

FEBRUARY 1976  
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# electronics TODAY

INTERNATIONAL

*Special Offer*  
**CORDLESS  
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IRON**

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**CALCULATOR TO WIN!**

**FM TUNER PROJECT PREVIEW**

# TOP DECK.



1669



1668



1667



1655

Whichever cassette deck you finally adopt from the JVC range, you can't lose. All have been designed with the sound connoisseur in mind.

If, however, money is no object and you won't settle for less than one of the best, then may we recommend the 1669 and 1950.

1669 — ANRS — JVC exclusive noise reduction system, separate motors driving the capstan and reels, feather-light operation with servo assisted controls, memory counter with automatic restart.

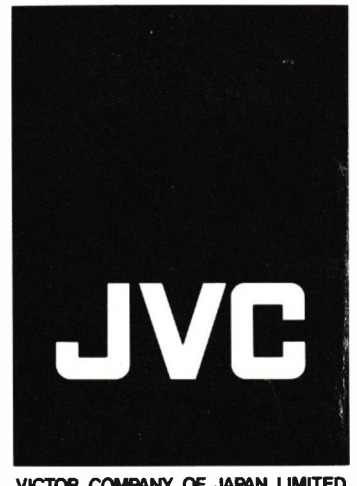
1950 — Once again ANRS — JVC exclusive noise reduction system, cronus head for greater fidelity and life, independent drive mechanism, plus all the controls built up front.

These are just some of the features that make these one of the best.

But whatever you're prepared to pay, with JVC you can be sure your money is on the top deck.



1950



VICTOR COMPANY OF JAPAN LIMITED

# electronics TODAY

INTERNATIONAL

FEBRUARY 1976, VOL 6, NO.2

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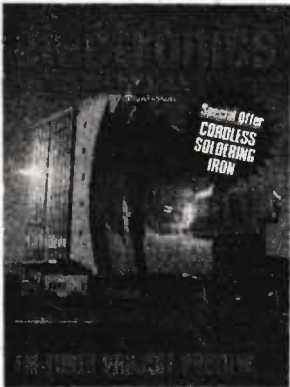
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**COVER:** Over 1000 kW of thermal  
energy is delivered at the focus of the  
CNRS solar furnace at Odeillo in France.  
Photo courtesy CNRS.

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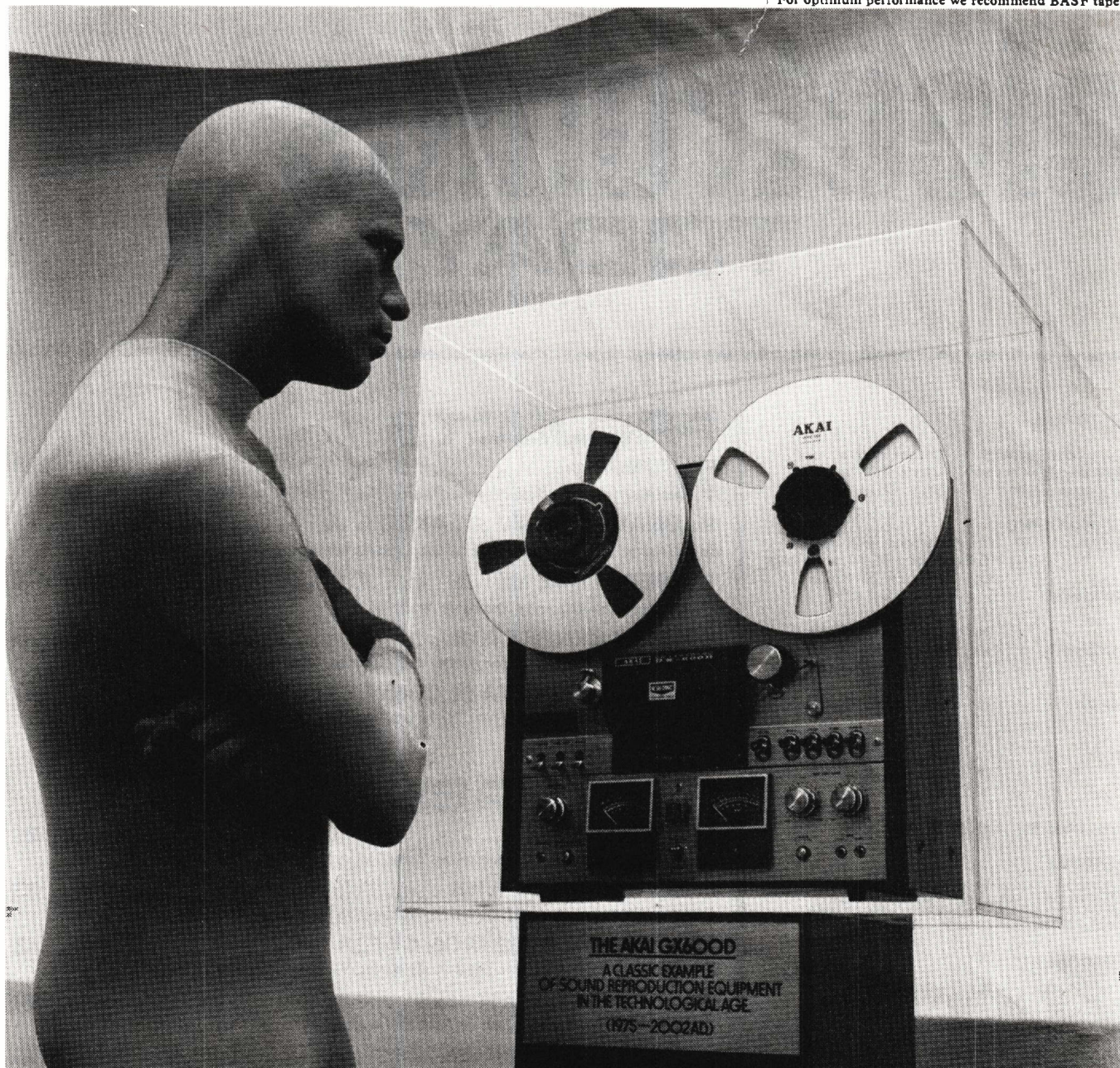
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A MODERN MAGAZINES PUBLICATION



## Its rewards might be in another place and time, but yours are here and now.

The GX600D tape deck illustrated above is one of our top models. It retails around \$770. That's a lot. But the GX600D is a lot of tape deck. It's totally professional in every function. Recording, dubbing, mixing, playback.

Yet the controls are beautifully simple. After all, we want to give you good times. Not hard times.

It comes, like all AKAI hi-fi equipment distributed by

AKAI Australia, with our Complete Protection Plan\*. Which means: 12 months full parts and labour warranty, 12 months free insurance, and a lifetime guarantee on all GX recording heads.

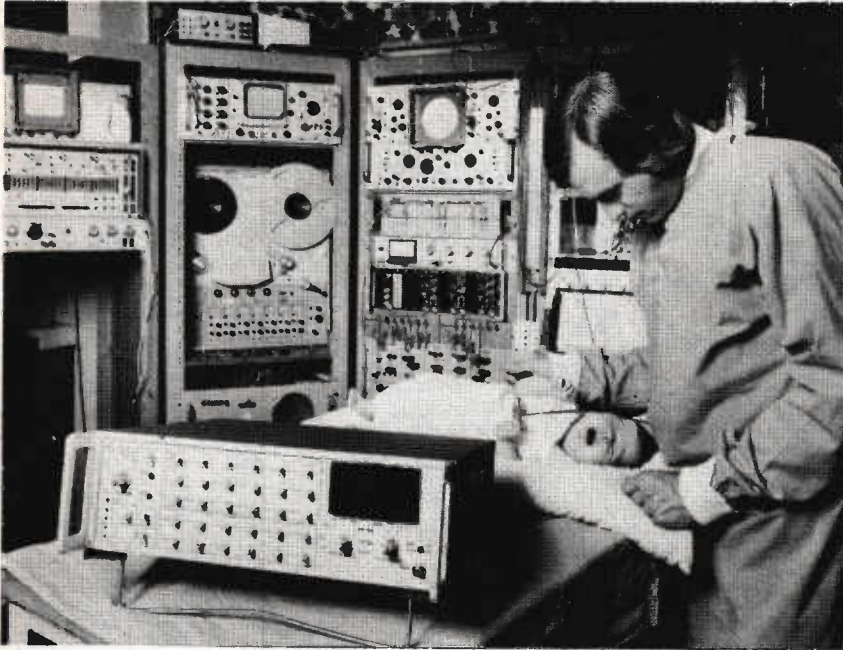
If you're still thinking about the price, think about this: Sure, we could have compromised and saved a hundred. But we can't see any future in that.

The AKAI Hi-Fi Professionals are: **NEW SOUTH WALES:** Albury: Haberechts Radio & TV Pty Ltd 610 Dean St Bega: Esesdowns Pty Ltd 187-191 Cargo St Bowral: Fred Hayes Pty Ltd 293 Bong Bong St Broken Hill: Fee Jay Sound Centre 364 Argent St Burwood: Electronic Enterprises Pty Ltd 11 Burwood Rd Concord: Sonart Music Service 24 Cabarita Rd Chatswood: Autel Systems Pty Ltd 639 Pacific Highway Crowsnest: Photo Art and Sound 287 Military Rd Crows Nest: Allied Hi-Fi & Records 330 Pacific Highway Dee Why: Mastertone Electronics 824 Pittwater Rd Five Dock: Douglas Hi-Fi 65 Parramatta Rd Gosford: Gosford Hi-Fi 163 Mann St Griffith: The Record Centre 222 Banna Ave Hurstville: Hi-Fi House 127 Forest Rd Lismore: Norman Ross Discounts 69-73 Magellan St Marrickville: Apollo Hi-Fi 283 Victoria Rd Miranda Fair: Miranda Stereo & Hi-Fi Centre Pty Ltd Shop 67 Top Level Mona Vale: Warringah Hi-Fi Shop 5 Mona Vale Court Bungen St Newcastle: Eastern Hi-Fi 519 Hunter St Newcastle: Ron Chapman Hi-Fi 880 Hunter St Nowra: G P Walker & Son Pty Ltd 96 Kinghorn St Parramatta: Magnetic Sound Industries 20 Macquarie St Parramatta: Selsound Hi-Fi Pty Ltd 27 Darcy St Roselands: Roselands Hi-Fi Pty Ltd Gallery Level South Hurstville: Selsound Hi-Fi Pty Ltd 803 King Georges Rd Summer Hill: Fidela Sound Centre 93B Liverpool Rd Sutherland: Sutherland Hi-Fi 5 Boyle St Sydney city: Jack Stein Audio Pty Ltd 275 Clarence St Sydney city: Magnetic Sound Industries 32 York St Sydney city: Duty Free Travellers Supplies 400 Kent St Sydney city: Opta Hi-Fi Pty Ltd 187 Clarence St Taree: Taree Photographics Graphic House 105 Victoria St Wagga Wagga: Haberechts Radio & TV Pty Ltd Baylis St Wollongong: Hi-Fi House 118 Keira St Wollongong: Selsound Hi-Fi Pty Ltd 2-6 Crown Lane **AUSTRALIAN CAPITAL TERRITORY:** Canberra City: Allied Hi-Fi & Records 122 Bunda St Civic Fyshwick: Douglas Hi-Fi 53 Wollongong St **VICTORIA:** Melbourne: Douglas Hi-Fi 191 Bourke St Melbourne: Pantiles Hi-Fi Cnr Flinders Lane & Elizabeth St Warrnambool: A G Smith Pty Ltd 159 Liebig St **QUEENSLAND:** Booval: Woolworths (Qld) Pty Ltd 302 Wickham St Mackay: David Jones Pty Ltd Sydney St Mt Isa: The Sound Centre West St Newstead: Hendrix Pty Ltd 107 Breakfast Creek Rd Southport: Trevor Stokes Scarborough St Toowoomba: Catchpools Cassette Centre T & G Arcade Ruthven St Toowoomba: Humphreys Hi-Fi Centre Ruthven St Townsville: Woolworths (Qld) Ltd 345 Flinders St **SOUTH AUSTRALIA:** Adelaide: Ernsmiths 48-50 King William St Adelaide: Flinders Trading Co 55 Flinders St Adelaide: Sound Centre 2601 115 Gouger St Glenside: Metrovision TV Rentals Pty Ltd Conygham St **WESTERN AUSTRALIA:** Perth: Douglas Hi-Fi 883 Wellington St **TASMANIA:** Burnie: James Loughran & Sons Pty Ltd 29-31 Wilmot St Hobart: Quantum Electronics Pty Ltd 181 Collins St **LAUNCESTON:** Tasman Acoustics Pty Ltd 62 Tamar St **LAUNCESTON:** Wills & Co (1954) Pty Ltd 7-11 Quadrant **UTVERSTON:** Gillards Music Centre 37A Reiby St **NORTHERN TERRITORY:** Darwin: Pfitzners Music House Smith St.

