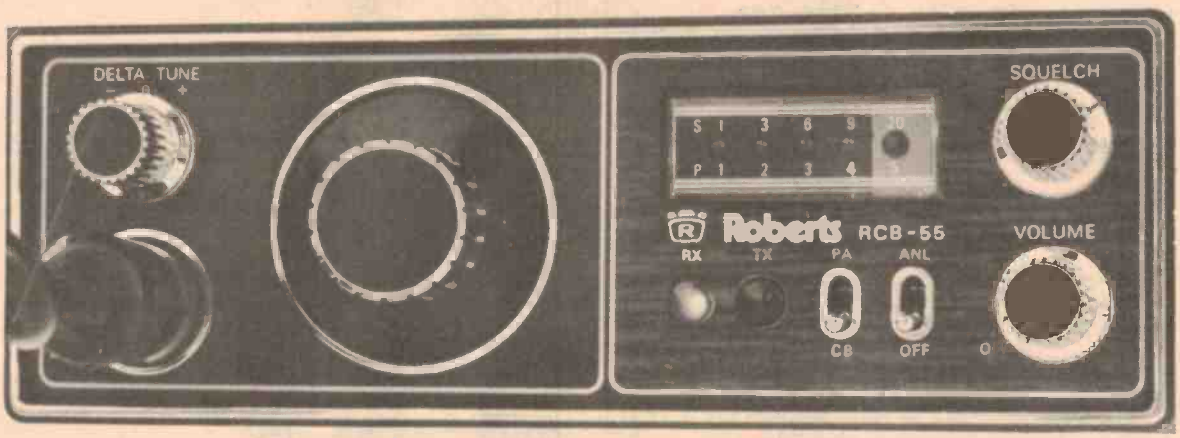
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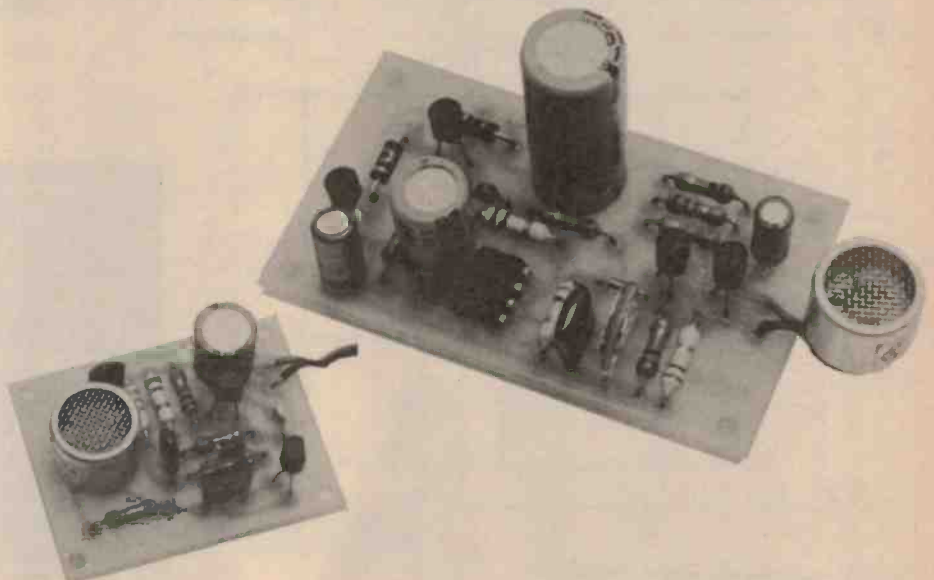
ULTRASONIC SWITCH

Two-board design forms basis for a wide range of applications from door-bells to data transmission!

THE USE OF an invisible beam to transmit information or to act as an alarm system has always been fascinating. We have described light operated systems of the infra-red (invisible), normal light and laser beam types. We have also published a radar alarm system. This unit uses a high frequency acoustical beam, well above the range of human hearing, which can be used simply as a door monitor, i.e. to give an alarm if the beam is broken, or can be modulated at up to several hundred Hz. This will allow information to be transmitted — details of how to do this will be given in future issues.



Construction

The construction of the units is not critical — any method may be used although the PC boards are recommended. We didn't mount the relay on the PCB as it can vary in size and if the unit is later used with a modulated beam, the relay will not be needed.

The only adjustment on the unit is the sensitivity control and this should be set to give reliable operation. The transmitter needs a supply voltage of 8 V to 20 V at about 5 mA. This could come from the regulated supply on the receiver board.

If it is required to extend the effect of a quick break in the beam or a quick burst from the transmitter, the resistor R9 can be replaced by C4 and this will give a minimum operation time of about 1 second.

SPECIFICATION — ETI 585

Frequency	40 kHz
Range	5 meters
Maximum modulation frequency (not with relay output)	250 Hz
Output	relay, closed when beam is made.
Power supply	
Transmitter	14–25 V dc 10–20 V ac
Receiver	8–20 V dc, 4 mA

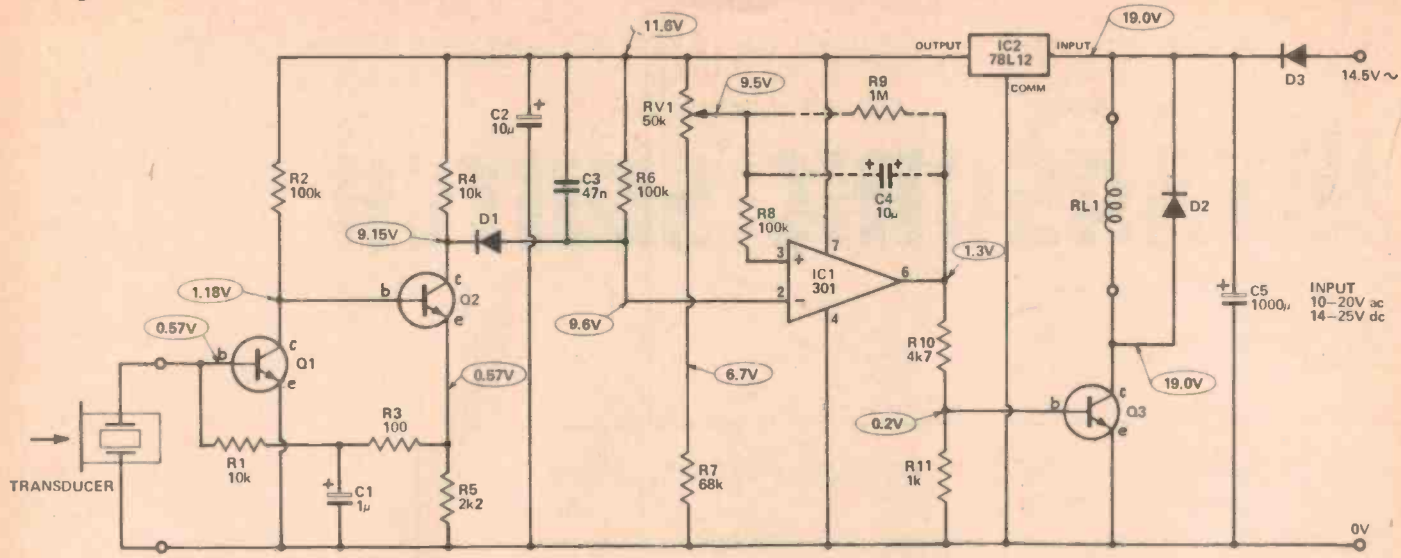
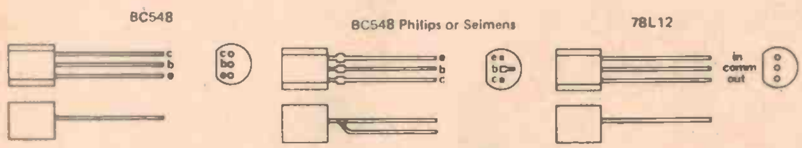
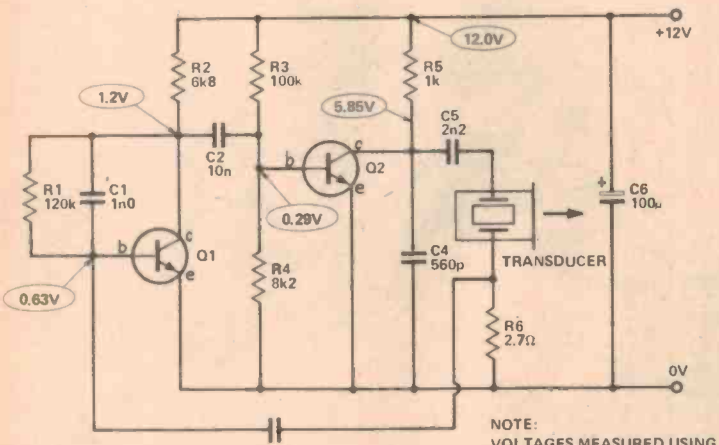


Fig. 1. Circuit diagram of the receiver.

NOTES:
VOLTAGES MEASURED WITH NO INPUT SIGNAL USING A VOLTMETER WITH 10 MEG OHM INPUT IMPEDANCE.
Q1—Q3 ARE BC548
D1 IS 1N914
D2,D3 ARE 1N4001
C4 IS USED INSTEAD OF R9 IF A MONOSTABLE ACTION IS REQUIRED.





NOTE:
VOLTAGES MEASURED USING A VOLTMETER WITH 10 MEG OHM INPUT IMPEDANCE.

Fig. 2. Circuit diagram of the transmitter.

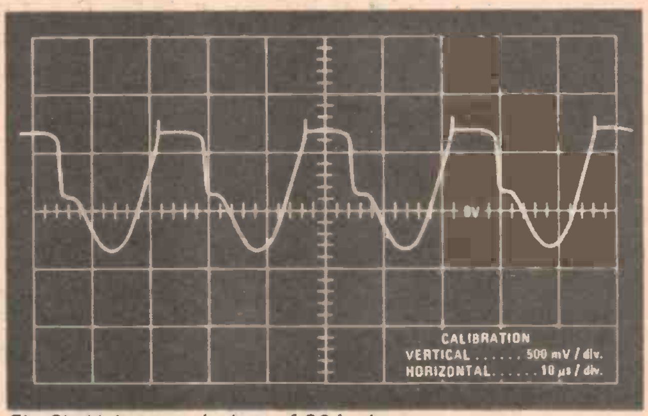


Fig. 3b. Voltage on the base of Q2 in the transmitter.

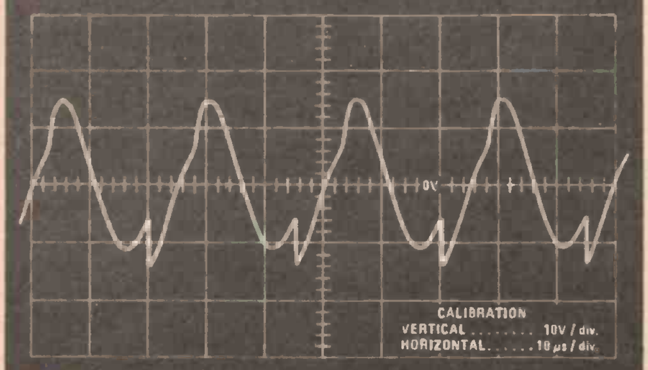


Fig. 3a. Waveform across the transducer on the the transmitter.

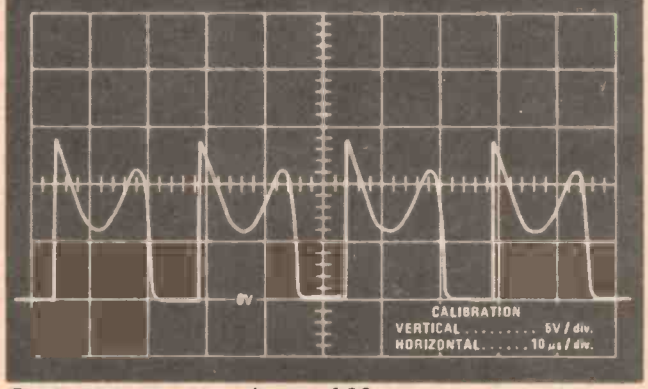


Fig. 3c. Voltage on the collector of Q2.

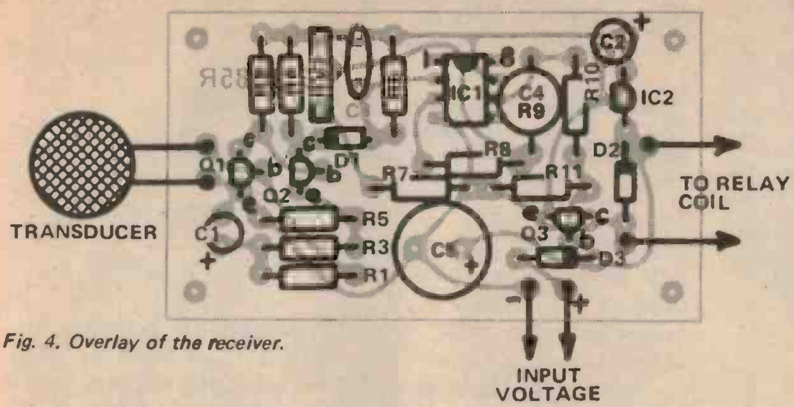


Fig. 4. Overlay of the receiver.

PARTS LIST – ETI 585 T

Resistors all ½W 5%

R1	120k
R2	6k8
R3	100k
R4	8k2
R5	1k
R6	2.7 ohms

Capacitors

C1	1n0 polyester
C2	10n "
C3	47n "
C4	560p ceramic
C5	2n2 polyester
C6	100µ 25V electro

Transistors

Q1,2 . . . . . BC548

Miscellaneous

PC board ETI 585 T
40kHz transmitter
case to suit

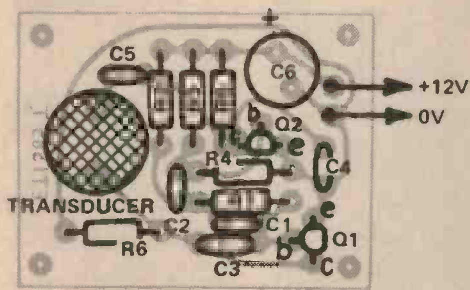


Fig. 5. Overlay of the transmitter.