70604 \*The Complete Protection Plan does not cover equipment purchased outside Australia.

**AKAI**  
The name you don't have to justify to your friends.

## COT DEATH RESEARCH



A machine which gives a breath-by-breath analysis of the breathing of young babies will help a Sydney research team in their investigations into the mysterious cot-death syndrome.

Cot-deaths — the unexplained death of an apparently normal baby — have long baffled doctors and scientists. A research team at King George V Hospital is now making a fulltime study of cot-deaths, with a programme which may extend up to five years.

The machine, which analyses the gases entering and leaving the lungs of babies, is the most advanced of its kind in the world. The electronics for the machine were designed by Dr. Peter Nickolls, a Research Fellow in the Department of Electrical Engineering at Sydney University, and it was built by Amalgamated Wireless (Australasia) Limited.

A recent American review concluded that cot-deaths are the leading cause of death among infants between one week and one year of age. Cot-deaths claimed 124 babies in N.S.W. alone last year; in America the total was nearly 10,000.

Doctors have found that when very premature babies fall into a certain sleep phase they literally "forgot to

breathe". Their oxygen supply becomes dangerously low and if this is allowed to continue they can die or suffer brain damage.

In the late 1940's and 1950's oxygen was widely administered in these circumstances, but a secondary problem arose. It was found that too much oxygen could damage the retina of the eyes and cause blindness.

The leader of the research team, Professor David Read, Associate Professor of Physiology at Sydney University, describes the balance between too much and too little oxygen as "a knife edge situation".

It is therefore crucial, he says, to be able to follow the oxygen and carbon dioxide levels in a baby's breathing and to regulate them carefully.

The baby's breath flows from a connection at his nose into a vacuum chamber where the breath is ionised and separated into its constituents. The processor works out the percentage of oxygen and carbon dioxide in the breath. It can simultaneously follow another six gases to provide additional information about the circulation and the function of different regions of the lungs. This information is processed at 25 times a second.

Ultimately, it is planned to link the processor to an automatic, computer-controlled system which will adjust the baby's oxygen supply as its breathing changes.

## WESTON ELECTRONICS — NEW 1976 LOCATION

Weston Electronics, a member company of Kemtron Ltd., has moved to Kingsgrove. The move is part of a programme to centralise the operation of companies within the Kemtron Ltd group. Enquiries and correspondence should now be directed to:— Weston Electronics Company, The Crescent, Kingsgrove, N.S.W. 2208.

## FOUR THOUSAND DOLLAR WATCH

This digital watch/calculator combination from the US Time Computer company is designed around two CMOS chips — one for time and the other for calculation.

The calculator section has five functions, plus floating decimal and display overflow. The assembly is mounted in a gold case — which must account for a large part of the massive US\$3950 price tag.



## SPACE AGE WINDMILL

The Energy Research and Development Administration's (ERDA) experimental wind energy turbine was officially dedicated October 29 at the National Aeronautical and Space Administration's (NASA) Plum Brook Station near Sandusky, Ohio. The big windmill's 38 metre diameter rotor

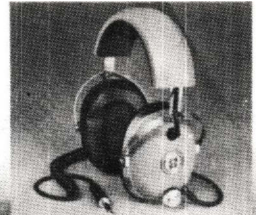
# "Bring it back alive."

When you relax to the purest sound of your favourite music, few things bring it back alive like the incredible sound of KOSS. From the deepest toe-curling bass notes of a pipe organ, to the crisp, brilliant highs of the brass section, you would

find it hard to match the excitement of a live performance as well as KOSS Stereophones. In particular PRO-4AA. Because the KOSS PRO-4AA features the only driver element designed specifically for stereophones. So when it comes to mixing

the sound in your head instead of on the walls of your living room, you'll hear two more octaves than you've ever heard before in a dynamic stereophone. Hear it like you've never heard it before on KOSS Stereophones . . . prices

from around \$30 upwards. Ask your Audio Specialist for a live demonstration.



Choose from any of the following KOSS Stereophones:

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HV/1: High Velocity Stereophone  
 PRO/5LC: Professional Volume Control  
 PHASE 2 + 2: Quadrafone and Programmer  
 ESP/9B: Electrostatic Stereophone  
 ESP/6A: Electrostatic Stereophone

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342 Kent Street, Sydney, 2000. Phone 29 6731  
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is designed to turn at 40 r.p.m. in a 30 km/h wind and produce 100 kilowatts of electricity. Each of the rotor's blades, designed and built by Lockheed-

California Company, measures 19 metres long with a base width of 1.37 metres tapering to 450 mm at the tip.

## NEW CSIRO AID MAY HELP DEAF

A new communications aid combining the features of a radio receiver and a hearing aid has been developed at CSIRO's National Measurement Laboratory at Chippendale, Sydney.

The device, still at the prototype stage, has promising applications for people suffering severe hearing loss, as well as for workers with normal hearing employed in industries where high noise levels make ordinary conversation impossible.

A major problem for many people with hearing problems is that it is difficult to distinguish between speech and the background noises which conventional hearing aids cannot avoid amplifying along with the conversation.

The new device overcomes this problem by combining with a conven-

tional hearing aid a small frequency-modulated (FM) wireless receiver tuned to receive the voice of another person carrying a transmitter.

In a school classroom, for example, the new aid would serve as an interference-free link between deaf pupil and teacher. A teacher wearing a lapel microphone and a small battery-powered transmitter would have his speech relayed to a deaf pupil at the same time as he addressed the rest of the class normally. While the teacher spoke, the deaf pupil's own unit would act as a wireless receiver, reverting back to being a hearing aid automatically when the teacher stopped talking.

The system does not employ normal radio transmission but incorporates a unique combination of FM and transmission by induction.

The prototype device must undergo further refinement and miniaturisation by CSIRO in collaboration with the National Acoustic Laboratories and industry before it becomes available to the public.

## HP-45 STOPWATCH

Hewlett Packard's HP-45 calculator can be used as a digital stopwatch according to several of our readers!

It's a slightly tricky operation apparently as several keys must be depressed simultaneously to trigger the beast into the 'stopwatch mode' but it is said to become easy enough with practice.

To start it off you switch on press RCL and then *simultaneously* press the keys R↓, STO and CHS. The display will then appear as four pairs of zeroes representing hours, minutes, seconds and hundredths (from left to right).

Pressing CHS along then starts the timer rolling and EEX stops the hundredths display.

The unit is switched back to the normal calculator mode by pressing ENTER ↑.

Another method of causing the calculator to switch into the 'stopwatch' mode is to press CHS, 7 and 8 *simultaneously*. The RCL key must of course be pressed first and also before any subsequent attempt.

We understand that Hewlett-Packard prefer not to know about it!

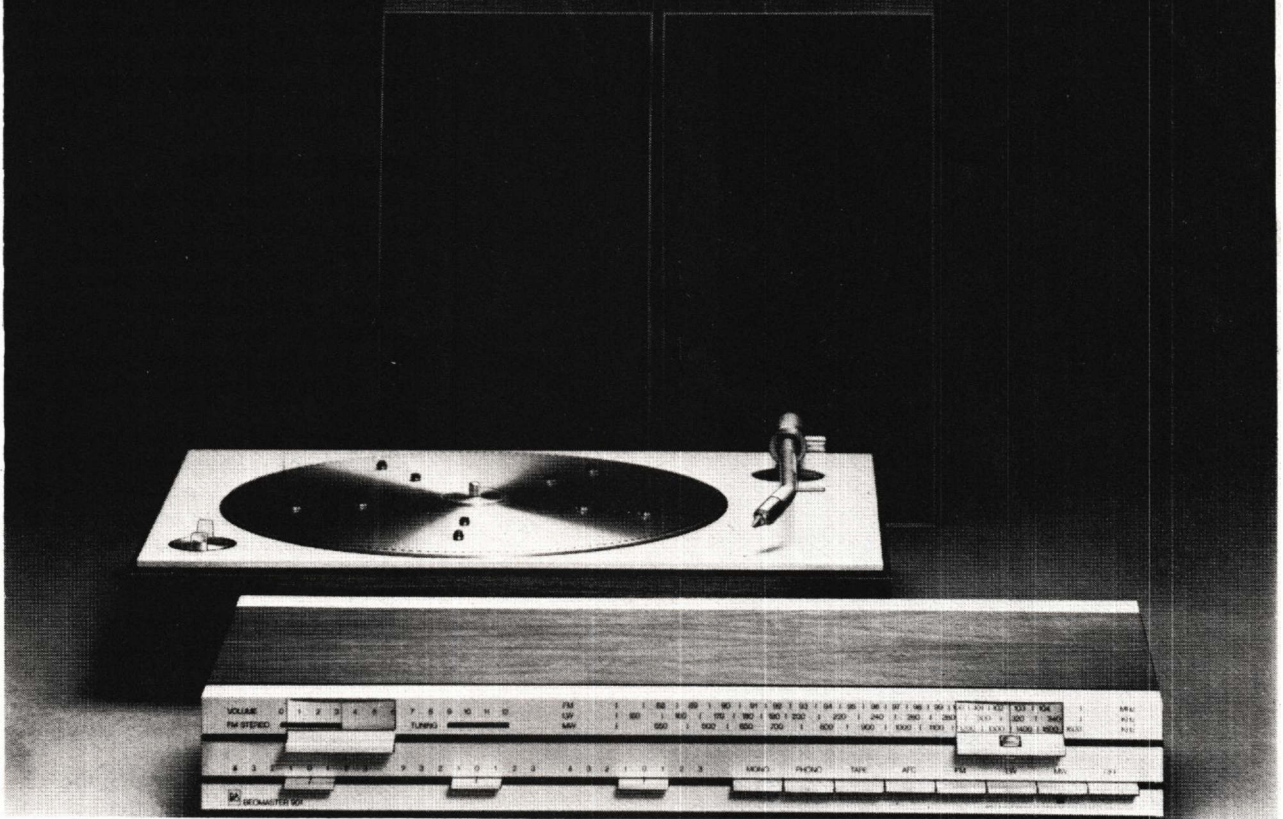
## TWO TIME ZONES SIMULTANEOUSLY

The exact time in any two zones can be kept simultaneously by a new 6-function CMOS watch circuit which is now available in quantity from NS Electronics Pty Ltd for hybrid assembly into LED (light-emitting diode) wrist watches.

Known as the model MM5880, the new watch circuit provides all the control signals that are needed by a four-digit LED watch. The circuit provides hours, minutes, seconds, and month-with-date under control of a single push-button.

A second push-button controls the display of seconds, minutes, and hours in a different time zone. This feature permits travellers to keep track of the time in the home zone while maintaining local time. Businessmen will find this feature

# Announcing Bang & Olufsen's 50th Anniversary present-to you!



## More than \$1000 worth of the world's most advanced stereo sound equipment-for \$695.

When a company of Bang & Olufsen's high international repute celebrates an anniversary, you can be sure the offer they make is not a cloaked attempt to clear stocks of a superseded model or a disguised effort to accelerate sales of a slow moving line.

Just the reverse—for instance, the B & O 50th Anniversary System offered here includes the world's most recent development in loudspeaker technology—two new B & O Uni-Phase speakers. This loudspeaker system was released in Australia in October 1975!

**HERE'S WHAT YOU GET IN THE BANG & OLUFSEN 50TH ANNIVERSARY SYSTEM.**

**1. The Beomaster 901 Stereo Tuner/Amplifier** A stereo amplifier combined with a stereo FM and Medium Wave radio tuner. The Beomaster 901 includes AFC

(Automatic Frequency Control) which keeps the radio tuned in to the desired FM station.

The stereo amplifier has a 2 x 20 watts RMS output, which is more than sufficient in most homes. The exclusive Darlington output stage provides for less than 0.5% distortion at full power.

There are, of course, inputs for turntable and tape recorder, and outputs for headphones and two pairs of stereo loudspeakers.