PARTS LIST – ETI 585 R

Resistors all ½W 5%

R1	10k
R2	100k
R3	100 ohms
R4	10k
R5	2k2
R6	100k
R7	68k
R8	100k
R9	1M
R10	4k7
R11	1k

Potentiometer

RV1 . . . . . 50k trim

Capacitors

C1	1µ0 25V electro
C2	10µ 25V "
C3	47n polyester
C4	10µ non polarised electrolytic
C5	1000µ 16V electro

Semiconductors

Q1–Q3	BC548
IC1	LM301A
IC2	78L12
D1	1N914
D2,3	1N4001

Miscellaneous

PC board ETI 585 R
40 kHz receiver
12 V relay
case to suit

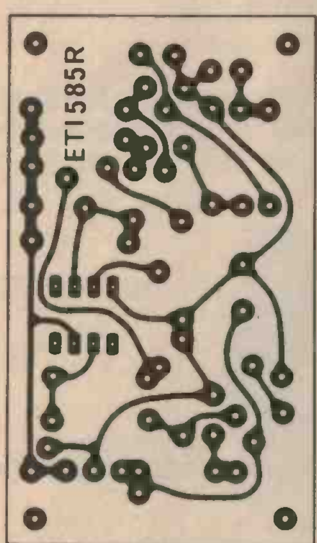


Fig. 6. Printed circuit board of receiver. Full size 70 x 40.

HOW IT WORKS – ETI 585

Transmitter

This is an oscillator the frequency of which is determined by the transducer characteristics. The impedance curve of the transducer is similar to that of a crystal with a minimum (series resonance) at 39.8 kHz followed by a maximum (parallel resonance) just above it at 41.5 kHz.

In the circuit the two transistors are used to form a non-inverting amplifier and positive feedback is supplied via the transducer, R6 and C3. At the series resonant frequency this feedback is strong enough to cause oscillation.

Capacitors C1 and C4 are used to prevent the circuit oscillating at the third harmonic or similar overtones while C5 is used to shift the series resonant point up about 500 Hz to better match the receiver.

Receiver

The output from the transducer is an a.c. voltage proportional to the signal being detected (40 kHz only). As it is only a very small level it is amplified by about 70 dB in Q1 and Q2. D.c. stabilization of this stage is set by R1 and R3 while C1 closes this feedback path to the 40 kHz a.c. signal.

The output of Q2 is rectified by D1 and the voltage on pin 2 of IC1 will go more negative as the input signal increases. If the input signal is strong the amplifier will simply clip the output, which on very strong signals will be a square wave swinging between the supply rails.

IC1 is used as a comparator and checks the voltage on pin 2, i.e. the sound level, to that on pin 3 which is the reference level. If pin 2 is at a lower voltage than pin 3, i.e. a signal is present, the output of IC1 will be high (about 10.5 volts) and this will turn on Q3 which will close the relay. The converse occurs if pin 2 is at a higher voltage than pin 3.

A small amount of positive feedback is provided by R9 to give some hysteresis to prevent relay chatter. If R9 is replaced by the capacitor C4 the IC becomes a monostable and if the signal is lost for only a short time the relay will drop out for about 1 second. If the signal is lost for more than 1 s the relay will be open for the duration of the loss of signal.

We used a voltage regulator to prevent supply voltage fluctuations triggering the unit. The relay was not included on the regulated supply, allowing a cheaper regulator to be used.

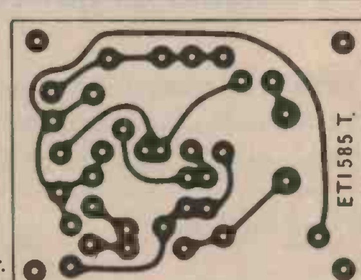


Fig. 7. Printed circuit board of transmitter. Full size 46 x 36.

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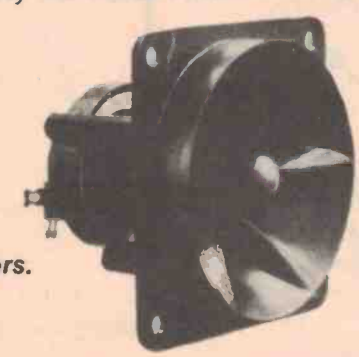

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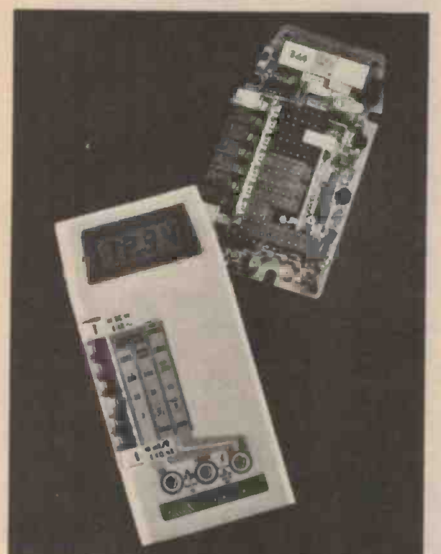

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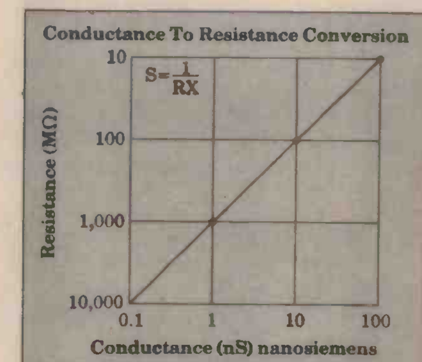

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Varicaps for AM

Modern advances in the fabrication of Varicap diodes have produced fairly high values of capacitance suitable for use in MW receivers. By Brian Dance.

FM RECEIVERS can be tuned mechanically by means of a conventional ganged tuning capacitor, but many modern FM receivers are tuned by means of variable capacitance semiconductor diodes known as 'Varicap' or 'Varactor' diodes. The junction capacitance of these diodes varies with the applied tuning voltage, so they can be used to replace a ganged capacitor.

In the past it has not been possible to construct economical receivers for the AM bands (long, medium and short waves) in which tuning is carried out by Varicap diodes, since the maximum capacitance of reasonably priced examples has been limited to less than about 100pF. However, during the past few years economical Varicap diodes with maximum valves of some hundreds of pF have been developed both in Europe and in the USA.

Some Advantages

A number of these high capacitance Varicap diodes can be employed to replace the conventional ganged capacitor used in an AM receiver which has a typical maximum capacitance value of some 150pF to 550pF per section. This brings the advantage that much space is saved, since multi-section ganged capacitors for AM tuning are fairly large components. In addition, it is easy to place the Varicap diodes in any position in the receiver and one can therefore usually reduce the lead lengths and unwanted stray coupling between circuits.

In the past it has not been possible to employ a single tuning knob in an FM/AM receiver when the FM section is tuned by Varicap diodes. However, the new high capacitance diodes may be employed in the AM section of such receivers and can be fed with the same tuning voltage as that which is used to tune the FM Varicap diodes. A single potentiometer may be used to provide this tuning voltage, but it should normally be a 10 turn potentiometer so that it can be easily adjusted with the required accuracy. Alternatively a potentiometer which has a long linear movement (a slider type) may be used. If required, fine tuning is easily incorporated using another potentiometer.

An important advantage obtained by the use of Varicap diodes is the ease with which remote tuning can be incorporated. Remote tuning is much more difficult to arrange when ganged capacitors are used.

On the other hand Varicap tuning is usually more expensive, while another possible disadvantage is the generation of harmonics in tuned circuits due to the non-linearity of Varicap devices; this will only be important at very high signal levels where the signal voltage is large enough to modulate the tuning voltage and hence affect the instantaneous value of the Varicap capacitance. It is most likely to be important only in the oscillator circuit where the alternating voltage is relatively high.

Principle of Operation

The principle of operation of Varicap semiconductor diodes follows from the theory of semiconductor pn junctions, which may be briefly illustrated by Fig.1. As the negative reverse bias applied to the p type side increases, the negative electrons in the n type material are repelled further away from the p type material into the n type.

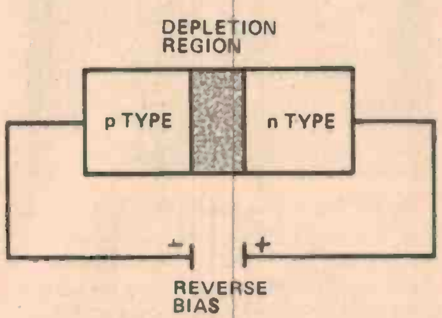

FIG. 1

Fig. 1. The reverse bias applied to a semiconductor junction controls the depletion depth and therefore the capacitance of the diode.

Similarly the positive bias applied to the n type repels any holes farther into the p type. Thus the increase in the applied bias increases the width of the layer which is depleted of mobile charge carriers.

The depletion region of this semiconductor capacitor has a very high resistivity, since it contains few charge carriers. Thus it may be compared with the insulating material between the plates of a conventional capacitor. An increase in the applied voltage increases the width of the depletion layer and therefore effectively separates the plates of the capacitor so that the capacitance value decreases. The change of capacitance is a non-linear function of the applied reverse voltage.

Motorola Devices

The capacitance of the Motorola MVAM-1 and MVAM-2 diodes at various values of reverse voltage is shown in Fig.2, the scales being logarithmic. The MVAM-1 is a triple diode, each diode having a capacitance of about 500pF at an applied reverse voltage of 1V.

The maximum reverse voltage is 28V and the capacitance is guaranteed to fall by a factor of at least 15 as the applied voltage rises from 1V to 25V. The three diodes are fabricated by ion implanation techniques on a monolithic chip so that their capacitance values are matched to ±1.5 percent over the whole of the 1 to 25V working range. This interesting component is now being discontinued, so it will not be discussed any further.

Motorola introduced the MVAM-2 dual AM tuning diode towards the end of 1974. As shown in Fig.2, the capacitance of each diode is somewhat less than that of the MVAM-1 diodes. However, the MVAM-2 device offers the same minimum capacitance ratio of 15:1 over a range of 1 to 25V, whilst the capacitance value of the two diodes is guaranteed to be matched to ±1.5% over the whole of the working range. It is intended that one diode should be used in a signal frequency stage of an AM receiver and the other in the oscillator circuit, so close matching is important if correct tracking is to be obtained.

It is also important that the Q factor (Quality factor) of the diode should be large if the selectivity of the tuned circuits is not to be impaired by its use. Figure 3 shows that the Q factor

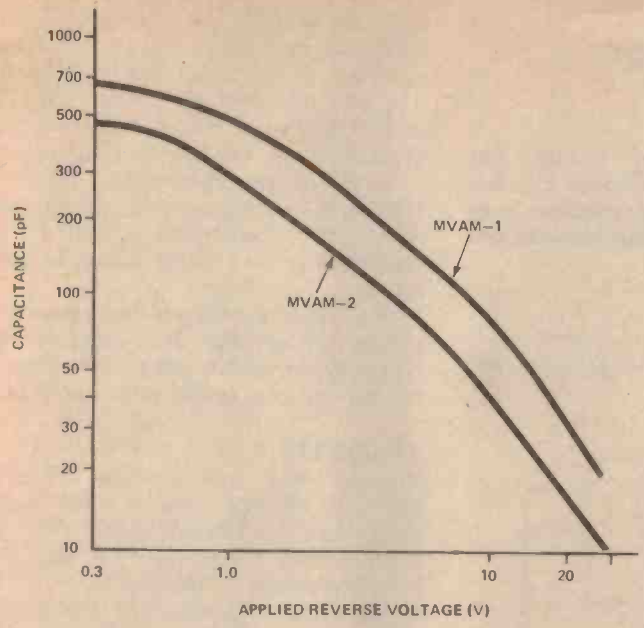

FIG. 2

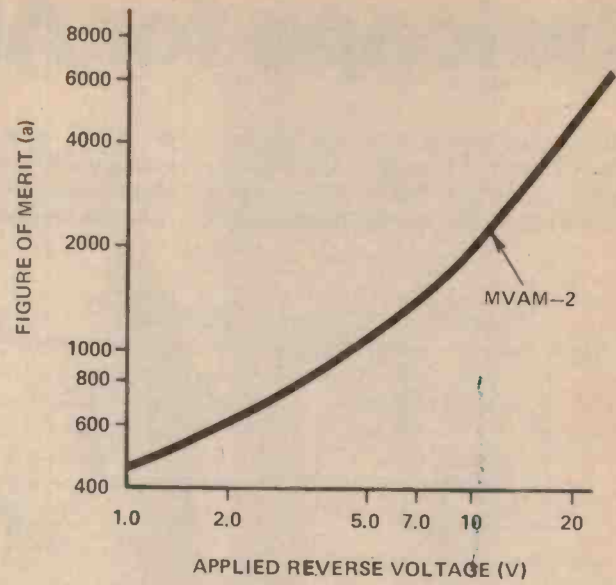

FIG. 3

Fig. 2. Variation of the capacitance of the MVAM-1 triple diode and of the MVAM-2 double diode with the applied voltage. The graphs apply to any one of the diodes in a device.

Fig. 3. The Q factor of the MVAM-2 plotted against the reverse voltage.

of an MVAM-2 diode increases from about 450 at 1V bias to about 6000 at 20V bias. The temperature coefficient of the capacitance value is about 435 parts per million per ^{o}C at 1V bias, but falls by a factor of about 2 as the bias is increased to 6V and by about another factor of two as the bias rises to 25V. The MVAM-2 is encapsulated in a small plastic transistor type package with 3 leads, the cathodes of the diodes being common.

Motorola is now introducing single diodes for AM tuning. These should enable reduced coupling between the signal and oscillator circuit and should render the design of printed circuit boards easier than when a multiple tuning diode is employed. The variation of capacitance of these MVAM-115 and MVAM-125 diodes with respect to applied voltage is shown in Fig. 4. The recommended working range is 1 to 15V for the MVAM-115 and 1 to 25V for the MVAM-125 with absolute maximum voltages of 18V and 28V respectively to prevent possible breakdown. In both types the minimum capacitance swing is 15:1 over the working range, whilst diodes of the same type are matched to within ±1.5% of 1pF over this voltage range. At 1V the capacitance is typically 500pF (minimum 440pf, maximum 560pF).

Typical circuit

The type of circuit in which the Motorola AM tuning diodes may be used is shown in Fig. 5. Three of the tuning diodes are shown (D1, D2, D3), the special symbol indicating that these diodes are being used as capacitors. In some receivers the RF stage and the RF tuned circuit will be omitted, in which case only two tuning diodes will be required or one MVAM-2 double diode.