**2. The Beogram 1203 Record-Player** A fully automatic stereo record-player with high fidelity specifications. With its single press-button control, nothing could be easier to operate. The turntable and pick-up arm are mounted on a separate floating sub-assembly preventing vibrations effecting the tracking of the pick-up cartridge.

The special pick-up cartridge—the SP14A—has a spherical diamond

stylus and a tracking pressure of under two grams, protecting your records from wear. The unit comes complete with hinged cover.

**3. The Beovox Uni-Phase S.30 Loudspeakers** From Bang & Olufsen's new range of Uni-Phase loudspeakers, a pair of S.30's with a power handling capacity of 30 watts RMS each. The most outstanding features of the Uni-Phase S.30's is that they take up much less room than conventional pressure chamber loudspeakers of a comparable power handling capacity. As well, they produce sound more accurately than most commercial loudspeakers on the market to date.

**4. The Bang & Olufsen Guarantee** Your B & O 50th Anniversary System is covered by the normal one year guarantee for both parts and labour.

The Bang & Olufsen 50th Anniversary Offer is a genuine price reduction made possible by Bang & Olufsen of Denmark celebrating 50 years of designing and producing the world's most advanced sound equipment. As a result, this complete system which normally retails for \$1,015.00 is offered at \$695.00 for a period limited to three calendar months from December 1st, 1975.

**BANG & OLUFSEN  
OF DENMARK**



with respect for the true sound

Danish HI FI, Southern Cross Plaza, 638930 and Burke Road, Camberwell, 824839 Melbourne. Convoy Technocentre, Woolloomooloo, 358 2088 Sydney. Danish HI FI, Mount Lawley, 710100 Perth. Brisbane Agencies Audio Centre, Fortitude Valley, 21 9944 Brisbane.

BO/720MM



useful when communicating long-distance.

Resetting the second time zone does not affect the time kept for the first zone. This ensures accurate calibration at all times.

Also available is a second version of the watch circuit, the MM5860, which is designed to present calendar information in the European format of date-and-month. (The American format presents the month first). Both models, European and American, may be connected to display time in either a 12-hour or 24-hour format. The 23-hour version provides an a.m. indication, which is useful in setting the calendar.

Outputs interface directly with currently available standard bipolar segment-driver and digit-driver circuits.

The circuits operate from any dc source that supplies a voltage between 2.4 and 4.0 volts. Circuit chips are furnished in a form suitable for hybrid assembly in modules.

NS Electronics, Cnr Stud Rd & Mountain Highway, Bayswater, Vic. 3153.

## COLOR-TRAK SIMPLIFIES SETTING UP COLOUR TV SETS

A new device which gives the broadcaster and retail serviceman an effective grey-scale tracking aid is available from Parameters Pty Ltd. Known as Color-trak, this portable low cost reference was developed in the UK in conjunction with the BBC.

Grey-scale tracking is often sadly neglected in setting up procedures causing poor skin tones and shadow rendition. These inaccuracies in colour balance and tracking are often seen in retailer's demonstrations and often deter prospective customers. The problem has now been effectively overcome with the availability of an accurate colour reference at an economical price.

Broadcasters now transmit a white point of colour temperature 6,500°K or illuminant 'D'. It is essential that a similar white point is achieved at the receiver if the picture is to be obtained 'as transmitted'. Although many servicemen claim to be able to grey-scale track without a reference, this often proves to be incorrect since their eyes are accustomed to working with normal black and white sets operating at a colour temperature of 9,300°K —

it is extremely difficult for the human eye to differentiate accurately between whites.

Color-Trak was specially manufactured to solve this problem. It is quality controlled against a tungsten light source calibrated by the British National Physical Laboratory, and provides a constant colour reference virtually unaffected by voltage fluctuations and ambient temperature variations.

A four step wedge is used with uniform light transmission over the required spectral band with brightness set at 21 ft Lamberts (224 apostilbs) which is the recommended white setting. The steps are in nominal densities of 0.5, 1.38 and 2:1.

The process of grey-scale tracking is carried out by individually setting the gun cut-off points to the same value and adjusting each video drive until the white point matches the 'Color-Trak'.

The Color-Trak itself consists of a special fluorescent tube made to BSI853 1967 with a photographically produced grey-scale having 38x25 mm segments. The tube and wedge are housed in a rugged acrylic tube having the correct spectral response. The power lead incorporates the choke for the tube.

Almost all broadcasting stations in the UK are using the Color-Trak which is also widely used by TV service companies and personnel. It sells in Australia for \$70 (plus sales tax). Further information is available from Parameters Pty Ltd. 68 Alexander Street, Crows Nest 2065 Tel 439 3288.

## RESTORER-ANALYSER QUICKLY TESTS AND RESTORES CRT TYPES

Dynascan Corporation's B&K Precision Test Equipment Products Group has an improved colour and black and white CRT restorer/analyser, Model 467, that employs an exclusive "tri-dynamic" test method to test all three guns of a colour CRT simultaneously under actual operating conditions.

The guns are tested in sequence, 20 times per second, and the results are displayed at once on three colour coded "good-bad" meters. Model 467 tests for true beam current — current that passes through the G1 aperture to the screen.

Another feature is the 467's combination of powerful restoration

with minimal danger of cathode stripping. This is done by using the cathode of the CRT to time the restoration. When restoration current is applied the heater current is shut off. When the cathode cools below the point of emission, restoration current stops. Heavier cathodes automatically get more restoration than fragile cathodes.

The programmed control panel of the 467 facilitates use as an ordinary tube tester. The same procedures are used to test and restore most types of colour or black and white picture tube without calculation or reference to charts. The company claims that the 467 is the only unit of its type that tests focus electrode continuity. It also provides a tube life indication, finds and removes shorts, identifies and corrects tracking deficiencies in colour CRT's and/or in-the-home service calls.

Tecnico Electronics, Premier St., Marrickville. 2204. NSW.

Tecnico Electronics, 2 High St., Northcote. 3070. Vic.

## AUTORANGING DIGITAL MULTIMETER

Hewlett-Packard's newest Digital Multimeter uses new technology to provide versatile measurement capability at low cost, thus bringing the advantages of making digital measurements within the budget range of a much larger number of engineers and technicians.

The new 3 1/2 digit HP 3476A measures:—

- dc volts — from  $\pm 100$  microvolts to  $\pm 1000$  volts,
- ac volts — from 300 microvolts to 700 volts rms,
- dc current — from 100 microamperes to 1.1 ampere,
- ac current — from 300 microamperes to 1.1 ampere, and resistance — from 1 ohm to 11 megohms.

Built-in logic provides autoranging, autozero blanking and auto-polarity thus ensuring the display is always in volts, amperes or kilohms. The user need no longer be concerned with what range the instrument is on.

For those few occasions where noisy or spikey signals, such as are encountered in TV circuits, cause autoranging problems, an "auto hold" button has been provided. This feature also facilitates measurement of diode resistance and speeds up repetitive

# Roll over, chromium!

**New particle:** TDK has developed a new particle called Super Avilyn. It's cobalt and ferric-oxide in a single layer. It is **not** the same as so-called 'cobalt-doped' and 'cobalt-energized' tapes.

**New performance:** The superior high-end saturation of Super Avilyn's high-coercivity formulation (allowing it to take more high frequency energy during recording), combined with its compatibility with the CrO<sub>2</sub> equalization (1EC 70 microsecond time constant) results in a simultaneous suppression of high-end noise (for better S/N) and delivery of a flat response curve with better highs.

SA's performance exceeds even CrO<sub>2</sub>, which suffered from reduced output in the middle and low frequencies (SA provides 1.5-2db more output than the best CrO<sub>2</sub> in those ranges, equal output at high frequency).

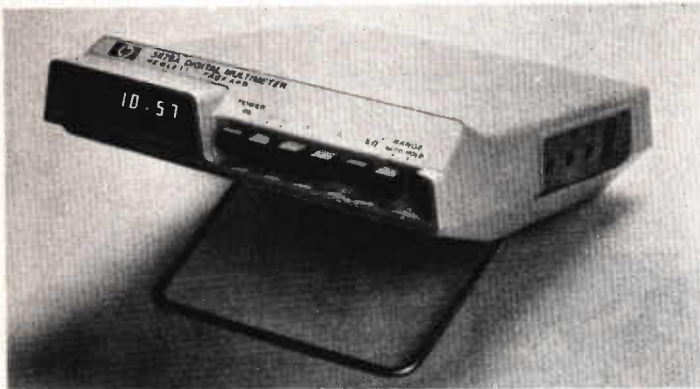
SA also outperforms the ferric-oxide tapes (regular and cobalt-energized) which are unable to take full advantage of the noise reduction benefits of the CrO<sub>2</sub> equalization because their high-end saturation characteristics are not compatible with this standard.



## Ask for TDK SA Cassettes.

Australian Distributor: Convoy International Pty. Ltd.  
4 Dowling Street, Woolloomooloo 2011. 358 2088.

PF 648



measurements of near constant inputs.

This combination of features at a low price has been achieved through a major technological advance, according to William E. Terry, vice president and general manager of Hewlett-Packard's Instrument Group. "Our development of fine-line, tantalum nitride resistor technology has enabled us to eliminate the use of more costly discrete precision resistors. Using this new technique, we are now able to offer this high-quality, compact DMM with features such as five functions with full autoranging at a very low price," says Terry.

Typical accuracy for dc voltage

measurements is 0.5%, dc current accuracy is 1.0%. On ac voltage ranges, frequency is specified to 10 kHz, while ac current measurement is to 5 kHz. Accuracy of resistance measurements on the three highest ranges is to 0.6% and to 0.4% on the two lower ranges.

A range hold feature is included that allows the instrument to be locked to any desired range. This feature is necessary when measuring diode resistance for example. It also makes repetitive measurement faster. The LED readout gives all voltage readings in volts, all resistance readings in kilohms and all current readings in amperes.

## HIGH ACCURACY AT LOW PRICE



A new digital multimeter has been introduced by Parameters Pty Ltd, Australian agents for Trio test instruments, known as the DL703, it uses the popular dual slope technique to achieve an accuracy of  $\pm 0.3\%$  of reading

$\pm 0.15\%$  of full scale on its dc ranges.

The instrument measures ac and dc voltage, dc current and resistance and has a  $3\frac{1}{2}$  digit display. It is housed in a rugged metal case and operates from 240 Vac mains.

Ranges covered are dc voltage from 2 to 1000 V; ac volts from 2 to 350 V, dc current to 200 mA and resistance from  $200\Omega$  to  $20\text{ M}\Omega$ . Maximum sensitivity is 1 mV. Zeroing and polarity are automatic and the input is fully protected.

The DL703 is very competitively priced at only \$120 (plus Sales Tax) and will find many applications where a rugged, accurate replacement for analog type instruments is required. Parameters Pty Ltd. 68 Alexander Street, Crows Nest.

## CHANGE AT McMURDO

As from January 1st, 1976, McMurdo (Australia) Pty Ltd will be known as Swann Electronics Pty. Limited, more accurately identifying the 100% Australian ownership of the Company.

Extensive export markets have necessitated the change of location to a new 70,000 square feet complex at Mt. Waverley. The new plant is expected to be fully operational by the end of December and production will be maintained during the changeover.

The new address for Swann Electronics will now be Corner of Forster and Hardner Roads, Mt. Waverley, 3149, and the same phone numbers 544-3033 and telex number will be retained.

## HIGH-EFFICIENCY LED'S IN LOW-PROFILE PACKAGE

Fourteen different low-profile T-1 3/4 LED lamps are now available from Hewlett-Packard. High-efficiency red, yellow and green come in a choice of diffused and non-diffused lenses and choice of two luminous intensities. The high-efficiency red and yellow are gallium phosphide on gallium phosphide; green LED's are gallium phosphide. Two red gallium arsenide phosphide on gallium arsenide lamps are available in two luminous intensities with red diffused lenses. All fourteen configurations are shown in the attached table.

These new lamps have a nominal dome height of 5.8 millimeters (0.23 inch) compared to currently available T-1 3/4 LED's with a dome height of 8.7 millimeters (0.34 inch). They are designed to be used where space is limited such as lighted switches, backlighting and panel illumination.

# 'The AR-6 is just about the finest inexpensive speaker one could hope to encounter.

At Acoustic Research our first aim is to produce the most accurate speakers we can make, regardless of size or cost. The only limiting factors are the state of the art and our own engineering skill.

## Low-cost loudspeakers

We have also designed speakers in which price was a consideration. But the performance standard has remained the same — the natural reproduction of music without exaggeration or artificiality of sound. And in designing the lower-cost AR speakers, it has been our aim to choose those compromises with cost that would have the least effect on the accuracy of sound reproduction.

This approach has resulted in a number of speakers in various price ranges whose performance often comes surprisingly close to that of the most expensive AR speakers.

## The AR-6

One such speaker is the AR-6, which *Stereo Review* described this way: 'It is noteworthy that the bass response measured for the AR-6 was almost identical to that we measured for the AR-5 . . . This is exceptional performance for a speaker of this size and price . . . As we have mentioned, the AR-6's polar response was very good . . . quite similar to that of the more expensive AR speaker system



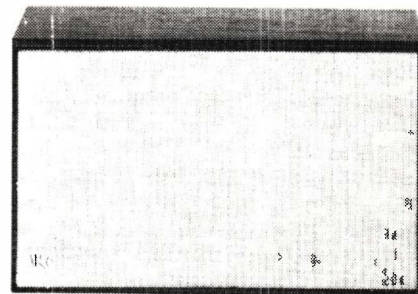
'All in all, the AR-6 acquitted itself very well in our tests. It was not quite the equal of the much more expensive AR models, whose sound it nevertheless resembles to an amazing degree, but on the other hand it out-performed a number of considerably larger and far more expensive systems we have tested in the same way. We don't know of many speakers with as good a balance in overall response, and nothing in its size or price class has as good a bass end.'

## Musical realism

*High Fidelity* magazine characterized the AR-6 as 'another great bookshelf speaker from AR . . . a really terrific performer. The AR-6 has a clean, uncolored, well-balanced response that delivers some of the most natural musical sound yet heard from anything in its size/price class, and which indeed rivals that heard from some speakers costing significantly more.'

Our headline, quoted from Robert C. Marsh, writing in the *Chicago Sun-Times*, summarizes these observations. A low-cost speaker system that embodies so many of the performance characteristics of more expensive speakers would obviously provide exceptional value.

And, as with all AR speakers, the performance characteristics of the AR-6 are guaranteed for five years.



*The AR-6: 'The finest inexpensive speaker one could hope to encounter'.*



**Australian Distributors W.C. Wedderspoon Pty. Ltd.**  
**3 Ford St. Greenacre. Box 21, P.O. Greenacre 2190.**  
**Telephone 642-3993 642-2595.**

*Available only through these franchise dealers:*

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 Mastertone Electronics  
 Miranda Hi-Fi  
 Apollo Hi-Fi  
 Electronic Enterprises  
 Hi-Fi House  
 Instrol Hi-Fi  
 Autel Systems  
 Sydney Hi-Fi.

### Melbourne

Instrol Hi-Fi  
 Tom's Hi-Fi  
 Denman Audio  
 Brash's  
 Mordlalloc Electrical  
 Pantiles

### Adelaide

Blackwood Sound Centre

### Darwin

Pfitzners Music House

### Brisbane

Reg Mills Stereo  
 Stereo Supplies

### Newcastle

Ron Chapman & Assoc.

### Wollongong

Hi-Fi House

### Canberra

Douglas Hi-Fi

### Hobart

Quantum Hi-Fi

### Launceston

Wills & Co

### Perth

Alberts T.V. & Hi-Fi.  
 Douglas Hi-Fi  
 Leslie Leonard.

### Geelong

Sound Spectrum.

## NEW COMPONENTS COMPANY



— Mr Brian Cleaves

An Australian Company, C & K Electronics (Aust) Pty, Limited has been formed in association with the American Principals, C & K Components Inc., U.S.A. The objective is to market the extensive range of professional subminiature switches, manufactured by the American principals, within the Australia/New Zealand electronic equipment manufacturing industry.

Mr Brian P. Cleaves, formerly of Plessey Australia, Components Division, Villawood, will head the company as managing director.

The new company operating from recently acquired premises at Merrylands, N.S.W. is geared to ensure continuity of supply of these popular switches to the many C & K orientated customers throughout Australia/New Zealand.

Mr Cleaves will explore export market potential in the near future to further the expansion of this new venture.

The company's address is 82a Mary St, Merrylands, N.S.W. Tel. 682-3144.

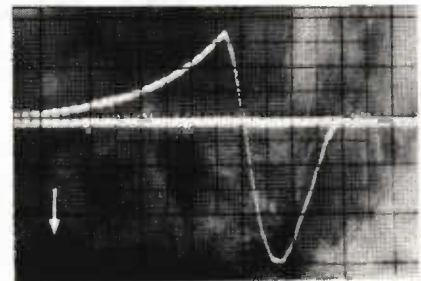
## PIEZOELECTRIC PUSHBUTTON

Many elevator and television sets are equipped with touch controls or proximity switches, where the user's finger brings about a change in the conductivity or capacitance of the sensor area and by so doing generates the actual switching signal. These sensor buttons are mechanically simple in design and very sound, however sensors of this kind are sensitive to moisture and are therefore restricted in application.

Following extensive research, Siemens has now produced a new sensor element (B 39 910) based on the piezoelectric effect. A pressure-sensitive piezoceramic transducer responds to light pressure (approx. 150g) producing a voltage of about 0.8V. The deformation that occurs is less than 0.5/um.

The actuating area can be designed as part of a virtually rigid and hermetically sealed surface. Moisture and soiling have no effect on the switching characteristics, and inadvertent touching does not result in false operation, since the switch has to be actuated with a definite minimum pressure. In view of these qualities, the piezoelectric pushbutton is predestined for equipment exposed to unfavorable environmental conditions as well as for consumer electronics, including portable equipment.

The pushbutton is based on ferroelectric piezoceramics such as are already used for cigarette lighters and phono pickups. A thin foil, cast to form an edge-mounted transducer element whose top edge can be subjected to mechanical force and which is supported on either side to prevent bending, serves as a pressure transducer. The extremely slender shape of the transducer greatly increases the piezoelectric energy at a given pressure.



Voltage trace upon actuation of piezoceramic pushbutton — maximum of 0.8 V after 150 ms, at a pressure of approx. 150 g, followed by return to zero after release.

## SPECIAL PURCHASE

### TRANSISTORS — CAPACITORS —

We have purchased from a manufacturer who has ceased the production of radio equipment due to the tariff reductions, their current stock of capacitors transistors and resistors, which we can offer at a fraction of original cost.

All Transistors, Capacitors and Resistors are New & Branded.

Transistors: 12-2N3055-1 Power transistors, 12-BC108 General purpose audio, 6-BC109C Low noise audio, 6-TT770 N.P.N. low level amp, 12-EM404 silicon rectifiers 400 volt 1 amp.

PLUS 24 mixed silicon transistors.

**60 TRANSISTORS PLUS 12 DIODES for \$9.00** Post & Packing \$1.00  
Mounting kits for 2N3055 mica washers & bushes 9c ea.

TRANSISTORS: 24 BC108 General purpose audio. 6-BC109 Low noise audio. 6 TT770 NPN low level amplifier. 12-EM404 silicon rectifiers 400 volt 1 amp, PLUS 20 mixed silicon transistors.

**56 TRANSISTORS PLUS 12 DIODES FOR \$4.80** Post & Packing \$1.00

RESISTORS: 100 ½ & 1 watt carbon resistors Morganite, I.R.H. & DUCON each pack contains 15 standard values.

**100 RESISTORS FOR \$1.00** Post & Packing \$1.00

CAPACITORS: 100 comprising approx. equal quantities of Philips tubular polyester (315 series) Polyester film "greencaps" & Stryoseal in standard values to .47 mfd with a list price of over \$18.00.

**100 CAPACITORS FOR \$3.50** Post & Packing \$1.00

POSTAGE \$1.00 WILL COVER POSTAGE ON ANY 3 PACKS

## METROPOLITAN RADIO SUPPLIES.

2 WATTLE STREET, HABERFIELD.

POSTAL ADDRESS: BOX 105 P.O. HABERFIELD 2045.



## A screwdriver and about 1/2 an hour is all you need to build this 40 watt Philips speaker system.

Philips make it easy and inexpensive for you to own a professional speaker system. Assemble it yourself in about 30 minutes and you have 40 watt (RMS) capacity speakers to complement your hi-fi gear.

The AD8K40 Speaker Kit includes:

- 2 precut, pre-finished wood grain cabinet enclosures with pre-painted baffle boards.
- 2 mounted grill cloths with pre-painted baffle boards. • 2 x 8" woofers. • 2 x 1" dome tweeters.
- 2 x 2-way crossover networks with leads and fastons fitted.
- Innerbond lining. • Wood screws.
- Wood glue. • Caulking compound.

Plus full assembly instructions.

For further information contact  
ELCOMA  
Electronic Components and Materials,  
P.O. Box 50,  
Lane Cove N.S.W. 2066.  
Or phone 42 1261 or 420361  
Branches in all States.

# ELCOMA

153-0129

In order to protect the new element from false trigger action, which can be caused by vibrations of a particular amplitude and frequency, an RC lowpass filter is integrated in the push-button.

The piezoelectric pushbutton does not pick up quiescent current and is therefore suitable for battery-operated equipment such as portable radio and TV sets. A further advantage is its insensitivity to moisture, dust and other deposits, which, in conventional sensors, is liable to cause undesirable changes in the conductivity controlling the switching function.

## BELLING & LEE GLASS FIBRE-OPTICS — NEW EXPERIMENTAL KIT

Belling & Lee have just released details of a new fibre-optic connection system for the transmission of signals via glass fibre light guides. The complete system which is marketed under the brand name, Fibretran, includes light guides, senders,

receivers, connectors, modulators and demodulators.

The experimental kit which includes all these items except the modulator and demodulator has been launched to serve as an introduction to engineers from a wide range of industries who are interested in studying these techniques.

Tecnico Electronics, Premier St., Marrickville 2204. N.S.W.

## ERRATA AND ADDENDA

### CALCULATOR STOPWATCH ETI 534

January 1975

Due to the charge time of C7 on switch-on, the calculator may occasionally start with a random number in the display — which cannot be cleared by the keyboard. This condition may be cleared by switching the calculator off and on again or be completely cured by adding a 47 ohm resistor in series with diode D5.

National have advised that a few of their calculators may not run at 100 Hz even with the recommended speed up network. To cure this the calculator must either be selected for operation at 100 Hz or the resolution must be changed from 1/100 sec to 1/50 sec.

This can be done by increasing C5 to 0.1 microfarad, R7 to 150 k and C8 to 0.015 microfarad. The wire which went from pin 8 of IC2 to pin 17 of IC3 should now be taken to pin 16 of IC3. This modification causes the calculator to add '2' 50 times per second — i.e. .02, .04, .06, .08 etc.

### CANNIBALS AND MISSIONARIES

December 1975

Page 101. Fig. 2. The line joining the contact of M3d to the buzzer common line should be deleted. Switch M3d should be normally open. Page 102. Fig. 5. A connection should be made between the bottom left contact of M3 and the bottom right contact of M1.

# next month

## • FM Tuner

Full constructional details.

## • Active Aerial

Eliminate need for long aerial for shortwave listeners. Ideal for flats or home units.

## • Touch Switch

Fascinating and versatile control.

## • RF Attenuator

Dc to 200 MHz attenuators for RF experimenters.

## • Full Test Report

Toshiba digital FM tuner.

The feature articles listed above are included amongst those currently scheduled for our February issue. However, unforeseeable circumstances, such as highly topical news or developments may affect the final issue content.

# electronics TODAY INTERNATIONAL

February  
Issue  
— on sale  
mid-January.