When S1 is in the position shown, the tuning voltage is taken from a multiturn potentiometer VR1. This can supply any voltage from 0 to −25V, but if MVAM-115 diodes are used, a −15V supply must be used. When S1 is in one of the other positions, the tuning voltage is taken from one of the multiturn preset potentiometers VR2 to VR4 inclusive. Any number of these preset potentiometers may be used for switched frequency selection. The −25V line must be stabilised to prevent frequency drift or the effects of any hum on the tuning line.

In the aerial tuned circuit C_T is the trimmer capacitor and the tuning voltage is fed through the coil to D1. Blocking capacitors must be employed to prevent the tuning voltage from being shorted out at the input or output. The radio frequency tuned circuit is some-

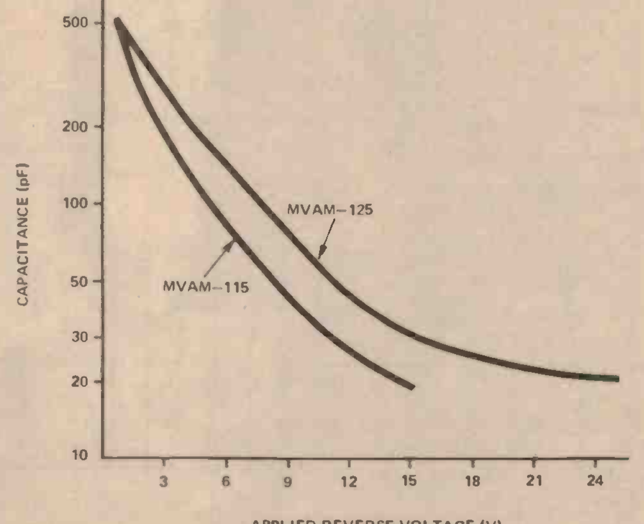

Fig.4. Variation of the capacitance of the MVAM-115 and MVAM-125 diodes with respect to applied voltage.

Varicaps for AM

what similar except that the tuning voltage is applied through a 470 kilohm decoupling resistor and a single 0.1μF blocking capacitor. The oscillator tuned circuit is again rather similar, but contains not only the trimmer C_T, but also the normal padding capacitor C_P to maintain correct tracking between the oscillator and the signal frequency circuits. The maximum value of the reverse current is 100nA at 15V for the MVAM-115 and the same for the MVAM-125 at 25V, while it is 150nA at 25V for the MVAM-1 and MVAM-2. Thus in all cases the voltage drop across the 470 kilohm decoupling resistors will be less than 0.1V. These resistors will therefore have a very small effect on the tuning.

The circuit shown employs a negative tuning voltage, but the design of the circuit could be changed so that a positive tuning is fed to the diode cathodes.

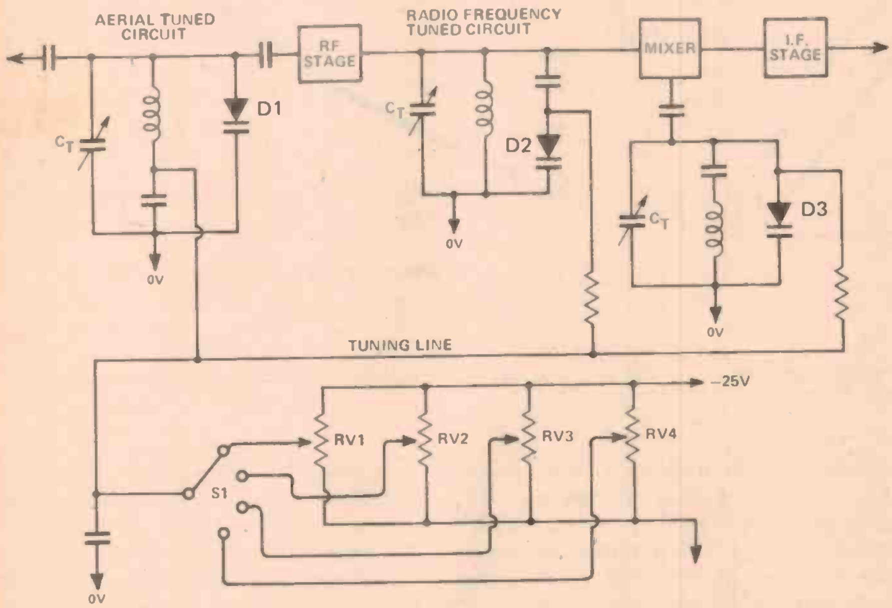

FIG. 5

Fig. 5. Typical circuit for the use of AM tuning diodes.

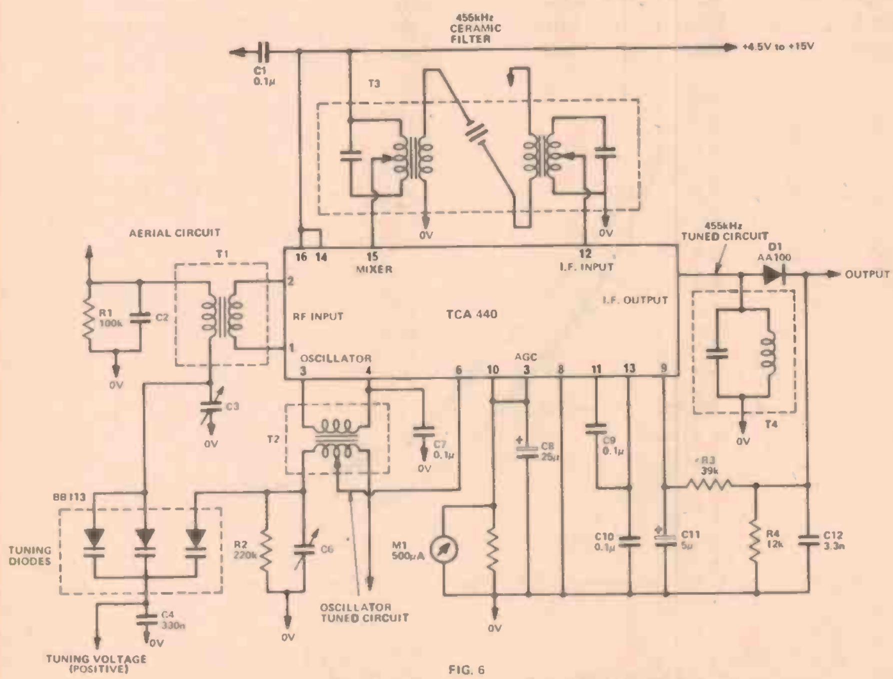

FIG. 6

Fig. 6. A circuit using the BB113 tuning diodes and the TCA440 monolithic AM tuner.

The BB113

Another AM tuning diode is the Siemens BB113 which has been marketed by the Philips group. This has a capacitance of between 230 and 280 pF per diode at 1V bias, falling to 13pF or less at 30V. Each BB113 device contains three similar tuning diodes matched to about 6%.

The three diodes of a BB113 may be used in three separate tuned circuits. An interesting example is detailed in Fig. 6, in which two diodes of a BB113 are used in the aerial tuned circuit and the third in the oscillator circuit and therefore the capacitance can be smaller.

This receiver circuit employs the Siemens TCA 440 integrated circuit. The latter contains all of the semiconductor devices required for the RF stage, mixer, oscillator, IF amplifier and AGC circuit. The audio output can be used to feed almost any monolithic audio amplifier device or a suitable audio amplifer using discrete components.

The TCA440 can be used for receiving frequencies of up to 50MHz. The meter M1 provides an indication of the signal strength. The AGC range of the RF section is 38dB and that of the IF section 62dB; thus the overall range is very large. A ceramic IF filter is shown in Fig. 6 between pins 15 and 12, but a normal IF double tuned circuit can be employed with inferior selectivity.

Unlike the circuit of Fig. 5, the Fig. 6 circuit requires a positive tuning voltage to the BB113 diodes.

Conclusion

The use of Varicap tuning diodes by the home constructor can greatly simplify the problems associated with the provision of a suitable tuning scale and with remote tuning. In addition, it greatly simplifies the component layout in the receiver, since the tuned circuits can be placed at any convenient point and are not dependent on the position of the various sections of a ganged capacitor.

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NEWS

EPROMOTION

The 2708 EPROM (1 Kbyte Erasable Programmable Read Only Memory) is a very useful chip when you're working with microprocessors. Programs can be written and debugged first in RAM, then the EPROM can be programmed and a prototype system can be run for some time to check for the (inevitable) remaining bugs. If any are found, they can be exorcised by erasing the EPROM under ultra-violet light and then reprogramming it with a corrected version of the program. Finally, if you're a manufacturer, the EPROM will be replaced by a mask-programmed ROM in production units.

Amateurs use EPROM's like the 2708 for developing bootstrap loaders and other short routines which they may only need for a short time. Once a PROM is blown, it can't be re-used, whereas a 2708 can be erased. The only problem for amateurs is the price.

2708's have, until recently, been in the $50 range. But now, a round of severe price cuts are in the offing, following the introduction of the 2716 (a 16 Kbit EPROM). Texas Instruments are planning a price reduction from $32.75 to around $22 (US 100-off price). The reason is simple; manufacturers are not just using them for development but are actually putting them into production equipment (as a hedge against bugs), so quantities are bigger than expected.

Many of the chip makers are ready to follow TI's move, including Mostek, Motorola and Signetics. Already some people are anticipating a price of $10 by the end of the year. All this is good news for amateurs — we can predict that the 2708 will be very much more popular with hobbyists.

More On 2708

National have announced their version of the 2708, priced in Australia at $32.75 in 100-up quantities. Meanwhile, Motorola have had a bright idea. Normally, the 2708 is packaged in a ceramic DIP with a quartz window (to allow UV erasure), but Motorola reckon that a lot of their customers never erase their chips, and so are packaging them in a plastic DIP as conventional non-erasable PROM's. This means they can make a lot more, and make them cheaper.

Radio Shack Computer

The giant US electronics chain, Radio Shack, has released details of its TRS-80 microcomputer system. The US$599.95 system includes a 12 inch CRT, keyboard, cassette recorder and CPU with 4 Kbytes of RAM and 4 Kbytes of ROM containing a BASIC interpreter. The CPU chip is a Z-80: witness that BASIC in 4 Kbytes. The bus structure is a Radio Shack 48-pin design which allows peripherals to be 'daisy-chained' — all the boards plug together rather than into a mother board.

Coming soon are RAM expansion to 62 Kbytes and 12 Kbytes of ROM, with extended BASIC, including double precision floating point package and graphics. Also in the pipeline are a mini-floppy and a printer.

Zilog Z-8

Many hobbyists are familiar with the Zilog Z-80, the top-of-the-line micro, the 'super 8080' with all kinds of nice features. Zilog is now readying to release the Z-8, a single-chip microcomputer for control applications. On the Z-8 are 2 Kbytes of ROM, 96 bytes of RAM, four 8-bit I/O ports, a serial I/O port, two timer/counters and a prescaler. A key feature of the Z-8 is its speed: maximum instruction execution time is only 750 ns.

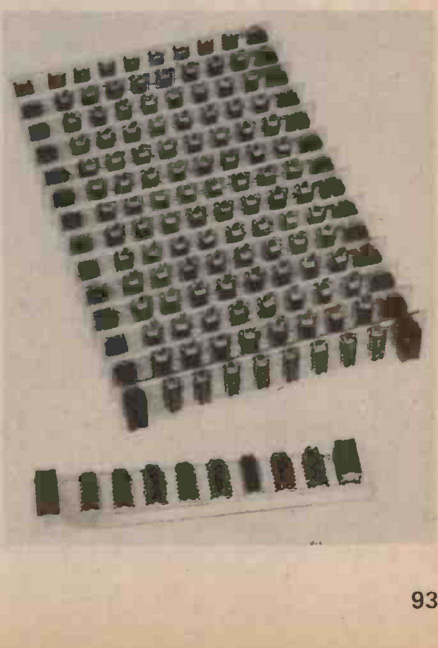
Meanwhile, the Z-80 is now being second-sourced by SGS in Europe in addition to Zilog, Mostek and Sharp. The rest of the world is playing guessing games and wondering what the Z-800 will be like!

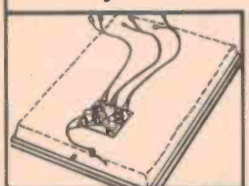
1 Mbit Memory

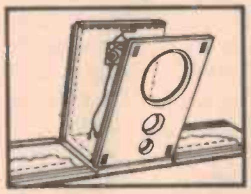
The growth of memories continues with the spotlight gradually moving off MOS memories to more exotic types such as CCD's and magnetic bubble memories. Rockwell International's Autonetics Electronics Research Division has developed a one megabit bubble memory which it may introduce commercially by late 1978. The 10 x 9.5 mm chip utilises 1.8 micron diameter bubbles, and can operate at clock rates up to 300 kHz.

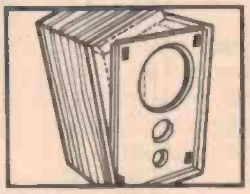
RAM Sticks

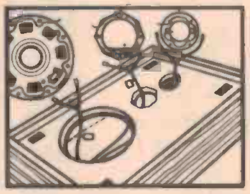
This ingenious solution to the not-yet-ages-old problem of memory expansion comes from *Applied Technology* of *109 Hunter St., Hornsby, NSW 2077.* Each board carries eight low power 2102's, and plugs into other RAMsticks so that they can be stacked. The RAMsticks are supplied fully assembled and tested, and 4 K will set you back $99, while 8 K is $189. The sticks can be expanded in 1 K increments, and Applied Technology have designed a 32 K x 8 bulk memory unit which includes power supply and stand-by battery.

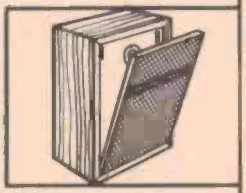












THE S100 BUS

Whether you're for it or agin it, you really should know about it. Here's Kevin Barnes with the inside info.

THE PIN DESIGNATION and PC card size originally used in the Altair 8800 computer has become somewhat of a standard in the US personal computing scene. So much so that there are over 40 manufacturers supplying electronically and mechanically compatible products for the Altair bus. The bus has also picked up a new name: it's now being called the S100 bus.

Originally defined by MITS when they designed the Altair 8800 computer around the 8080 microprocessor, S100 gained momentum as a standard when IMSAI released their 8080computer also using this bus. Now the range of boards available encompasses memory boards, which are the most common, floppy disk controllers, colour TV graphics boards, high speed cassette interfaces, multifunction and analog I/O boards, video monitor interfaces and even speech synthesizers and recognizers.