# 4

## TOP QUALITY SYSTEMS TO CHOOSE FROM

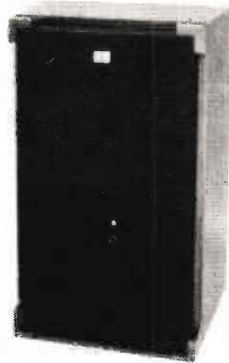
Leak 600 Speakers  
TEAC AS.100 Amplifier  
Sansui 525/91ED \*Rank Turntable

**\$749**



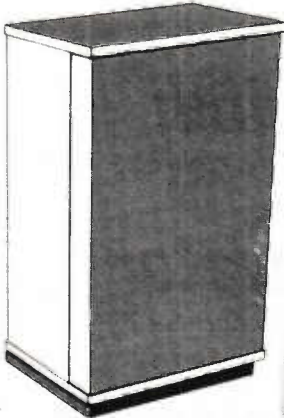
Sony SS.7100 Speakers  
Sansui 4400 Amplifiers  
Apan Bfu. 121 Turntable

**\$559**



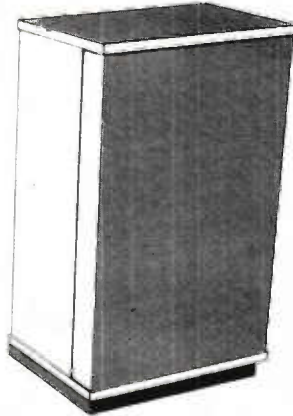
Nikko 500 Amplifier  
PHF 3 ways Speakers  
Sansui 212 Turntable

**\$449**



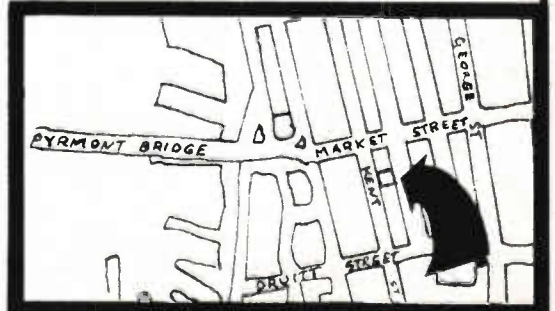
Technics SU.3000 Amplifier  
Kenwood 1022 Turntable  
PHF 2 ways speakers

**\$379**



# KENT HI-FI

412 KENT STREET, SYDNEY Ph. 29-6973





## T.D.K. INTRODUCE ENTIRELY NEW CASSETTE

TDK have just released to the Australian market an entirely new cassette, SUPER AVILYN (SA) CASSETTE.

SA was originally introduced as TDK's top-of-the-range Video Tape and is a patented formulation of cobalt, ferric oxide and other proprietary elements. It is not a "cobalt doped" tape. In the manufacturing process a cobalt ion is added to an extremely fine ferric oxide particle by absorption and the resultant coating on one mil mylar is said to out-perform chromium dioxide formulations and to provide higher coercivity and higher density.

Head wear is claimed to be the same as for ferric oxide — less than chromium dioxide tape. Consequently tape life and head life are both extended. The frequency response that can be achieved with Avilyn is said to be far better in the low and middle areas and it is said to equal the response of chromium tape at the HF end.

Ferrichrome or dual layer tapes have been available for some time. In any dual layer composition the chromium dioxide coating is bound to be extremely thin — approximately one micron. There are obvious manufacturing problems to be overcome and although this material can be used with conventional iron oxide bias settings and replay equalisation, optimum performance requires an adjustment approximately half-way between iron oxide and chromium dioxide conditions.

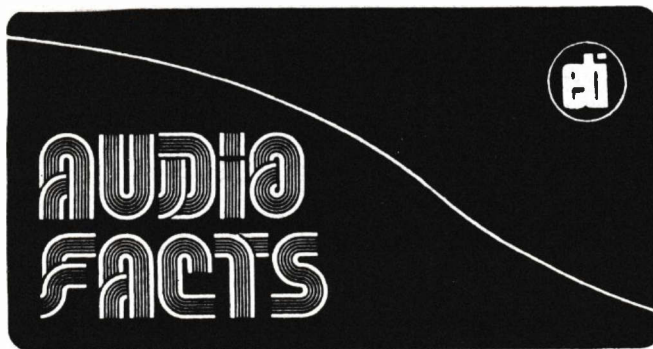
We are pleased to note that TDK have provided in Avilyn cassettes the necessary cut-out at the rear in order to trigger the automatic chrome setting of some recorders. Considerable effort will be required on the part of dealers to acquaint the public with the fact that although this is an improved ferric oxide material it is correct for the chromium dioxide pilot light (where one is present) to be illuminated when it is inserted in a cassette machine. It will probably be even more difficult to convince owners of tape decks with manual tape switching to use the chromium dioxide setting for an iron oxide tape.

Nevertheless from the technical data supplied it would seem that this new material does offer significant performance improvements with an extremely smooth wideband frequency response, high signal-to-noise ratio, high saturation and maximum output level coupled with low distortion. We will be publishing a full review of this new tape very soon.

## INTEGRATED STEREO UNIT

A new integrated stereo system, combining AM/FM/FM stereo radio tuner, pre-amplifier, power amplifier, turntable deck and a high performance cassette tape deck in one compact unit is announced by Toshiba-EMI (Australia) Pty. Ltd. Named the Stereo Music Centre SM-3200, the unit is attractively styled in a slim line walnut case with easily located front panel controls.

The radio tuner section provides FM mono and stereo



reception as well as both medium and long wave bands in AM.

The SM-3200 may be used with a variety of speakers. Speaker impedances of 4, 8 or 16 ohms can be readily accommodated, and 12 watts rms per channel is available.

While essentially a two-channel stereo system, a special built-in speaker matrix facility enables the SM-3200 to give four channel effects using an extra pair of speakers. The semi-automatic turntable player unit has only two controls, one is for speed change and the other for the semi-automatic functions of turntable start, and tone arm operation.

A special feature of the in-built cassette tape recorder is the Dynamic Noise Limiter (DNL) system. Operating only on playback, DNL greatly reduces background tape hiss, and can be switched in or out as required by a simple push-button control. Unlike Dolbyised systems with their specific record/playback requirements, DNL can be used on all cassettes — pre-recorded or otherwise. High quality chromium dioxide tapes or the more usual ferric oxide varieties can be used with the recorder.

## PHILIPS SQUAWKER

For some years now the Philips Dome Tweeter type ADO160/T has been acclaimed for its excellence in the reproduction of the upper frequencies in multi-way high fidelity loudspeaker systems.

The superior dispersion and transient response characteristics of the dome type diaphragm have now been extended to the very critical mid-range region with the release of the Philips Dome Squawker type ADO210 SQ. This squawker has a response curve which is almost flat ( $\pm 3$  dB) within the range from 50 Hz to 5 kHz. The resonance frequency is a very low 270 Hz.

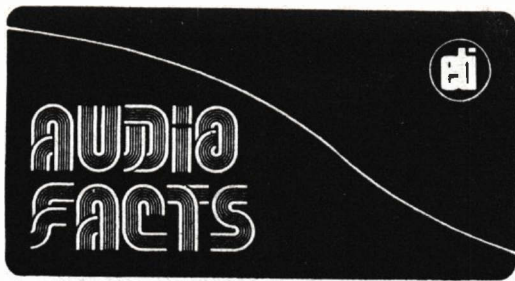
By using both the ADO160/T and the ADO210/SQ it is possible to obtain a much improved level of realism from high-fidelity recordings in the region from 500 Hz to beyond 20 kHz. Since the human ear is not very directional below 500 Herz, the conventional cone speaker is adequate for the bass region. Both the ADO160/T and the ADO210/SQ will be stocked in 4 ohms and 8 ohms versions.

The ADO210 SQ Dome Squawker is marketed by Elcoma. Electronic Components and Materials — 67 Mars Road, Lane Cove.

## HI-FI PURCHASERS CONFUSED BY DUTY-CUT REPORTS

Shortly before Christmas it was widely reported that a new Customs by-law would slash import duty on consumer electronic equipment: "from 35% to zero" according to one report, which estimated price reductions of around \$3 on a small transistor radio, and up to \$300 on the top range of equipment.

This latter area was naturally assumed by enthusiasts to



include hi-fi equipment — complete audio systems, and the tape decks, tuners, speakers and amplifiers from which they are assembled.

Regrettably, this is not so.

A detailed survey was indeed conducted by the Bureau of Customs to determine the extent of local manufacture. New by-law entry was, in fact, granted for certain items of electronic equipment such as ac radios, clock radios etc.

However, the official Customs policy states emphatically that by-law entry would not be appropriate on hi-fi equipment such as tuners, amplifiers, speakers, turntables and so on.

The early reports suggested that the 'new (reduced) prices' would be unlikely to take effect until after Christmas. Predictably, many people who intended buying hi-fi equipment in December delayed their purchases in anticipation of the illusionary lower prices.

According to a senior tariff consultant, the present Customs policy of "no by-law on hi-fi equipment" is unlikely to change in the foreseeable future.

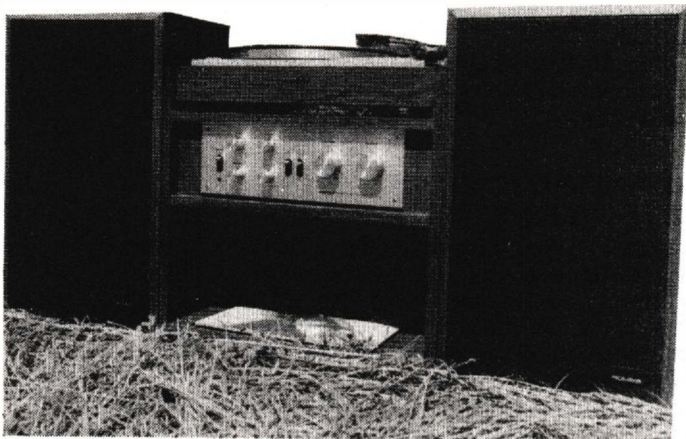
### PRELUDE 700

Pioneer Electronics have released a new hi-fi system aimed specifically to bridge the 'speaker' gap which previously existed in the market between the \$300 and \$500 price range.

Called the Prelude 700, the new system utilises the same amplifier and turntable as the popular Prelude 600 but incorporates a specially designed pair of speaker systems to satisfy customers who require better speakers in a price bracket under \$400.

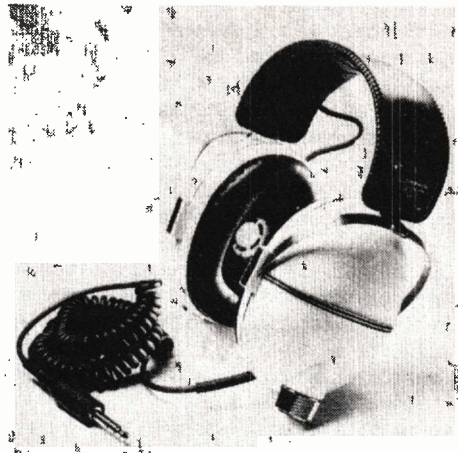
Pioneer's Marketing Manager, Mr. Doug Bell says that research has shown that people are spending more on first time system purchases. Consequently they require a system that will satisfy them for many years to come and to which they can add a cassette deck, tuner and headphones.

"The Prelude 700 fulfils this requirement delivering full, distortion free good quality sound at full power," Mr Bell said.



18

### HIGH SENSITIVITY HEADPHONES



Two new headphones released by Pioneer Electronics Australia Pty Ltd have the exceptionally high sensitivity of 100 dB/mW.

This sensitivity (or efficiency) means that you can connect them *directly* to your tape deck, tuner or pre-amplifier and enjoy high level musical reproduction.

The first of Pioneer's new headphones is called the Monitor 10 and is designed to be used either for professional type monitoring of tape recording sessions and the like, or for providing really high quality private stereo listening. The Monitor 10 uses a mylar diaphragm for its large 57 mm (2 1/4") cone drivers.

The other headphones released by Pioneer combine the advantages of the newly developed speaker cone material, called Carbon Fibre Blend, with the convenience and private listening appeal of the stereo headphones format.

These two new editions bring Pioneer's already comprehensive range of quality headphones to eleven.

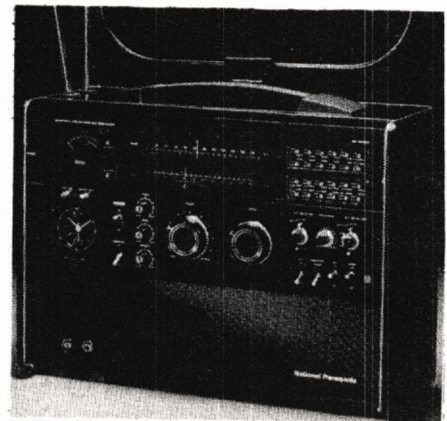
### PORTABLE RADIO COSTS \$2700!

National Panasonic's model RF 8000 must surely be the ultimate in portable domestic radio receivers. The unit can be tuned to any one of 24 bands from 150 kHz right up to 230 MHz in AM, FM SSB and CW.

Ultra-high selectivity and sensitivity is obtained by using a crystal-controlled double superhet system, tuned RF stages and a six stage IF circuit, ladder type ceramic filters etc.

Band selection is pushbutton controlled: the tuning scales are rotated by two dc motors driving a digitally-controlled turret-type selector using a memory circuit.

Recommended retail price is \$2700.



# Why you need 220 watts of power to listen to soft music.



SA-9900

Stated simply, Pioneer's new SA-9900 stereo amplifier was created to faithfully reproduce music at any volume you desire. At 110 watts RMS per channel, it doesn't matter whether you're trying to liven up a party or just warm up your sweetheart. Through a precision blending of Pioneer's advanced electronics, total harmonic distortion is never more than 0.1%. As a result, you hear all the sounds of all the music you play—clearly—even the soft ones.

And while the SA-9900 is easy to listen to, it's also easy to use. A newly designed chassis places all the output terminals on the left side and all

the input terminals on the right. Separated to eliminate any signal interference and convenient for access to cord connections.

The SA-9900 stereo amplifier. Another example of technical know-how and constant research applied to meet the listener's needs. After all, isn't that what you've come to expect from Pioneer audio equipment.

At Pioneer, we uphold that trust with almost 40 years of exclusive commitment to audio excellence. And from our vast resources as one of the world's leading audio specialists, we are privileged at this time to offer the SA-9900 as the best in an entire

line of outstanding stereo amplifiers. Stop by and see your local dealer for a demonstration. You'll get an earful of truly great music—any way you like it—loudly or softly.

**Pioneer Electronics Australia Pty. Ltd.**,  
178-184 Boundary Road, Braeside,  
Victoria 3195, Phone: 90-9011,  
Sydney 93-0246, Brisbane 52-8213,  
Adelaide 433379, Perth 76-7776

**PIONEER**  
leads the world in sound.

# TELETEXT TV

One hundred page 'magazines' are now regularly broadcast by Britain's BBC and ITV services. The 'magazines' are received on spare lines transmitted routinely at the end of each frame (i.e. following the sync pulse).

This article was recently published in the British edition of Electronics Today. Prices quoted within the article have been converted to Australian dollars.



IN OCTOBER 1972, Britain's BBC Engineering Division announced a completely new TV development which they named CEEFAX.

The system would enable a number of "pages" of text to be selected by anyone with a suitably equipped TV receiver for display on the screen. At the time, this received considerable publicity — not unnaturally most of it from the BBC itself — but we are today bombarded with so many ingenious gimmicks and curiosities that it has only dawned slowly what enormous potential it has and how soon it is likely to be part of our everyday lives.

Competition is always healthy and the IBA (Independent Broadcasting Authority) were not far behind with their own system: ORACLE. This was essentially the same but included some improvements. Sensibly the BBC, IBA and BREMA (representing the TV set industry) got together in a working committee to establish a single standard. This committee announced in March 1974 that a unified system had been agreed. This not only incorporated the best of CEEFAX and

ORACLE but built on them — the resulting standard being a significant advance on the original specification.

The BBC, who have shown enormous faith in this development, applied for, and received, permission for a two-year experimental transmission period; this started in September 1974. Since that date, for eight hours a day, a regular, live service (albeit experimental) has been carried on BBC-1 UHF transmitters throughout Britain.

The confusion over terminology is enormous. The BBC, who after all can claim to have been the inventors and driving force, continue to call the system (as well as the service) CEEFAX; the IBA are sticking to ORACLE for their service. Outside well-wishers dubbed the combined systems TELEDATA, until it was pointed out that this was a registered name for something completely different! Now the name TELETEXT has been adopted, though it has not yet caught on.

All very well — a new service, available now to anyone with a receiver — but where are they? The

▲  
*The BBC CEEFAX service as it was until very recently. Even now the entire equipment including two input consoles, the computer, monitors etc is contained in about 400 square feet. CEEFAX is put out from the 7th floor of the BBC Television Centre. In the picture Sub-Editor Ian Irving is preparing a news bulletin while Research Assistant Adrian Robson is operating the controls, and has summoned-up a weather map of Britain.*

BBC estimate that there are between 80 and 100 receivers in Britain — mostly built by the set makers for testing; the rest are owned by the BBC itself with perhaps half-a-dozen built by enthusiasts. (Until very recently, if anything went wrong with transmissions the BBC would 'phone up their viewers to tell them!)

Why the apparent lack of interest outside the BBC and IBA?

The problem arises over the enormous complexity of the equipment necessary to decode and display Teletext. The system is operating at the forefront of current technology: bank upon bank of TTL

and memory chips have, until now, been necessary and the cost of parts alone is in the order of A\$600. Complete circuits are *not* available - at least none that we know of. We have not even been able to get permission to publish a meaningful block diagram! However, things are beginning to move...

### THE BREAKTHROUGH

At least one semiconductor company, Texas, has been investigating Teletext seriously. At a major launch on May 6th, Texas disclosed that they have completed development work on a Teletext module, to be known as TIFAX, and that preproduction samples will be available in about four months with production quantities available in early 1976. If all goes as planned, the first receivers available to the public will be on sale in about a year.

The extra cost of a Teletext receiver can only be estimated. The first sets are expected to be about \$200 dearer, but by 1978, Texas estimate the market at 1 000 000 sets a year with \$40-\$75 being the extra cost. There is no technical reason preventing Teletext being incorporated with monochrome sets but it will probably only be available as an option on colour sets.

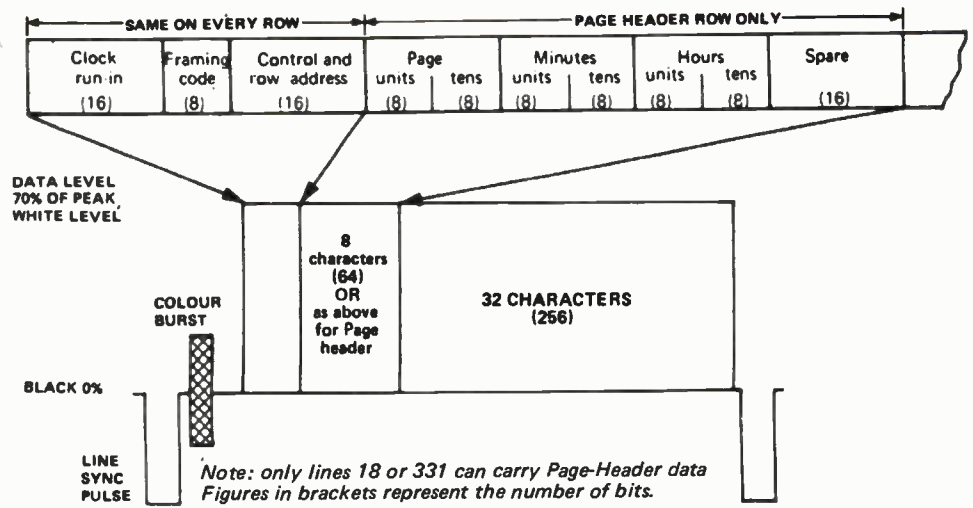
### HOW DOES IT WORK?

When the specification for the 625-line TV standard was drawn up, the state-of-the-art was far behind that of today. To tell the electron beam that it had reached the end of its frame, and to give it time to reach the top again, a sync pulse followed by 25 blank lines is transmitted. Current techniques need nothing like this number of lines.

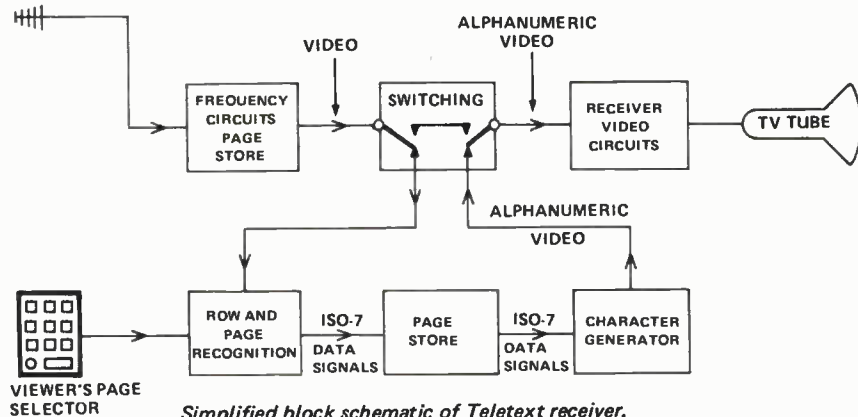
Teletext is transmitted on two lines: 17 and 18 (330 and 331 on the interlace). Anyone in Britain who hasn't yet seen Teletext encoded lines has only to reduce the height control and view the top of the picture - it's impossible to miss them.

On these lines, data in binary form is pushed out at 6.9375 Mbits/s. This information however, is meaningless by itself - it bears no relation to the normal analogue picture: this has led to a misunderstanding amongst even well informed engineers. The binary coded signal only gives instructions to equipment at the receiver end about what to display - it does not provide the display.

Let us take a close analogy to explain the point (though not actually part of Teletext). Most stations use at some time or other a simple clock display. This is a standard pattern which remains unaltered except for the seconds hand.



The organisation of Teletext data on lines 17, 18, 330 and 331.



Simplified block schematic of Teletext receiver.

To display this on a screen for one second requires on a conventional display some  $6 \times 10^6$  bits of information to be broadcast (625-line frequency bandwidth is 6 MHz). If the shape of the clock was generated in the set itself it would require only *one* bit per second to display the same shape - that item of information being a signal for the seconds hand to move on: this would represent an enormous saving in data transmission. It is by making good use of this technique that an enormous amount of information can be transmitted using Teletext in only two lines.

The specification of Teletext allows for 100 "pages" of information to be transmitted, each comprising 24 lines of 40 characters each. These characters can be in six colours and white and can be used to display simple graphics.

As the coded information is transmitted for only a tiny fraction of the time that it is displayed, the coded signals have to be stored in a memory.

Every page starts off with a special row called the "page header". This shows the page number, the date and the time (updated every second). Special codings are incorporated at the beginning of the page header so that

the receiver knows that a page is beginning and which page it is. When these signals match those selected by the viewer, the receiver starts to display the header row followed by the rest of that page.

Each TV line (17, 18 and their interlace) carries one line of Teletext data and as each page is made up from 24 lines, it will take 0.24 seconds to build up a complete page. This delay only occurs when the page is first displayed, for the information is held in the memory and can be accessed immediately. When a Teletext page is updated, it takes nearly a 1/4-second to complete the corrected page.

Apart from updating, pages can of course be cycled. On a particular page number, a series of different displays can be transmitted in sequence, but the viewer will not have the choice of starting on, say, the first page (like dialling the weather on the 'phone).

### VIEWER CONTROLS

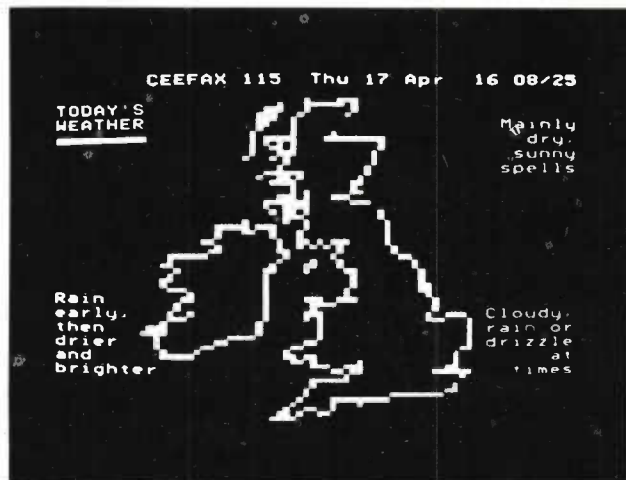
Receivers will have an additional control panel - most companies seem to favour something not unlike a calculator keyboard. The function keys will be labelled *Picture* (for normal TV reception), *Teletext* and

# TELETEXT TV

Picture and Teletext (the latter superimposed on the former). Other keys can be "Update" - bring up newflashes automatically when something new happens. "Time" for

selecting a particular page for display at a preselected time, etc.