1977 has also seen an added dimension to the S100 bus. This is the availability of CPU boards for other microprocessors than the 8080. Now available in the States are S100 CPU boards built around the Z-80, the 6800 and the 6502 microprocessors.

Expandability

The very variety of S100 boards has contributed enormously to the popularity of the standard. This variety means that you can tailor a system to your needs simply by plugging in the appropriate S100 boards. For example, you might want to add some graphics display capability, say for the kids to try drawing on a computer. You have a choice of buying an expensive new Tektronix type terminal or of plugging in an S100 board for quite a bit less: say a Merlin or Poly 88 video board.

However the S100 bus has not been without its critics. At a recent microcomputer club meeting, the announcement that a group of members was building an S100 system sparked a debate that lasted for more than two months.

BUS DEFINITION

PIN No.	SYMBOL	NAME	EXPLANATION
1	+8 V	+8 Volts	Unregulated input to +5 V regulators
2	+16 V	+16 Volts	Positive unregulated voltage
3	XRDY	External Ready	For special applications: pulling this line low will cause the processor to enter a WAIT state and allows the status of the normal Ready line (PRDY) to be examined.
4	VI0	Vectored Interrupt Line 0	
5	VI1	Vectored Interrupt Line 1	
6	VI2	Vectored Interrupt Line 2	
7	VI3	Vectored Interrupt Line 3	
8	VI4	Vectored Interrupt Line 4	
9	VI5	Vectored Interrupt Line 5	
10	VI6	Vectored Interrupt Line 6	
11	VI7	Vectored Interrupt Line 7	
18	$\overline{\text{STA DSB}}$	$\overline{\text{Status Disable}}$	This input to the CPU board tri-states the buffers that output the status information to the bus. Signals affected are SINTA, SWO, SSTACK, SHLTA, SOUT, SMI, SINP, and SMEMR.
19	$\overline{\text{C/C}}$ DSB	$\overline{\text{Command/Control}}$ Disable	This input to the CPU board tri-states the buffers that output the 8080 control signals to the bus. Signals affected are SYNC, DBIN, WAIT, WR, HLDA and INTE.
20	UNPROT	Unprotect	Is an input to the memory protect flip-flop on a memory board. To protect the contents of such boards a positive pulse should be applied to pin 70 to set the protect flip-flop. A positive pulse on the UNPROT line will reset the flip-flop.
21	SS	Single Step	This signal indicates the processor is performing a single step. It comes from the front panel and is an input to the CPU.
22	$\overline{\text{ADD DSB}}$	$\overline{\text{Address Disable}}$	This input to the CPU tri-states all 16 address buffers and so isolates the 8080 address bus from the system address bus.
23	$\overline{\text{DO DSB}}$	$\overline{\text{Data Out Disable}}$	This CPU board input tri-states the data out buffers. Use of the signals on pins 18, 19, 22 and 23 effectively disconnect the CPU board from the system for DMA.

The issue was never fully resolved (this type of discussion seldom is) but what did come out was that only a few people know the details of the bus well or understand what a commitment to it means. A bad situation when you could be spending hundreds of dollars.

At present, personal computer hackers are doing one of three things with S100: ignoring it completely and going their own way; using S100 and strictly S100 boards (i.e. buying boards proven to work with the bus); and thirdly using S100 but not staying within the strict S100 definition, for example changing the meaning of one or two control signals to suit their own CPU or peripherals.

The first and second groups don't run into any difficulties with the bus. The only exception is the member of the second group who wants to design his own boards to fit the bus. What he and the third group need is information about the bus. Hopefully, this article will provide some of that information.

Criticisms

The bus is also criticised because it is not completely standardised, the control signals are old-fashioned (?) and more complex than they need be. The justification for the claims is that there are variations in some control lines on boards from different manufacturers (not that they don't work, just that variations exist). What does worry people is that while board A may work with the bus and board B works with the bus, board A will not necessarily work with board B (without getting into the hardware, which many people are reluctant to do these days). One way around this is to plug the board into your system and try it before you complete the purchase, or borrow one from a friend or fellow club member.

The S100 bus was originally designed for only the 8080, at a time when some of its support chips (the 8228 and the 8224) were not available. This means that the control signals are using more of the bus than is absolutely necessary. One example of this is the allocation of three pins to send $\phi1$, $\phi2$ and CLOCK down the bus. $\phi1$ and $\phi2$ are the two phase clock signals used by the microprocessor and CLOCK is the output of the oscillator used to produce these signals. Some of the newer micro-

24	$\phi2$	CLOCK PHASE 2	
25	$\phi1$	CLOCK PHASE 1	
26	PHLDA	Hold Acknowledge	This CPU output indicates that the 8080 has entered the hold state and that the address and data outputs of the chip have gone tri-state (though not necessarily their buffers).
27	PWAIT	Wait	CPU output indicating 8080 in wait state.
28	PINTE	Interrupt Enable	CPU output indicating that the 8080 interrupt system is enabled and the chip will respond to interrupts.
29	A5	Address Line 5	
30	A4	Address Line 4	
31	A3	Address Line 3	
32	A15	Address Line 15	
33	A12	Address Line 12	
34	A9	Address Line 9	
35	DO1	Data Out Line 1	
36	DO0	Data Out Line 0	
37	A10	Address Line 10	
38	DO4	Data Out Line 4	
39	DO5	Data Out Line 5	
40	DO6	Data Out Line 6	
41	DI2	Data In Line 2	
42	DI3	Data In Line 3	
43	DI7	Data In Line 7	
44	SM1	M1	CPU status output; indicates instruction fetch cycle (important for front panel operation as machine must halt on M1).
45	SOUT	OUT	Indicates execution of an OUT instruction: address bus contains I/O port address and data bus will contain output data when PWR active. All memory boards should be disabled when SOUT or SINP at logic 1.
46	SINP	INP	As SOUT, but for an IN instruction. Data to be input should be placed on the data bus when PDBIN is active.
47	SMEMR	MEMR	CPU output indicating memory read in progress.
48	SHLTA	HLTA	CPU status output: halt acknowledge.
49	CLOCK	Clock	In the Altair this is the inverted output of the 2 MHz oscillator that generates the two phase clock. However, other S100 cards are not staying with 2 MHz. The Morrow, for instance, outputs 18 MHz from its 8224 clock driver, while Z-80 and other systems differ again.
50	GND	Ground	You have now read half way through this; congratulations on your perseverance and I hope you find what you're looking for!
51	+8 V	+8 Volts	See pin 1.
52	−16 V	−16 Volts	Negative unregulated voltage.
53	SSW DSB	Sense Switch Disable	CPU input; disables data input buffers so that data from the front panel sense switches may be strobed onto the processor's bidirectional data bus.

processors like the 6502, the 8085 and the 6802 have oscillators built into the chip. Others, like the Z-80 use only a single-phase clock.

However, there is a plus side to this multiplicity of signals, in redundancy of information available from the bus. To the circuit designer this is flexibility he can exploit to adapt his circuit to S100. The bus also has some unique control lines that provide quite convenient features. One example is the provision of remote memory protect. The S100 definition allows for a memory protect flip-flop on the memory board. Applying a momentary positive pulse on the MEMORY PROTECT line sets the flip-flop and prevents data being written into memory on that board.

ROLLING YOUR OWN S100

The physical facts of S100 are given in Fig. 1, a picture worth a thousand words. The bus supports sixteen address lines, allowing 65536 bytes of memory to be uniquely addressed. There are also two 8-bit data buses, one for data input (data flowing to the CPU) and one for data output (data flowing from the CPU to memory or peripherals).

There is also a set of control lines that are used for synchronisation, timing, data flow control and status control. Because the Altair is an 8080 based computer many of the control signals can be found described in the Intel data sheets. They can be found by looking at the similarity of names in Table 1 to those in the Intel User's Manual.

The S100 definition calls for each board to have its own voltage regulators. To this end there are three lines carrying unregulated voltages. There is +8 V on pins 1 and 51, +16 V on pin 2 and −16 V on pin 52. Ground is pins 50 and 100.

When you examine the different signals in Table 1 you will notice frequent reference to the front panel. In fact many of the control signals are generated on it. The Altair 8800 required the front panel to control the CPU board. However the newer CPU boards do not use front panel boards and themselves generate most of the control signals that are required by the S100 bus. This has happened through the use of an on-board ROM monitor program. You will need to bear this in mind if you plan to design and build your own CPU card.

54	EXT CLR	External Clear	Generated by the front panel; is used by the Altair as a reset signal for I/O devices. In other systems it is tied together with RESET and POC.
55 −67			Are currently undefined on the Altair systems. However, a number of proposals have been put forward for their use. One proposal calls for a real time clock on pin 55 and the use of 56 – 60 as memory board selects. This would allow memory expansion in banks. Another proposal calls for 56 to be a strobe signal obtained from the 8224 clock chip and for pins 62 – 66 to be used to interface mass memory. For the time being, these pins are fair game for any special signals your system may require.
68	MWRT	Memory Write	A function of WR and SOUT, indicating data on data out bus is to be written into memory.
69	PS	Protect Status	An output from the memory board currently being addressed; indicates status of memory protect flip-flop.
70	PROT	Protect	Is the input to the memory protect flip-flop on the board currently addressed.
71	RUN	Run	Indicates the state of the RUN/STOP flip-flop.
72	PRDY	Ready	CPU board input that controls the run state of the processor. Pulling PRDY low causes the processor to enter a wait state until PRDY goes high again.
73	PINT	Interrupt Request	
74	PHOLD	Hold	Causes the processor to enter a Hold state and subsequently acknowledge by putting PHLDA high.
75	PRESET	Reset	Resets program counter to zero.
76	PSYNC	Sync	Identifies beginning of a machine cycle.
77	PWR	Write	Indicates data is being written to memory or I/O. Data on bus is stable while PWR is low.
78	PDBIN	Data Bus In	Processor output control signal indicating that data is being read into the CPU. Data on the the data bus should be stable while PDBIN is high.
79	A0	Address Line 0	
80	A1	Address Line 1	
81	A2	Address Line 2	
82	A6	Address Line 6	
83	A7	Address Line 7	
84	A8	Address Line 8	
85	A13	Address Line 13	
86	A14	Address Line 14	
87	A11	Address Line 11	
88	DO2	Data Out Line 2	
89	DO3	Data Out Line 3	
90	DO7	Data Out Line 7	
91	DI4	Data In Line 4	
92	DI5	Data In Line 5	

S100 BUS STRUCTURE

The S100 system bus structure consists of 100 lines. These are arranged with 50 on each side of the plug-in cards.

The 'P' prefix indicates a processor command or control signal while the 'S' prefix indicates a processor status signal. All bus signals with the exception of the power supplies are TTL levels.

93	DI6	Data In Line 6	
94	DI1	Data In Line 1	
95	DI0	Data In Line 0	
96	SINTA	INTA	Indicates interrupt acknowledge.
97	$\overline{SWO}$	$\overline{WO}$	Processor output indicating write cycle.
98	SSTACK	Stack	Processor output indicating that the address bus holds the stack pointer.
99	$\overline{POC}$	$\overline{\text{Power On Clear}}$	When mains is first applied this signal is generated to set up initial conditions on other boards in the system.
100	GND	Ground	

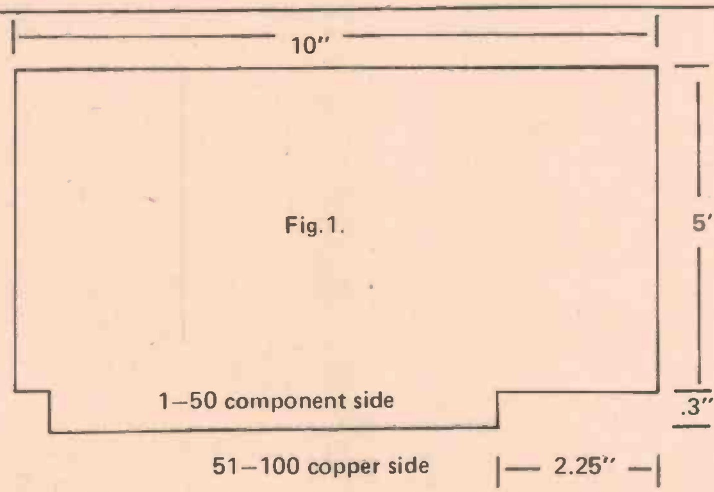


Fig. 1. Standard S100 card is 10" wide and nominally 5.3" high. Some manufacturers are using different heights depending on circuit requirements. The board plugs into a 100 position edge connector with 0.125 inch spacing. Note that the connector strip is offset to prevent backward insertion of the board. Pins on the component side are numbered one to fifty, on the copper side fiftyone to one hundred.

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THE NEW HEATHKIT COMPUTER

Heath's Computers

Firstly, sorry about the mix-up with the details of the Heath computers last month (what do you mean, you didn't notice?) — we managed to print a photo, but no story. Since then, we've received more details; here they are.

Heath have released two systems, based on the 8080 and on the LSI-11. The H8 computer has an 8080 CPU and an 'intelligent front panel' with 16 keys and a 9-digit LED display. The front panel works in octal and apparently is similar to the Morrow front panel reviewed last month. Like many older computers, the H8 has a built-in loudspeaker which beeps quickly if an operation has been performed correctly; if a long beep is heard, something is wrong.

There is a 1 Kbyte monitor program built in which presumably provides some of the front panel's intelligence as well as load and dump routines. The H8 doesn't use the S100 bus — apparently Heath's engineers considered it, but rejected it in favour of a 50-pin arrangement which will be known as the 'Benton Harbor' or 'BH' bus. An organisation with a lesser reputation than Heath's would almost certainly come up against strong consumer resistance to this change; but Heath are well known for the quality and reliability of their kits, and this will be the deciding factor for many people.

The H8 CPU board is supplied wired and tested. This, together with the legendary ease of assembly of Heathkits, will make the H8 a good choice for those without much hardware experience. (At the moment, it is estimated that as many as 80% of kit computers sold in the US never reach an operating state.)