For Teletext the calculator keyboard must be used. If you know the page number you want, this is punched up and the information stored. When the lines are broadcast with the same coding that you have selected, the Teletext data is fed into the memory and on the next frame the memory takes over the screen and plays out its coded messages to the character generator. The first line will always comprise the page number, title and the time.



Simple graphics such as maps are an integral part of Teletext.



A major attraction of Teletext is likely to be the Newsflash. Receivers will probably be designed to enable the viewer to choose for Newsflashes to be superimposed on a regular programme either in a box as shown or in white.

CEEFAX 101 Thu 17 Apr 16 06/30

BBC CEEFAX INDEX - p101

NEWS		INFORMATION	
Headlines	102	Demonstration	110
Home	103	Index repeat	111
Foreign	104	Exchange rates	112
Sport	105	Consumer news	113
Travel	106	Education	114
Charity	107	Weather	115
FT INDEX	108	TU programmes	116
Business	109	Radio	117
NEWS FLR	150	Pools News	119
		Fara prices	120
		FARM NEWS	121
		Test card "A"	122
		Test card "B"	123
		BBC NEWS	124
		Test designs 125-30	

A full CEEFAX magazine will be 100 PAGES on each channel updated between 6am and 6pm at present

The index page of CEEFAX used until recently. This is transmitted more frequently than the other pages to give faster access (one in every 10 pages).

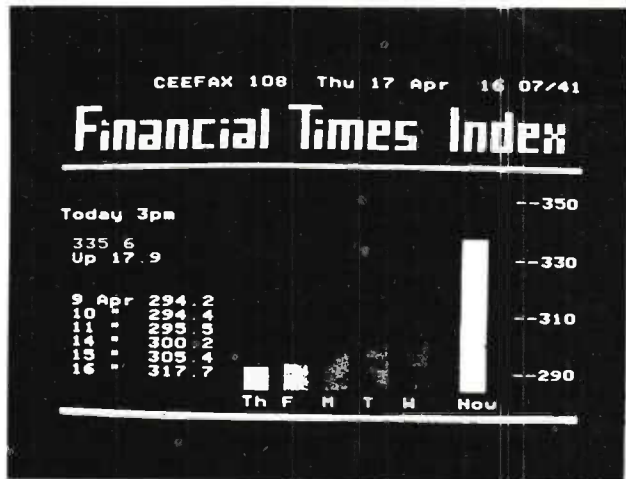
CEEFAX 105 Thu 17 Apr 16 09/55

**SPORTS NEWS**

**RACING** The start-stop Flat season celebrates its coming-of-age at Neumarket today. The ante-post favourite for the 1,000 Guineas, CRY OF TRUTH, makes her reappearance in the Nell Gwyn Stakes - the recognised trial for the first fillies' Classic.

**SOCCER** Malcolm MacDonald (Newcastle) became the first man to score 5 goals for England at Wembley. Cyprus lost 5-0. Wales beat Hungary 2-1 in Budapest & Northern Ireland defeated Yugoslavia 1-0 in Belfast. All were European championship games.

Racing results etc are ideal candidates for Teletext and it is this area that the BBC intend to expand in the near future. On this display only 17 lines are used but each page can be up to 24 lines (including the header) and 40 characters across. As many 'pages', including this one, are not full, it takes less than 0.24 seconds to build-up. Blank lines are not represented by a period with no display but by coding. This reduces the access time considerably.

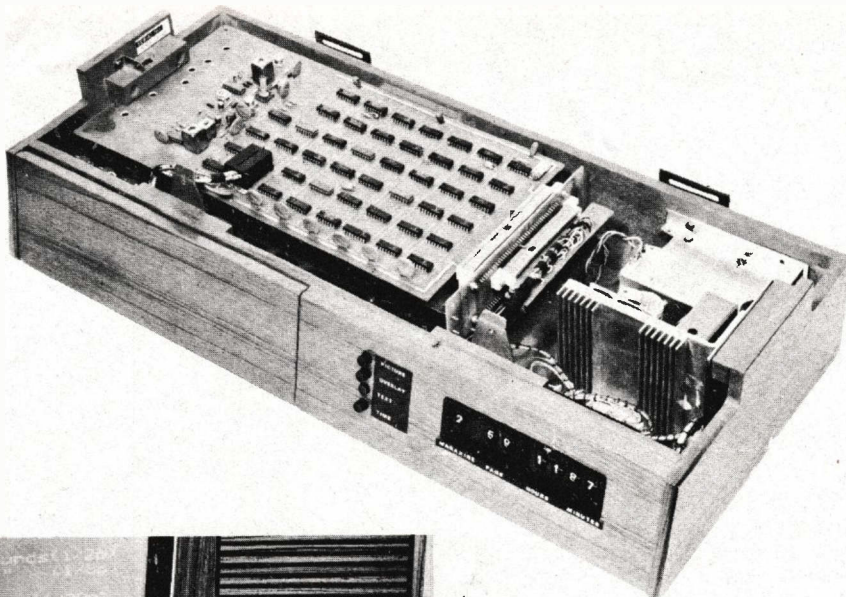


A good example of what can be done with Teletext - and is actually being transmitted by BBC's CEEFAX. The words Financial Times Index are made up from the graphics part of the alphanumeric generator rather than the straight-forward alphabet. At the top is shown the service (CEEFAX), the page number, the day and date with the time - correct to the second - on the right. This page could well be cycled with other related data such as major share price movements, gold and commodity prices and the current value of the pound. These would be on sub-pages which would repeat every 15 seconds or so.

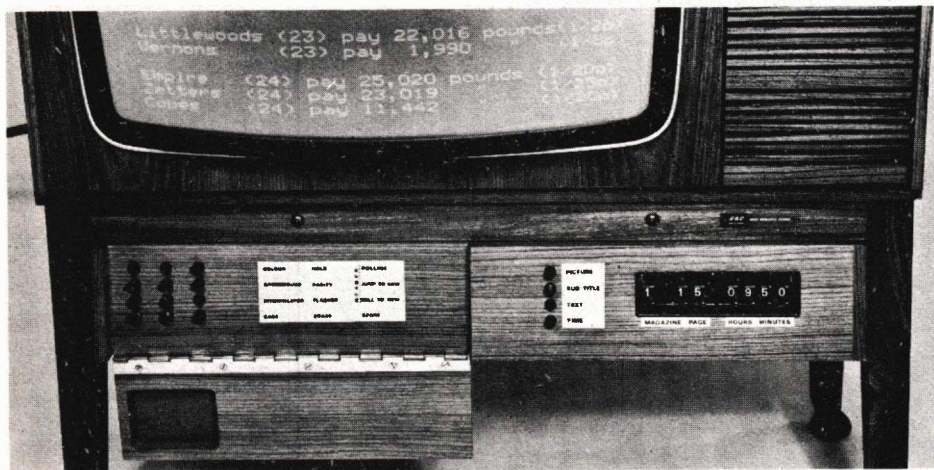
The remaining 23 lines, each capable of 40 characters, is then displayed.

## COLOUR

The Teletext characters can be displayed in white, the three primary colours and their complementaries. The first reaction is that this is a gimmick of unnecessary luxury: in fact, as Teletext is connected to the receiver at the c.r.t. drive stage, colour is very simple — it is estimated that it adds perhaps only 10% to the total cost, a small price to pay for the additional readability.



*Teletext receiver currently being made by GEC. The data circuitry is housed in a separate shallow box beneath the main receiver. Additional controls behind a hinged flap permit many variations in the data display. Cost is a cool £900 sterling!*



*The Teletext receiver is enormously complex — as can be seen here. However if the system becomes generally accepted at least some parts of the circuitry should become available in LSI (large scale integrated) form.*

## ACCESS TIME

With the 50 pages currently being broadcast by the BBC it can take up to 15 seconds to get your required page — when the full capacity of 100 pages is broadcast this will double. This access time is considered unacceptable by many who are familiar with the system. It is quite possible to incorporate a memory for each page, but this would add enormously to the cost. What may well happen is that decoders will have four or five memories which will hold those pages likely to be used most frequently. The Texas TIFAX module has only the basic memory.

## ADD-ON MODULES

Can existing sets be modified? In theory, yes, but a large market is not envisaged. An add-on module will be considerably more complex if it is simply to plug into the aerial socket — and a colour facility is very unlikely.

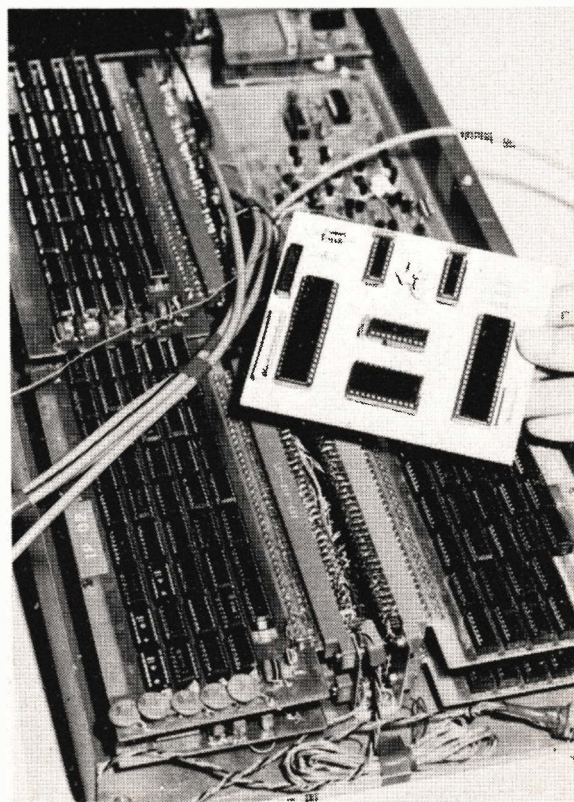
If modules become available to the hobby market, a competent engineer should be able to connect it into the set quite easily — there are few enough connections to make. We shall have to wait and see what happens in this field.

## THE FUTURE

The success of Teletext depends entirely on the public's willingness to pay the extra cost for the receiver. One of the surprising features is the tiny cost to the broadcasting authorities in providing the service. The BBC's experimental CEEFAX service is believed to be costing under A\$50 000 a year — less than the cost of one major TV programme. Even when operating with a full staff, a nationwide service will cost only about as much as a local radio station!

The capacity of Teletext is enormous. Only two lines are being used at present, but 16 are available: this would give an 800 page capacity per channel of 2400 on the three networks! The potential is enormous.

It is natural that electronic engineers drool over such an ingenious and interesting development — like children with a new toy — but it is the non-technical public who will determine the success of Teletext, and the public's interest will depend on the extra cost of the equipment. A start has been made by Texas in developing a moderately-priced module and it is now up to the TV set manufacturers to make the sets available.