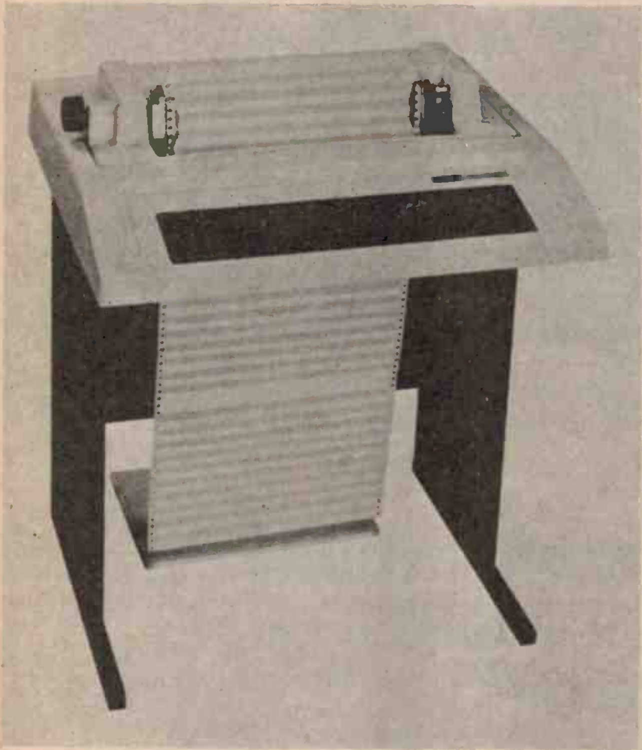
A 4 K static RAM board (H8-1) is available, as well as a parallel I/O card (H8-2), a 4 K chip expansion set (H8-3) and a serial I/O board (H8-5) which has a 300 and 1200 baud audio cassette interface. With its ten-slot motherboard the H8 can accept 32 Kbytes of memory and two I/O cards. Heath will release bus specifications soon; it will be interesting to see if any independent suppliers set out to supply other memory or I/O cards.

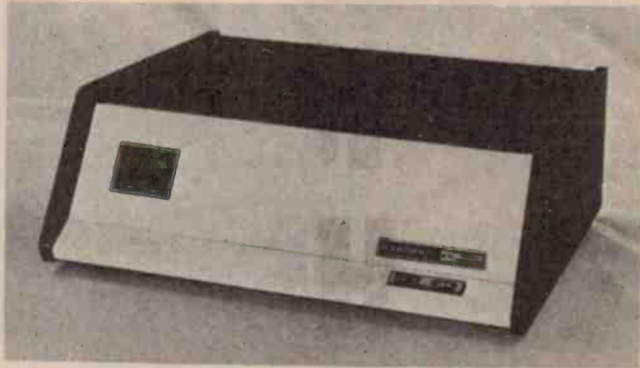
Extensive software is supplied with the H8, including PAM-8, the panel monitor, BUG-8, a debugger, HASL-8, an assembler, TED-8, text editor and BH (Benton Harbor) BASIC. The BASIC runs in 8 K and includes PEEK, POKE, PIN, OUT, SIN, COS, LOG and USER functions. It also features syntax error detection and automatic command completion (in other words, you type in the first few letters of a command, and the system supplies the rest). Extended BH BASIC runs in 12 K and includes string handling.

The H11

The heart of the H11 is Digital Equipment Corp's LSI-11 processor (it doesn't seem right to call it a *micro*processor), which means that it is virtually a PDP-11 minicomputer. The LSI-11 is a 16-bit device, and has 4 Kwords of RAM as standard, plus a built-in system monitor. The H11 also has a switching power supply, cooling fan and a back panel which will accept up to six cards.

A 4 K x 16 static RAM card (H11-1) is available, as well as a parallel interface (H11-2) and a serial interface (H11-3). But the nicest thing about the H11 is the fact that it is supplied with a DEC software package containing a PAL-II





assembler, editor, linker, on-line debug package (ODT), I/O executive, plus DEC BASIC and FOCAL. This is all *GREAT SOFTWARE*. Mind you, Heath don't mention the amount of memory required to run it! Last time I checked in the States, the LSI-11 module from DEC (KD-11F) would cost at least $850 and the single-user BASIC cost around $750 on top of that. In addition, if my memory serves me right, you needed the RT-11 operating system to run it, and that was roughly another $750! Obviously the Heathkit H11 at $1295 is great value, but that free software is a great incentive to buy a lot more memory!

At the moment, the H11 will support up to 20 Kwords of memory and is paper tape oriented; but expansion is planned and we should see some nice mass storage like floppy disks — Heath seem to be aiming at the small business systems market.

Hanging Around

As most of our readers will know, a computer is no use on its own; you've got to have lots of peripherals to hang round it. Heath have thoughtfully provided some nice bits and pieces to match your H8 or H11.

The H9 is a really stylish video terminal with 67 key keyboard, and 80 character by 12 line display. Amongst its beaut features are cursor control, batch mode, plot mode, and a format to display four 20-character columns of text. Serial interfaces are RS-232, 20 mA loop and TTL at selectable baud rates (110 to 9600 baud).

The H10 is the answer to many computer hobbyists dreams — a paper tape reader/punch unit at a reasonable price that even looks good! (You can tell I'm getting really enthusiastic, can't you?) The H10 interfaces through standard parallel TTL to any computer, and will read fanfold or rolled tapes at 50 c.p.s. The punch operates at 10 c.p.s. and both halves may be operated simultaneously (e.g. during an assembly).

For hard copy output, Heath will market DEC's LA36 DECwriter II printer. This is a really flash 30 c.p.s. printer with upper and lower case and forms handling capability. For such a fancy printer you can expect a fancy price — so this will still be a dream for many hobbyists.

Training

It's fun finding out the hard way in computers, as far as programming is concerned, anyway; but it can also be darned frustrating. Heath want their computers and their owners to be doing useful things quickly, and so they are putting together several programmed instruction courses. In addition, a small 6800-based trainer will be available to teach machine language programming and interfacing.

Heath have great plans for expansion in the near future, including better graphics capability (including colour, but this may be for NTSC only) a floppy disk system for the H11, and a printer. Various other ideas are under consideration, but Heath will rely on user feedback to guide them in development priorities. The Heath User's Group will obviously have a hand in this, as well as providing access to contributed software and information, in addition to minor software revisions from Heath.

The accent is very much on software and education of the user — in this field, it looks as though Heath already have a head start over their opposition. Their link with DEC is an interesting innovation; previously DEC did have a catalogue of 'Do-It-Yourself' computer products, but as previously mentioned, software was expensive and there wasn't anything like Heath's support available.

It looks as though Heath are on the right track and firing on all cylinders — they're at the top of my Christmas list this year.

HEATH COMPUTER PRICES

H8	$375
H8-1	$140
H8-2	$150
H8-3	$95
H8-5	$110
H9	$530
H10	$350
H11	$1295
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.037, .047, .056	12c
.068, .1, .12, .15	15c

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PL-259/R	Solderless PL-259 for RG58/U cable	$1 25
SO-239	Panel Socket with flange, suit PL-259	$1 25
SO-239A	Panel Socket without flange suit PL-259	98c
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M-258	Cable joiner double male suit SO-239	$1 65
M-358	Cable joiner "T" Connector (Double female and male)	$3.00
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D-258/A	Dummy load with resistor, non-inductive	$1.90
NC-535/1	14" Cable Assemble or SWR s etc	$2.10
PC-258	1 metre cable Assembly RG58/U cable with PL-259 plug each end — suit SWR and other test meters etc	$4.30
MP-4	CB 4 pin microphone plug	$1.50
MS-4	CB 4 pin microphone panel socket	$1.65
NC-512	CB 3 pin microphone plug	$1.65
NC-557	Universal jack adaptor	$1 10
NF-830	In-line fuseholder with wire	40
CC-2	Mic cable 3 conductor, single shield curly-cord, colour black	$1.75
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SWR-400	In-line SWR, PWR and field strength meter PWR 0-10, 0-100W, specs as SWR-300	$26.50
JD-310	In-line SWR and PWR meter to 10 watt	$19.95
JD-171	In-line SWR, PWR and field strength meter, deluxe with 2 metres for continuous measurement, 0-10, 0-100 watts specs as SWR 300	$29.50
JD-175	In-line SWR and Field strength meter with in-built Antenna Matcher, spec as SWR-300 and JD 140	$32.80
JD-140	In-line Antenna, Impedance matcher, use to 100 watts, with tune and load controls, low loss type, now lower your SWR by correct matching of CB transceiver and aerial	$16 50
SM-1	CB Transceiver slide mount kit, with lock, 2 keys etc Suits all types, for easy service, adjustment security	$9.50
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HL-2	Hot-line Filter-heavy duty 7 amp	$4 95
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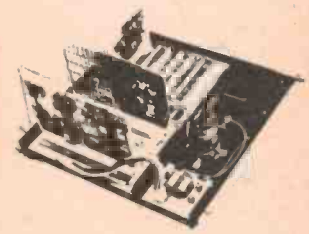

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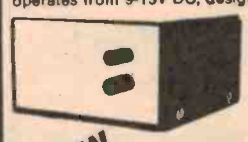

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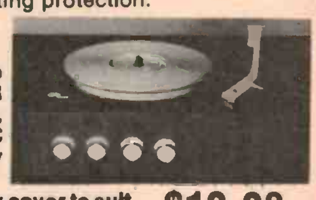

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CB NEWS

CB CONTEST RESULTS

After what seemed like several hours counting, Mike Sheridan and Collyn Rivers raised their heads and announced, 'Eight thousand two hundred and eighty one!'. That number (8281) is the number of diodes in the jar featured in the MS Components contest in the June issue of CB Australia. Congratulations go to Mrs. F. Hemming of Safety Bay, WA, who wins first prize of a Sidewinder III transceiver for her guess of 8282.

Second prize of an RF Signalizer goes to Garry Smith of Willagee, WA, and third prize (a Kaiser multimeter) to S.C. Hamp of Millicent, SA. Fourth and fifth were Ms. Phillipa Jarrett of Artarmon, NSW, and Bruce Notley of Kempsey NSW, who receive $15 and $10 gift vouchers, respectively.

We've already been in touch with the winners, but we thought we'd make them famous as well (How does it feel to see your name in print?). And now, the *infamous* department...

Wildest guess comes from someone in Belmont, Victoria who (for obvious reasons) we won't name. We would have needed 3800 jars to accommodate his guess of 31,415,927! Commiserations go to the character from Lakemba who wrote: 'I am going to WIN, DO YOU HEAR'. Frankly our hearts bleed for you.

BE PAID FOR YOUR HOBBY

CB Australia will shortly be re-introduced in an exciting and totally new format. The publishers are currently seeking correspondents in all States to supply regular monthly reports on all CB-related topics.

We need CB club news, trade news and general interest articles related to CB. All contributions will be paid for at normal journalistic rates. If you feel you can help, telephone or write to the Publisher, CB Australia, 15 Boundary Street, Rushcutters Bay, NSW 2011, or ring Collyn Rivers on 33 4282.

Bright CB Convention

The Apex Club of Bright is conducting a giant CB Convention on the weekend of October 8 and 9 in Bright. It is hoped that this will give CB'ers a chance to meet together in ideal surroundings to discuss CB as well as learn something through the planned lectures and demonstrations. Philips, Farad Electronics, Scalar Antennas, and Hills Antennas will give demonstrations,and there will be lectures on UHF, TVI, antennas, static displays of equipment, a ham radio setup and a 'Test your rig' booth. There will be plenty of opportunity for mixing with other CB'ers at the social functions and get-togethers organised by the Apex Club, which is running the convention to get CB'ers together and also to raise money for Lukaemia Research, which is the Apex Associations Project for this year. Further details from the Apex Club of Bright, P.O. Box 54, Bright, Vic. 3741.

$20 Licence – But Be Quick!

If you send in your licence application before October 1st it will be accepted and processed under the pre-budget licensing conditions. Only a $20 fee per set will be necessary to accompany the application. After that you'll be 'Lynched' for $25 per set as brought down in the August Federal budget. Get busy with your pens and cheque books.

27.065 MHz for Emergency Channel?

Following much lobbying, the NCRA has finally gained some, tacit at least, recognition by the P&T. Mr. Wilkinson, the 1st Assistant Secretary has asked the NCRA to provide comments on the proposal to dedicate 27.065 MHz (Channel 5 – or channel 9 in the old system) as an official emergency channel and how such an emergency service would operate.

As the Wireless and Telegraphy (1905!) Act is currently being overhauled, the Dept. seems set to consider specific legislation designed to cater exclusively for the Citizen Radio Service.

These items, amongst others, were set out in a letter to the NCRA from Mr. Wilkinson as matters for comment and/or discussion.

CRS Advisory Committee

The above-mentioned letter also indicated that the Dept. was interested in receiving proposals for the establishment of Advisory Committees to assist in resolving any problems that may arise between CB'ers and the community. The committees would operate in each state in a similar manner to the amateur radio advisory committees set up by the WIA.

Dick Donates Crystals

Forty special crystals were donated by Dick Smith to the Surf Life Saving Association (S.L.S.A.) of New South Wales early in August. The crystals were designed to overcome 'image frequency' interference to the S.L.S.A. radio network on 27.98 MHz, from CB radios operating on or near new channels 5 and 6, or those using old channels 9 and 10.

The Deputy Vice President of the N.S.W. S.L.S.A., Gordon McNaughton, said that there have been a number of occasions when clubhouses have lost radio contact with with mobile rescue vehicles because of this type of interference from CB transmitters.

The problem lies in the fact that the S.L.S.A. receivers' image frequency falls on 27.07 MHz. Strong CB signals on old channels 9 and 10 can be heard and thus cause interference.

The more than 300 radios used in surf clubs around N.S.W. all require conversion to avoid this type of interference. It is accomplished by fitting new receiver crystals above the 27.98 MHz safety frequency, putting the image well out of the heavily occupied CB band.

Midland 18 channel Australian CB

The Midland model 77A-857 is an AM rig fitted with the 18 Australian channels and meeting the Australian P&T Specifications (RB249).

Dick Smith is marketing the rig in Australia and the 77A-857 has been nick-named the 'Silencer' by his staff as it features an advanced noise-limiting circuit, claimed to be very effective in 'knocking out' troublesome ignition interference. The rig also includes a delta tune control (not a switch), built-in S-meter and RF power meter along with the usual volume and squelch controls, external speaker and P.A. speaker connections. Price is an economical $139.50, catalogue number D-1429.

Portable CB

Dick Smith has announced the release of a 'go anywhere' portable CB rig. Made by Midland, and designated the 13-861, it is a 23 channel, 5 W rig that features military styling, internal whip, internal batteries and a mike that doubles as a apeaker.

The 13-861 can also be operated as a mobile or base rig as it has facilities to connect an external power source (batteries or 13.8 V mains supply) and external antenna.

The rig is popular in the US with hiking and camping enthusiasts. It will retail locally for around $189 from Dick Smith and dealers.

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CB SYNTHESIZERS

A BEWILDERING VARIETY of CB transceivers is available on the Australian market today. There are economy AM transceivers, 'high-quality' dual-conversion AM transceivers, SSB/AM transceivers, PLL synthesizer transceivers, etc. — all finding some niche in the market according to price, promotion and performance. An increasing number are appearing 'tailored' to suit the Australian regulations (RB249), these being fitted for the local 18 channels — two of which are not in the US 23-channel scheme.

Well, let's have a look at how the various types of transceiver generate the required transmitter and receiver frequencies to put it on the channel you select.

CB transceivers are of the superhet type. For the receiver, the incoming signal is mixed or 'heterodyned' with another local frequency generated within the transceiver. The local frequency (generated by the local oscillator) is different from the received frequency by a certain fixed amount. The difference is called the intermediate frequency or IF. The signal is then amplified at this lower frequency and detected.

In a similar way, two oscillators within the transceiver can be mixed together to produce the required transmitter frequency on the same channel to which the receiver is tuned. This principle is used in some 'frequency synthesizers'.

Figure 1 shows the basic superhet scheme as it applies to a receiver or a transmitter.

Now, as the CB band is divided up into 18 channels the simplest transceiver would require one crystal each for the receiver and transmitter (non-superhet transmitter) for each channel — that's 36 crystals in all! At around $4 each to the manufacturer, that would be over $140! There's gotta be a better way! And there is — synthesizers.

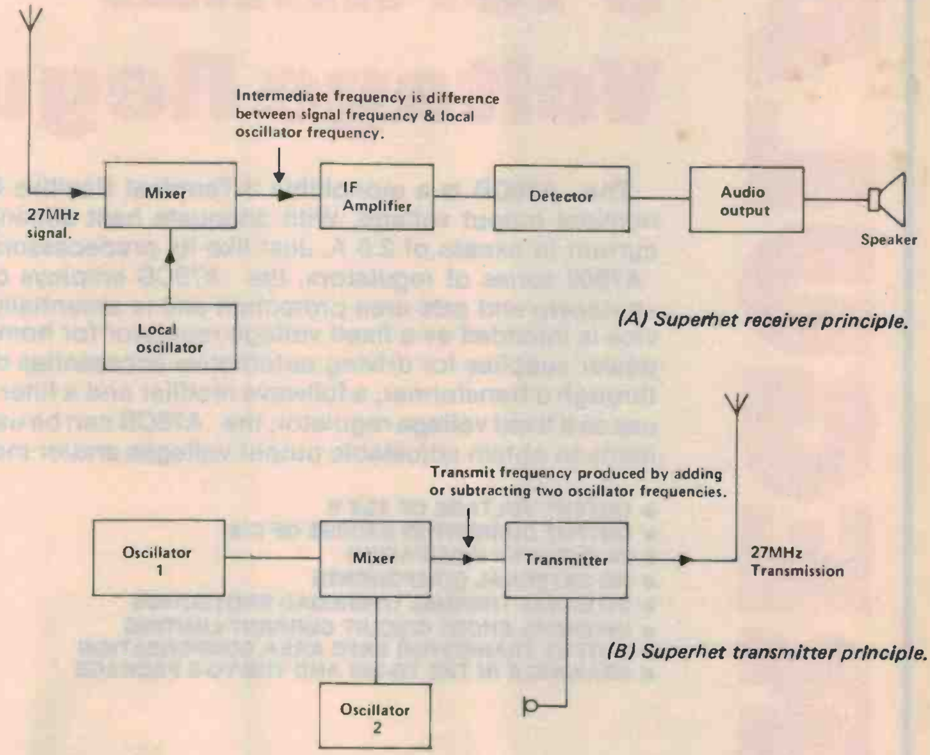

Figure 1. Basic principle of superhet as applied to receivers and transmitters.

Crystal Synthesizers

By using the superhet principle, the number of crystals required to generate the 18 channels on 27 MHZ can be reduced to 14 — a great saving!

Crystal synthesizers can be realised using any one of a number of basically similar systems. Generally, two sets of four 'low frequency' crystals are mixed with the outputs of six 'high frequency' crystals to obtain the required frequencies for the transmitter and receiver for each channel.

A typical single-conversion scheme, most often employed in economy AM-only transceivers, is illustrated in Fig. 2. For an incoming signal on 27.015 MHz (channel 1), the effective local oscillator signal for an IF of 455 kHz (0.455 MHz)

CB SYNTHESIZERS

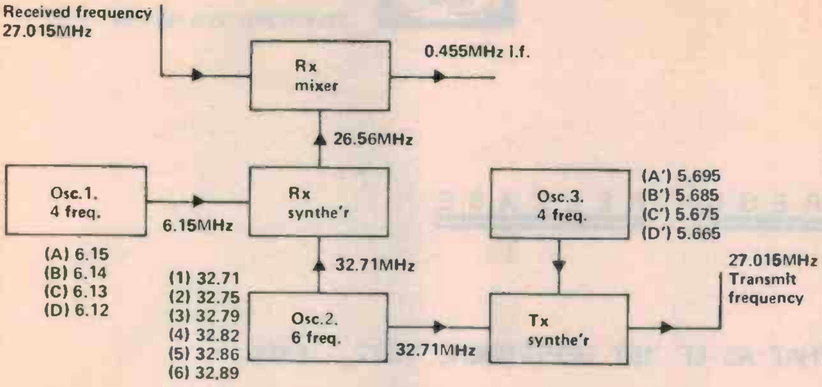

Fig.2. Crystal synthesis on an a.m. single conversion transceiver.

is 26.56 MHz. This is obtained by taking the difference between crystal A in oscillator 1 and crystal 1 in oscillator 2. (32.71 – 6.15.MHz = 26.56 MHz). A similar scheme applies for the transmitter. The difference between crystal A' in oscillator 3 and crystal 1 in oscillator 2 is 27.015 MHz! Each channel is obtained by selecting the appropriate crystals. This is accomplished by the switch operated by the channel selection knob on the transceiver.

Some transceivers employ 'dual-conversion' which is a simple extension of the superhet principle – instead of converting the incoming frequency to an intermediate frequency once only, it is done twice. This has a number of advantages, chief amongst them being the reduction in response of the receiver to 'image' frequency interference (see CB Australia, February 1977, p.9).

A typical synthesizer scheme for transceivers employing dual-conversion receivers is illustrated in Fig. 3. The crystal synthesizer system works in exactly the same manner as just described – only the numbers are different!

While AM transceivers may be relatively cheap, SSB has the advantage of greater efficiency over AM transmissions. Channel occupancy can be greater and there is often an advantage in greater range.

Most SSB rigs include AM transmission and reception and for this reason they employ dual conversion to a second IF of 455 kHz. The block diagram of a typical SSB/AM transceiver crystal synthesizer is illustrated in Fig. 4.

However, despite the popularity of the crystal frequency synthesis techniques, modern technology can reduce the number of crystals required to one; or two in practical systems, one for transmit and one for receive. These synthesizers use a circuit called a 'phase-locked loop', usually abbreviated to PLL.

PLL Synthesizers

PLL synthesizers utilise digital circuitry in parts of the system enabling a simple switch to 'program' the circuitry to produce the required frequency.

They have the great advantage over crystal synthesizers that their inherent frequency tolerance is much greater. All the channels are virtually 'spot-on', and remain that way over long periods. If one channel is out – all will be out!

The basic system of a phase-locked loop is shown in Fig. 5. The frequency of an oscillator is controlled by dividing down its output and comparing this with an accurate reference in a phase comparator which derives a control signal proportional to the difference between the divider output and the reference, thus setting the frequency of the oscillator and maintaining it very

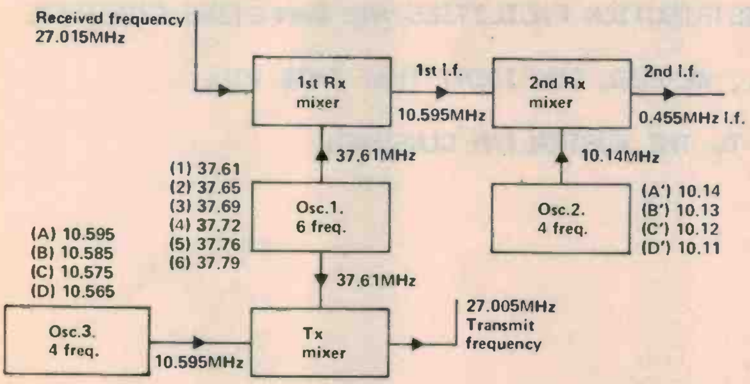

Fig.3. Crystal synthesis on an a.m. dual conversion transceiver.

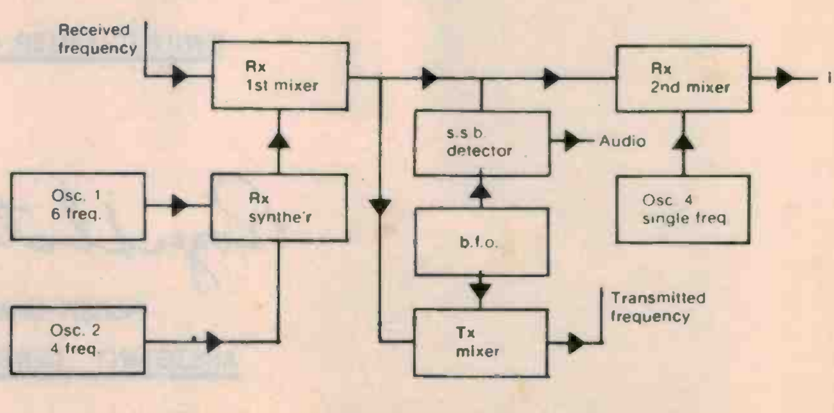

Fig.4. Crystal synthesis on an a.m./s.s.b. transceiver.

FANON/COURIER CORPORATION

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PRESS RELEASE

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WITH THE CONTINUOUS RESEARCH AND DEVELOPMENT PROGRAMME IN THE UNITED STATES OF THE FANON/COURIER CORPORATION, BACKED BY OUR PARENT COMPANY, RESDEL INDUSTRIES, COUPLED WITH THE DISTRIBUTION FACILITIES AND MARKETING EXPERTISE OF EXPO INTERNATIONAL PTY. LTD., WE FEEL CONFIDENT THAT THIS WILL ULTIMATELY BE OF GREAT BENEFIT TO THE AUSTRALIAN CONSUMER.

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Roger Shatafian

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Spartan PLL features a vertically mounted illuminated S/RF meter which provides fast direct readings. A local/distance RF switch PA/CB control and a switchable noise blanker are also conveniently located on **Spartan's** rugged face plate. Controls include a 800 Hz clarifier for optimum voice quality adjustable squelch and AM/Upper Sideband/Lower Sideband switch. The handsome illuminated channel indicator mounts in its own distinctive chrome housing.

Get everything you want in SSB with Spartan PLL.

recommended retail price

$289

SPECIFICATIONS

General

- Phase Locked Loop Digital Synthesizer
- Dimensions: 7-1/2" x 2-5/16" x 9-1/2"
- Weight: 6 pounds
- Transistors: 31
- Diodes: 47
- Integrated Circuits: 6
- Thermistor: 1
- FET: 6
- Lattice crystal filter for SSB
- Mechanical ceramic filter for AM
- SSB Noise Blanker: FET series gate type
- Pos/Neg. ground

Transmitter: SSB Section

- Input Power: 25 watts PEP at 13.8 VDC
- Output Power: 12 watts PEP at 13.8 VDC
- Spurious Harmonic Suppression: —50 dB
- Carrier Suppression: -40 dB
- Unwanted Sidebands: -45 dB
- SSB Filter: 7.8 MHz crystal lattice type 6 dB at 2.1 kHz, 60 dB at 5.5 kHz
- Output Impedance: 50 ohms
- Frequency Stability: ± .003 percent at -20 C to +60 C

Receiver: AM Section

- Sensitivity: 0.4 v for 10 dB S+N/N
- Selectivity: ±3.5 kHz at 6 dB
- Adjacent Channel Rejection: 60dB at 10kHz. 60dB at 20kHz.
- Squelch Sensitivity: 0.4 v

Receiver: SSB Section

- Sensitivity: 0.15 v for 10 dB S/N
- Selectivity: ±2.1 kHz at 6 dB
- Adjacent Channel Rejection: 70dB at 10kHz. 70dB at 20kHz.
- Squelch Sensitivity: 0.3 v

Both AM & SSB Sections

- Clarifier: ±800 Hz (Receive only)
- Noise Blanker: Series gate type (AM), FET (SSB)
- Audio Output: 5 watts: 450 Hz to 2500 Hz ± 6 dB

Transmitter: AM Section

- Output Power: 3 to 4 watts at 13.8 VDC
- Modulation Capacity: 100 percent
- Spurious Harmonic Suppression: 50 dB
- Output Impedance: 50 ohms
- Frequency Stability: ± .003 percent

PEARCE-SIMPSON BOBCAT 23D

• 23 channel 5 watt crystal controlled synthesized • AM/CB transceiver • ANL PA/CB Delta tune Large easy to read illuminated power and "S" meter mounting brackets supplied • Receiver sensitivity 0.3uV at 10 dB signal/noise.

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CB SYNTHESIZERS

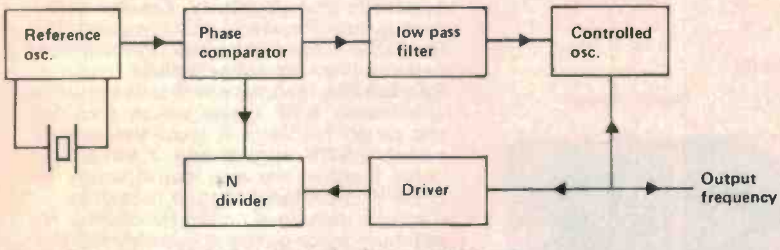

Fig.5. Basic phase locked loop synthesiser arrangement.

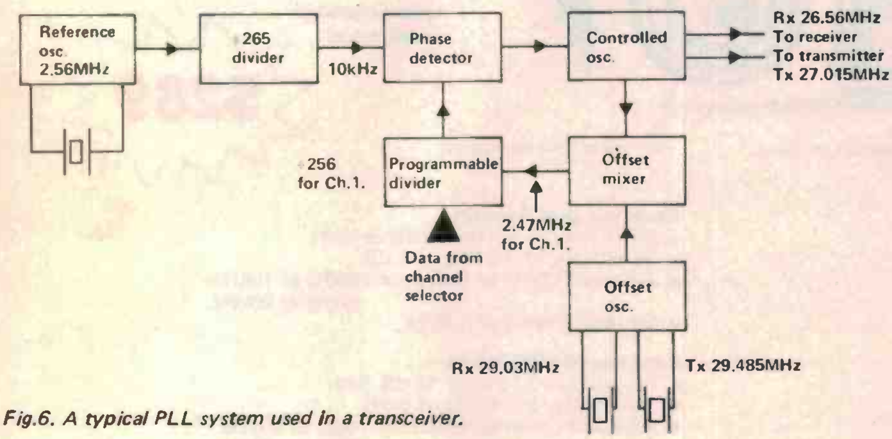

Fig.6. A typical PLL system used in a transceiver.

accurately. The controlled oscillator provides the output frequency. If the divide ratio (or number), N, is changed, then the oscillator will be forced onto a new frequency. The low pass filter between the phase comparator and the controlled oscillator helps to maintain the oscillator on frequency without any noticeable 'jitter', or small jumps and wanderings of the frequency.

As you can see, the circuit forms a loop which includes the controlled oscillator, the driver and divider, the phase comparator and low pass filter — hence the name, phase-locked loop.

A typical PLL system used in a transceiver is illustrated in Fig. 6. A reference crystal oscillator on 2.56 MHz is divided down to 10 kHz and fed to the phase comparator which incorporates a low pass filter. Why isn't a 10 kHz crystal reference oscillator used? Well, 10 kHz crystals are quite expensive and the combination of a high frequency crystal followed by a divider is quite a lot cheaper.

Some output from the controlled oscillator is fed to a mixer which mixes it with the frequency of the 'offset oscillator'. This serves to alter the frequency for transmit and receive, these being 455 kHz apart. The receive offset oscillator frequency is 455 kHz lower than the transmit offset oscillator frequency to provide the correct frequency for the receiver mixer which produces the IF of 455 kHz as explained earlier in the article.

On receive, the controlled oscillator will be on 26.56 MHz for channel 1 reception. When this is mixed with the receive offset frequency of 29.03 MHz, the output of the offset mixer will be 2.47 MHz. The programmable divider is set to divide by 247 by the channel selector switch. Now 2.47 MHz divided by 247 equals 10 kHz, which is fed to the phase comparator. If the controlled oscillator is slightly different to the required frequency, say 26.565 kHz, then the output of the offset mixer will be 2.475 MHz. The programmable divider will divide this down to 10.02kHz which differs from the reference frequency of 10 kHz. The phase detector will then apply a control signal to the controlled oscillator, forcing it back down to 26.56 MHz. When the correction is complete, the output of the programmable divider will once again be 10 kHz and the loop will be back in the 'locked' state. All this happens very rapidly, in a tiny fraction of a second!

When the transmit button is pressed, the output of the offset oscillator is changed to 29.485 MHz. But the controlled oscillator will be on 26.56 MHz, thus the output of the offset mixer will be 2.925 MHz at this instant. The programmable divider will divide this down to 11.842 kHz. As this is a large difference from the reference frequency the output of the phase detector will be high, forcing the controlled oscillator to quickly change frequency.

When the controlled oscillator reaches 27.015 MHz, the output of the programmable divider will again be 10 kHz and the loop will be locked — all before you can say your first word!

When you switch to channel 2, the programmable divider will be set to divide by 248 and the whole process will be repeated — faster than you could run through the channels!

Advantages

The PLL synthesizer has many advantages over the old one-crystal-per-channel and heterodyne crystal synthesizers. The PLL synthesizer is a self-correcting device that cancels any 'drift' that may otherwise occur. The synthesizer requires only three crystals, greatly reducing the chances of crystal failure (a common fault in CB transceivers) and it allows more compact circuitry. Much of the circuitry of the PLL synthesizer may be (and is) incorporated in integrated circuits.

A LEGITIMATE AMATEUR PRODUCT

Finally a true 80-10M linear amplifier **really** designed for amateur use, not a cheap class-C biased "CB" unit. The HF-150 is a true, band switching, class-B linear amplifier. Perfect for use with many of the low-powered HF transceivers now on the market.

INSTRUMENT QUALITY

The HF-150 is designed and built by Communications Power, Inc., a company well established in the manufacture of industrial power amplifiers and ferrite RF components.

●● Thus, the HF-150 has such quality features as —50db minimum harmonic suppression on all bands, with built-in switchable harmonic filters. 10 times better than current FCC and ITU regulations.

●● In addition there is absolute stability into all phase angles of a 3:1 VSWR mismatch, plus a built-in 20db gain, low noise receiver pre-amplifier.

●● 200W PEP input power

●● Typical RF output: 100W AM-4W drive at 30MHz 160W PEP SSB-12W PEP drive 13.6VDC 150W CW-10W drive.

●● positive or negative ground

●● SSB-AM-CW operation

●● The built-in 20db gain, 2db noise figure broadband receiver rf preamplifier operates independently of the power amplifier and is just the thing to perk up a "dead" receiver.

●● Compact size: 6.5"W-2"H-7.75"D

●● Provisions for simple plug-in installation of C.P.I.'s RC-1 remote control head.

Note: Illegal for use on the Citizens Band

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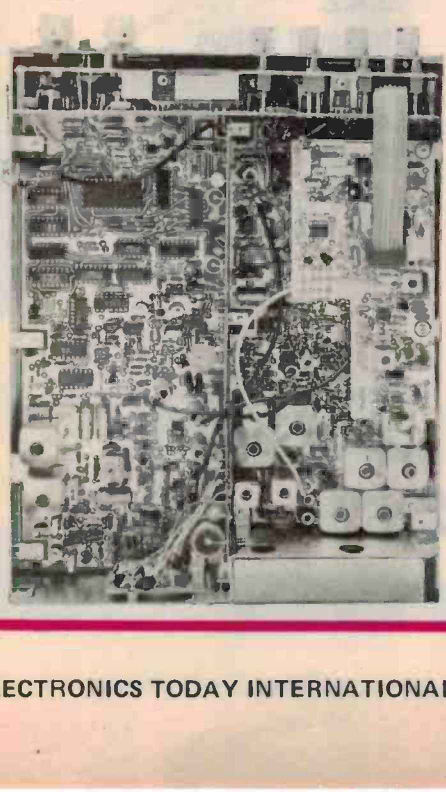

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Please Explain

Why Binary

I understand how the binary system works but what I don't see is why it's used in computers. Why on earth don't they design them so they use the decimal numbering system that we've all grown up with?

J.L. Penrith, NSW.

It's possible to build computers the way you suggest but it's not practical. The difficulty is that 'decimal working' computers would need circuitry that generated, recognized and manipulated ten discrete voltage levels — one level for each digit and these voltage levels would have to be maintained very accurately. Whilst such a system is technically feasible it is far easier and inherently more reliable to use the binary counting system (scale of 2) in which only two voltage levels are required.

Transistor switching circuits are admirably suited for binary manipulation. Thus a transistor which is 'cut-off' can represent a '0' and a transistor which is driven hard on (saturated) can represent a '1'. The technique is very simple to implement and is inherently stable.

DC Inverters

I have been searching unsuccessfully for the circuit of an inverter for a particular application. The required specifications are: 12 V dc input, 240 V ac, 50 Hz sinewave output, power output approx. 250 W. Do you have any circuits or information which may be of use to me?

I.L. Nambour, Qld.

Many people have asked for an inverter similar to this but most people don't realise the implications.

An invertor of this power, running off 12 V dc would have an efficiency of only about 60%. This means an input power of about 400 watts or a current of 30 amps. As most car batteries are only 40 AH, this would give a life of a fully charged battery of only about one hour.

The generation of a sinewave output (with any efficiency) is not without problems. The commercial units use a special transformer which has high magnetic leakage between primary and secondary and the output is tuned by a capacitor to give the sinewave output. The alternative to this method is to use more complex electronics.

Both of these are expensive, but we are still looking at the problem and may publish a design in the future.

Doubling the power

A friend insists that if I wish to double the sound intensity from my hi-fi system I will have to use ten times the amplifier power. Seems crazy to me — but he insists it's so — would you please advise.

F.W. Double Bay, N.S.W.

He's right. Most (if not all) human physiological functions are vaguely logarithmic not linear. Hearing follows this law. In this case you'd need to increase amplifier power at least nine times to double the perceived loudness level.

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Oscilloscope, BWD 530A. 25 MHz dual beam current model (professional) Suit new buyer. $550 Peter Webb, Melbourne. Phone 439 1992

Melbourne Tape Friends. The Recording Society of Australia meets monthly for lectures, demonstrations, life recordings, etc. For further information, ring AH (03) 4591717

For sale VT-110 Akai B/W portable video recorder, camera, AC adapter, portable monitor. Good cond. Plenty extras, 24 ¼" tapes. $485 o.n.o. Ringwood 870 7074.

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CITIZENS BAND ANTENNAS

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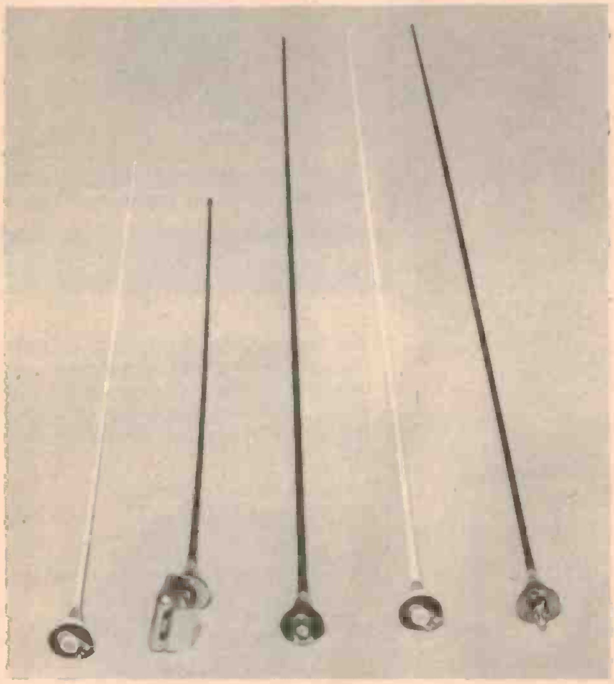
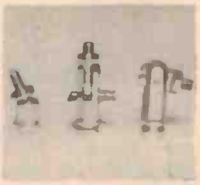


CB 1220 CB1120 CB1420 CB1520 CB1320

CB 1220	42" centre loaded
CB 1120	30" centre loaded
CB 1420	60" helical
CB 1520	60" helical/sector/top loaded
CB1320	60" centre loaded

SCALAR Citizen Band antennas are designed to provide efficient performance with reduced length. Either helical, centre or top loading on fibreglass rods, many thousands are already efficiently in use throughout Australia in vehicle, marine and base installations.

Dipole Simulator meets the need of installations of 27 MHz antennas where a ground plane is not available. It can be used with any **SCALAR** 27 MHz whip top and is particularly useful in installations on fibreglass and wooden boats and vehicles having fibreglass cabins. The helipole converts the whip into a 1/2 wave centrefed dipole, assuring a very stable and efficient antenna system.



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Ideas for experimenters

These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.
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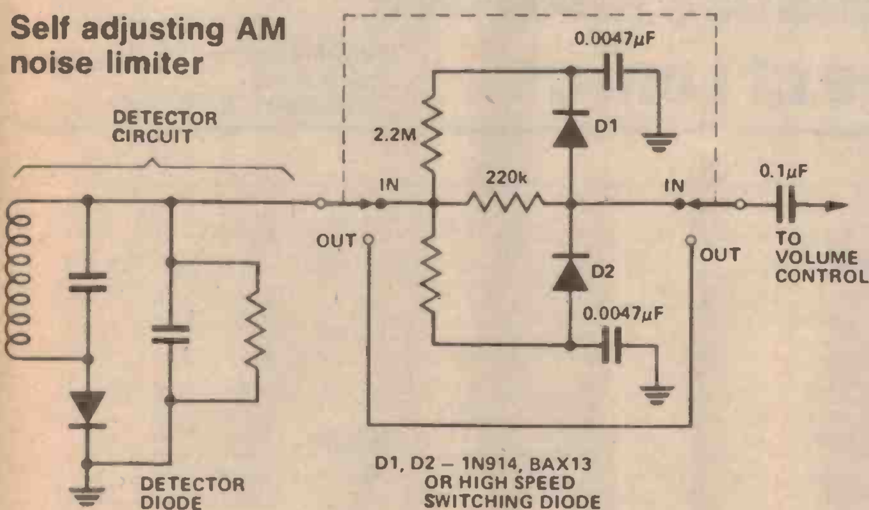
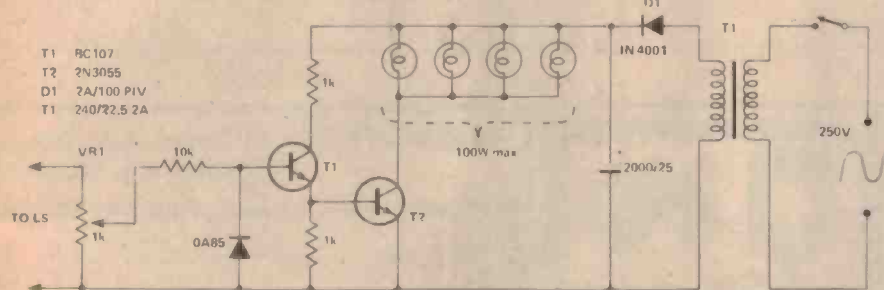
Self adjusting AM noise limiter



This is a very effective self-adjusting positive and negative peak noise limiter. The detector diode is part of the usual detector arrangement in a receiver and provides a negative bias which varies with the average signal strength (bias provided by D1 and D2). When a noise spike appears on the positive swing of the demodulated audio wave form. D1 conducts flattening out the spike. Similarly when a noise spike appears on negative swing of the audio, D2 conducts flattening out the spike.

The circuit causes considerable reduction in audio output when in circuit and cuts the high frequency response.

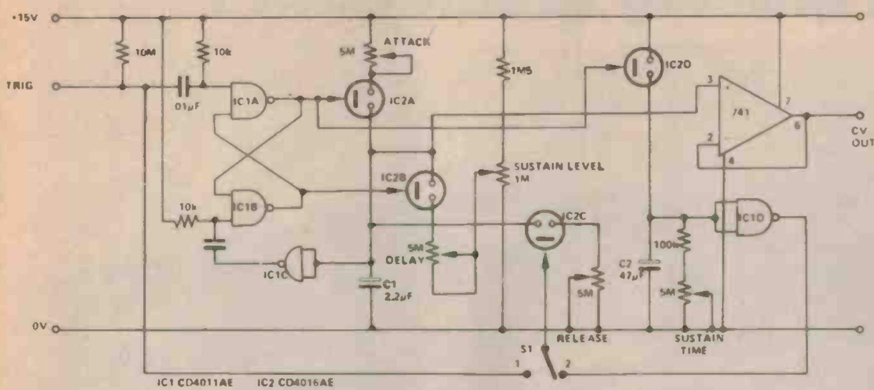


DANCING LIGHTS

This device will produce a shifting light display in time to the signal from a loudspeaker. Setting will vary according to the volume at which the music is played. When VR1 is at maximum the lights remain lit most of the time. At minimum the lights may not come on at all. A suitable position can be established in between these two extremes.

The bulbs used can be any number at 25V each and the total should not be more than 100W. A heatsink should be used for the power transistor.

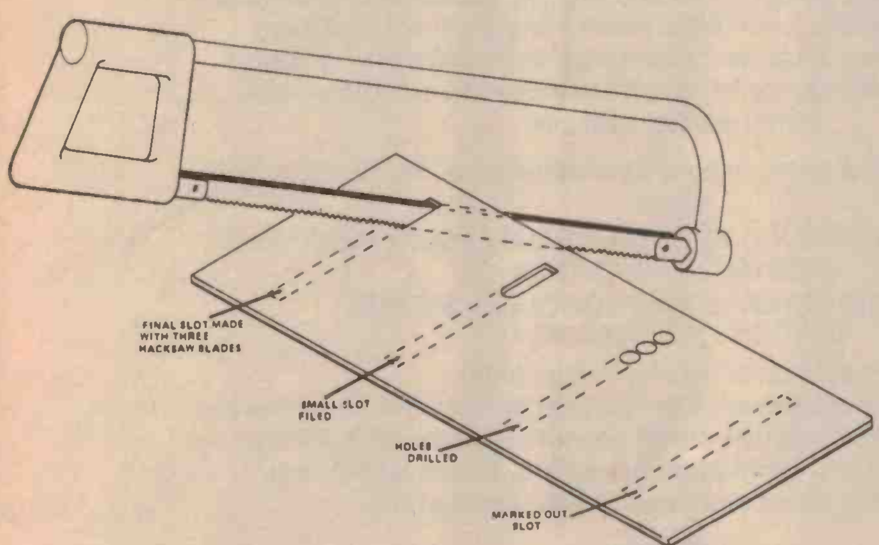
Ideas for experimenters



ADSR ENVELOPE SHAPER

When a negative going trigger pulse is applied to the input, IC2(c) disconnects the 'release' pot, the bistable is set and the 'attack' pot connected to C1. C1 charges up to the threshold voltage of IC1(c) where the bistable is reset. IC2(b) causes C1 to discharge to the level set on the 'sustain level' pot. If S1 is in position '1', when the trigger pulse goes high again IC2(c) causes C1 to discharge via the 'release' pot.

During the time IC1(a) is high C2 is charged up forcing the output of IC1(d) low. Once IC1(a) has gone low C2 begins to discharge and after a while IC1(d)'s output will go high sustain is controlled by the monostable thus formed. It is retriggerable so that should a second trigger arrive before the cycle has completed the cycle will restart. The 741 buffers the output.

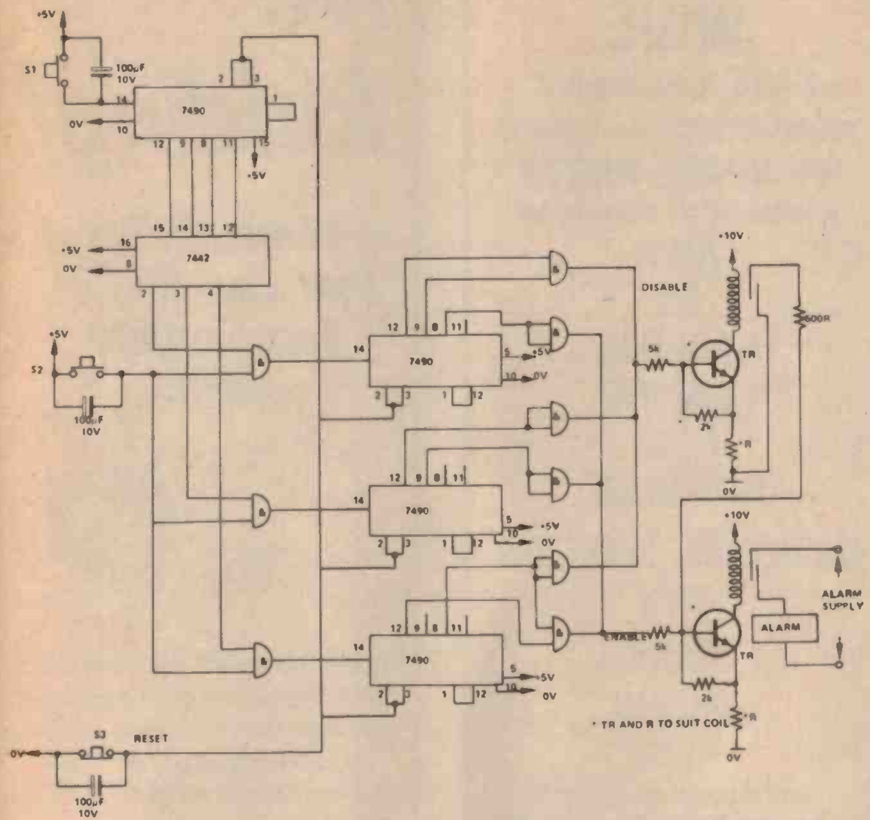


EASY SLIDER FITTING

After making out the slots in their respective positions, three or four holes are drilled close to each other at one end of the slot. These holes are then joined up by initially using a needle file followed by a flat ward file. The resultant slot should be large enough to accommodate three hacksaw blades side by side as shown on the sketch.

These blades are fixed in a standard hacksaw frame or can be hand held. Using this arrangement, the required width of the slider control slot can be easily cut for any given length, and finishing off with a file.

Ideas for experimenters



COMBINATION LOCK

The circuit and switching system is simplified by the use of a multiplex system. S1 inputs pulses to the decade counter 7490. The resulting BCD is decoded by the 7442. It is the decimal output of this which carries out the multiplexing via the AND-gates.

S2 inputs pulses which are transferred to the other 7490 decade counters by the AND-gate multiplex system. The BCD output from the 7490's is taken to the AND-gates whose outputs control the Alarm 'Disable' and 'Enable' switch system.

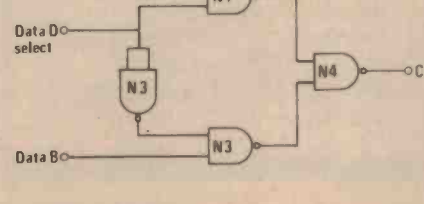
The 'Disable' function effectively prevents TR2 from being biased on and hence prevents the 'Enable' Reed relay from working.

This circuit has several advantages over conventional electronic combination locks as only two switches need be installed on the object to be guarded, regardless of the number of figures in the combination. The value of the example combination is 314. The alarm is triggered if any of these digits is exceeded in value. While the circuit is capable of directly driving an actuator it is recommended that it is only used to disable an alarm system — conventional locks doing the actual locking. (To operate the example the switch sequence would be: S1, S2, S2, S2, S1, S2, S1, S2, S2, S2, S2.)

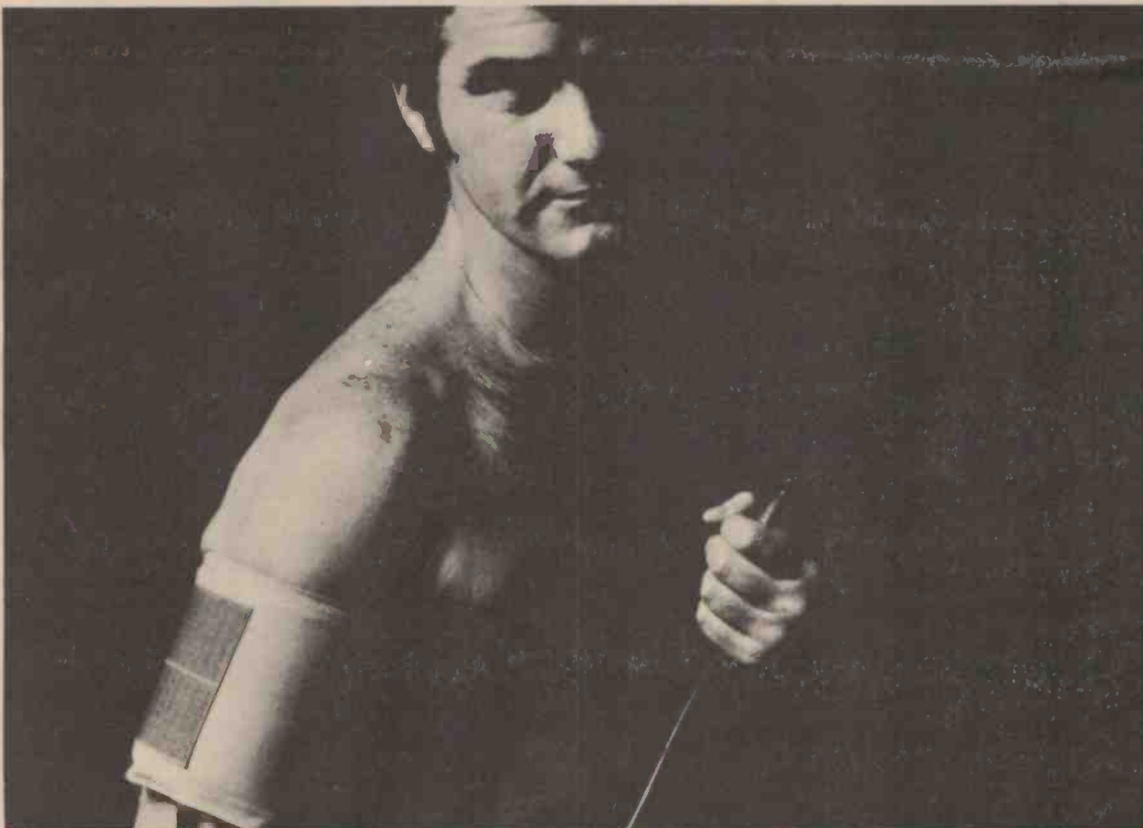
THE 7400 A TWO-WAY DATA SELECTOR!

When the "DATA SELECT" terminal is at logical 'O', the output of N1 is held high, whilst information presented on the "DATA B" terminal is transferred to the output of the circuit. Similarly, when the "DATA SELECT" terminal is at logical "1", the output of N3 is held high, whilst "DATA A" is transferred to the output. In a parallel data system one 7400 would be used for each bit.

input			output
D	A	B	C
0	X	0	0
0	X	1	1
1	0	X	0
1	1	X	1



ARREST A KILLER!



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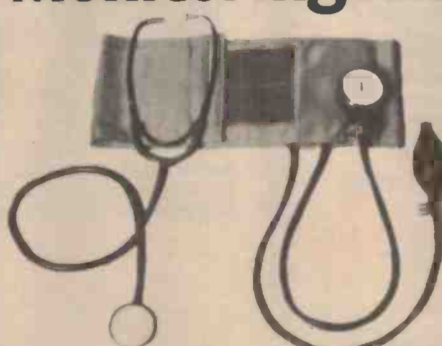

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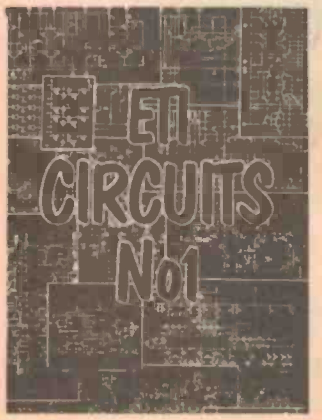

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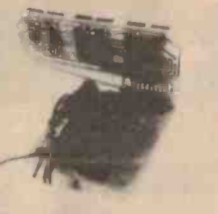

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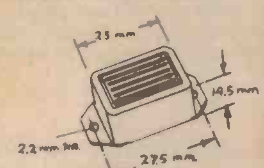

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WHY YOUR NEXT CASSETTE SHOULD BE A MAXELL UD

3 THE SHELL — Even the best tape can get mangled in a poorly constructed shell. That's why Maxell protects its tape with a precisely constructed shell, made of lasting heavy-duty plastic.

No fixed guide posts are used. Instead Maxell uses nylon rollers on stainless steel pins thus eliminating the major cause of skipping, jumping and unwinding.

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Maxell doesn't use a welded seal, but puts the cassette together with precision screws. Result — Maxell doesn't jam.

ULTRA–DYNAMIC UD

1 THE RESEARCH — More than twenty years ago, Maxell produced their first reel of magnetic tape. At that time, Maxell made a commitment to produce and sell only the finest magnetic products their technology could create.

That commitment still stands today.

2 THE TAPE — This continuous research has lead to the development of the Maxell UD (ultra dynamic) cassette. A tape that has a coating of super-fine PX gamma ferric oxide particles with an extra smooth mirror-finish surface.

All of this adds up to high output, low noise, distortion free performance and a dynamic range equaling that of open reel tapes.

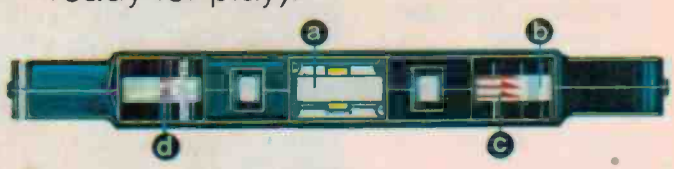
4 THE LEADER — A leader tape that has a four function purpose.

a) Non-abrasive head cleaning leader (cleans recording head for 5 secs.).

b) 5 second cueing line (recording function starts 5 seconds after the line appears).

c) Arrows indicating direction of tape travel.

d) A/B side mark (indicates which side is ready for play).



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