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#### ACCUPHASE T-100 TUNER PERFORMANCE

FM Section (tests at 95 MHz and signals PD 75 ohms)

IHF: least usable sensitivity	1.4 $\mu$ V
30 dB quieting	0.8 $\mu$ V
50 dB quieting	2.2 $\mu$ V mono; 20 $\mu$ V stereo
Full limiting	1.5 $\mu$ V
Ultimate S/N ratio	78 dB mono; 75 dB stereo
Ultimate hum and noise	-62 dB
Output 30% modulation	540 mV fixed; 0-540 mV var.
Muting threshold	(1) 5 $\mu$ V; (2) 20 $\mu$ V
Tuning accuracy	within 1%
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Rated IHF alternate ch. selectivity	80/100 dB
Front-end selectivity (figure of merit)	> 100 dB
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Repeat spot suppression	100 dB
AM rejection ratio	60 dB
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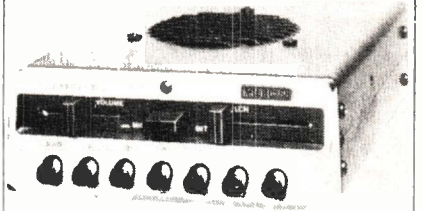
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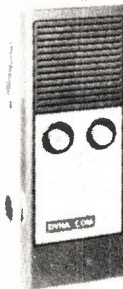
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## LAFAYETTE

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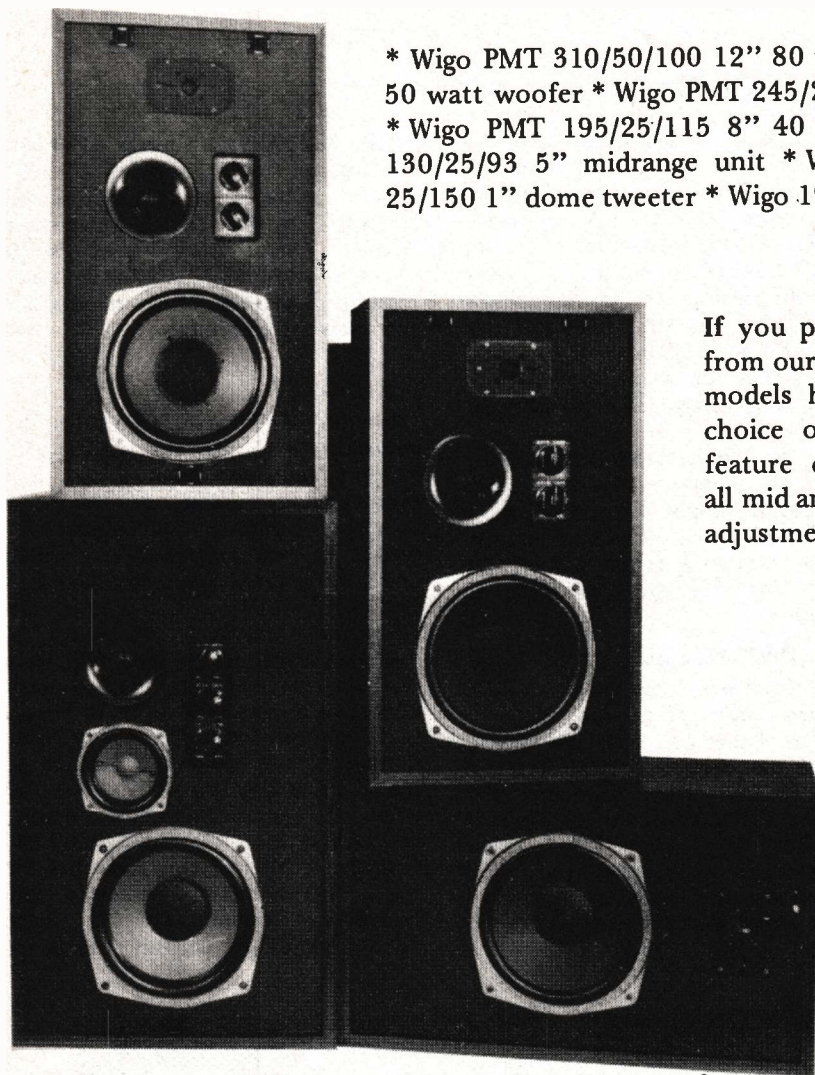
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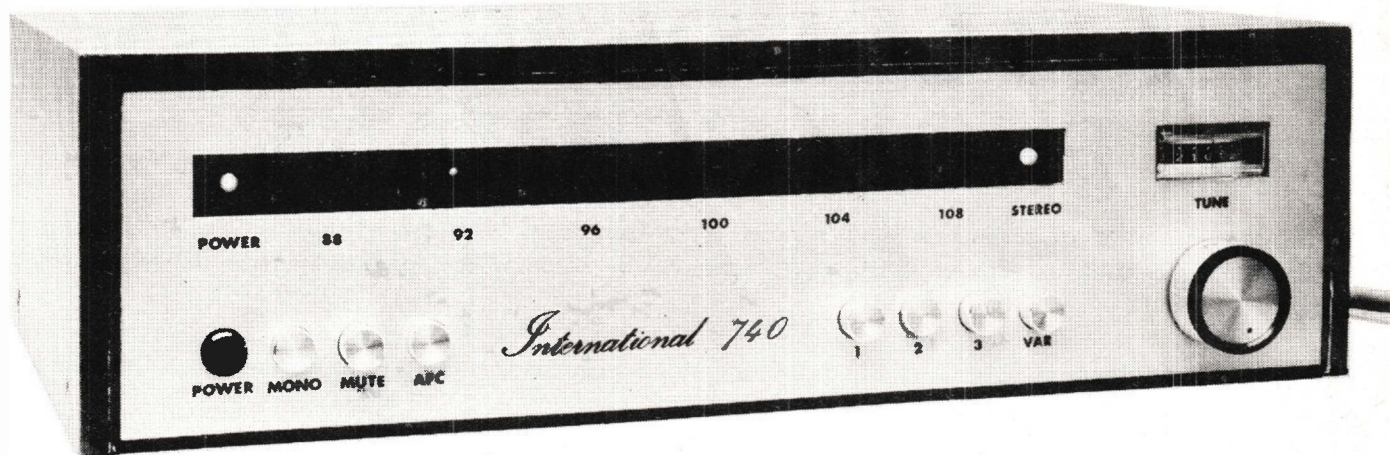
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# FM TUNER



## All electronic design eliminates mechanical dial.

THE ETI 740 FM tuner has been designed to provide the highest possible performance consistent with a cost that we feel will be generally acceptable to most of our readers.

A very great deal of effort has been put into simplifying construction both mechanically and electronically, and similar effort has been expended on ensuring good appearance.

Virtually the entire unit consists of two printed circuit boards — one of which is directly soldered into the other. The only wiring necessary is the power cord, the antenna sockets, three wires to the tuning potentiometer and two to the tuning meter.

Apart from the assembly of the two printed-circuit boards the only wiring necessary is the power cord, the antenna sockets, the three wires to the tuning potentiometer and the two to the tuning meter.

An all electronic dial assembly completely eliminates the hassles of pulleys and cords as in mechanical dials. Additionally the use of a commercial prealigned tuner module eliminates the need for alignment. These two measures greatly simplify construction.

The main printed-circuit board has been designed so that it may be assembled either as a single board or cut up and assembled as separate modules. If one wishes to construct the 10.7 MHz IF as a separate unit this is entirely possible without designing a new board layout. In fact we understand that boards for separate modules may be made available by Applied Technology (See note on page 29).

Only three adjustments are necessary to align the complete tuner and these are relatively simple. Thus the tuner is quite readily constructable by anyone who can correctly handle a soldering iron — no special knowledge is required.

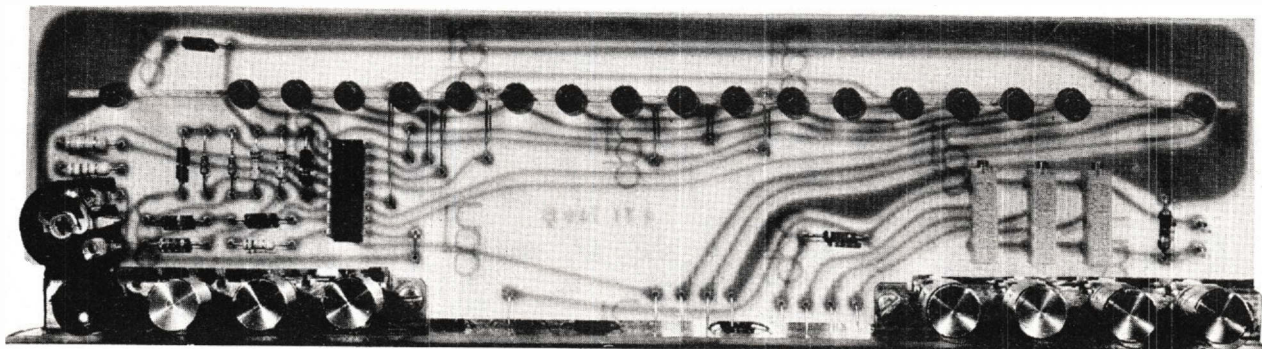
## THE TUNER MODULE

Many different tuner modules were evaluated, even some we specially imported from overseas. We finally selected the newly released AP 2157 from Philips. This tuner is the preferred replacement for the Mullard LP1186 and combines good performance, reasonable price and ready availability. However any other varicap tuner module may be used if desired.

The AP2157 is a varicap tuner and requires a stable three to 27 volt control voltage to tune across the range 87.5 to 108 MHz. The tuner uses bipolar transistors, three single varicaps and two 10.7 MHz tuned circuits to provide 20 dB of gain and reasonable rejection ratios.

## THE DIAL

As with any kind of radio tuner the provision of a calibrated tuning dial presents problems from a cost and constructional point of view. A specially designed mechanical dial would be very expensive and would complicate the chassis metalwork — leading to further cost increases. The alternative approach of using an analogue meter to indicate frequency was also rejected because reasonably attractive meters with large scales are quite expensive also. Ultimately it was decided to use a digital dial based on the Siemens UA 160 IC. The UA 160 is an analogue to one-of-16 decoder and LED driver. Using this chip we can arrange LEDs in a row such that the LED illuminated indicates the frequency tuned. This is quite convenient as the control voltage for



*The electronic-dial mechanism.*

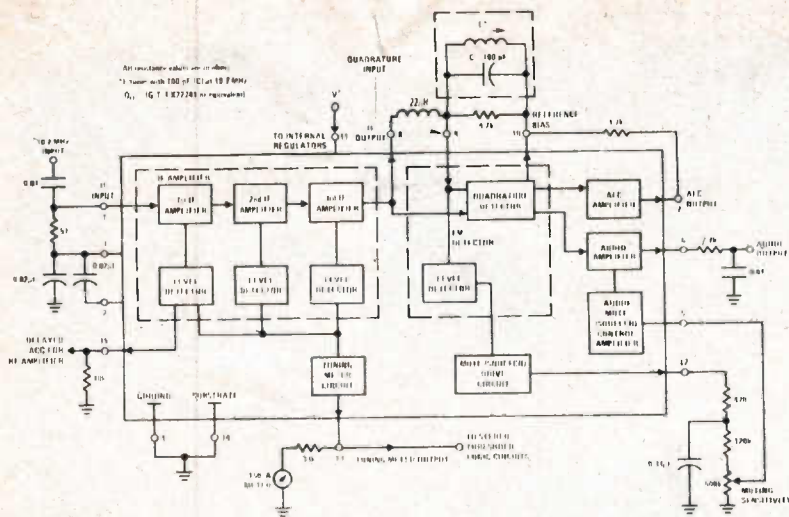


Fig. 1. Block diagram of the LM3089 FM receiver IF system.

the tuner module may also be used to drive the LED 'dial'. The tuned frequency is related to the control voltage in an exponential manner, so to have a linear dial it is necessary to use a network to tailor the control voltage before it is fed to the UA 160.

The ETI technique provides a dial having a good appearance, adequate length of 130 mm and no moving parts. The power-on and stereo indicators are green LEDs and are arranged to be in line with the dial LEDs which are red.

In addition to the manual-tuning control, which is selected by a push button, three other push buttons each select any one of three stations, each of which can be selected at any point over the entire tuning range by an individual preset potentiometer. The LED dial arrangement automatically indicates the frequency of each preselected station (something that is quite difficult to do with a mechanical dial).

The 16 LED display provides 800 kHz resolution. In practice this is adequate and it was not considered necessary or economically justifiable to increase resolution by adding a further IC and set of LEDs.

## IF AND DEMODULATOR

The output of the tuner is filtered by two ceramic filters (separated by a buffer stage) before being fed to a CA 3089 IC which is a complete FM IF and demodulator system containing over 80 transistors. The IC requires only one external tuned circuit (the quadrature detector coil) and provides AGC, AFC, muting, signal strength and tuning meter drive voltages.

In our circuit the muting level is set by an internal preset potentiometer and muting may be switched out by a front panel push button if desired. Another front panel push button selects AFC or manual tuning control, and a tuning meter is provided rather

than the more conventional signal strength meter. With FM very accurate tuning is required if minimum distortion is to be obtained and a tuning meter provides a much more accurate method than does a signal strength meter.

The CA 3089 is followed by an RC network to roll off the loop above 100 kHz, and an amplifier with a gain of three to provide an output level adequate for most power amplifiers.

## DECODER

The stereo decoder used is the LM 1310 phase-locked loop IC, which does not require any external coils whatsoever. The use of this IC virtually eliminates the setting up of coils which is often a major stumbling block for beginners. The only adjustment which needs to be made on the decoder is to the frequency of

operation of the phase-locked loop. This adjustment is performed very simply by using a preset potentiometer together with the stereo indicator lamp as a monitor.

## PILOT TONE FILTER

The stereo outputs from the decoder have de-emphasis applied and then are fed to unity-gain, active-low-pass filters to suppress the 19 kHz pilot tone, the 38 kHz sub-carrier and harmonics which would otherwise cause interference, when tape recording, with the bias oscillator of the recorder.

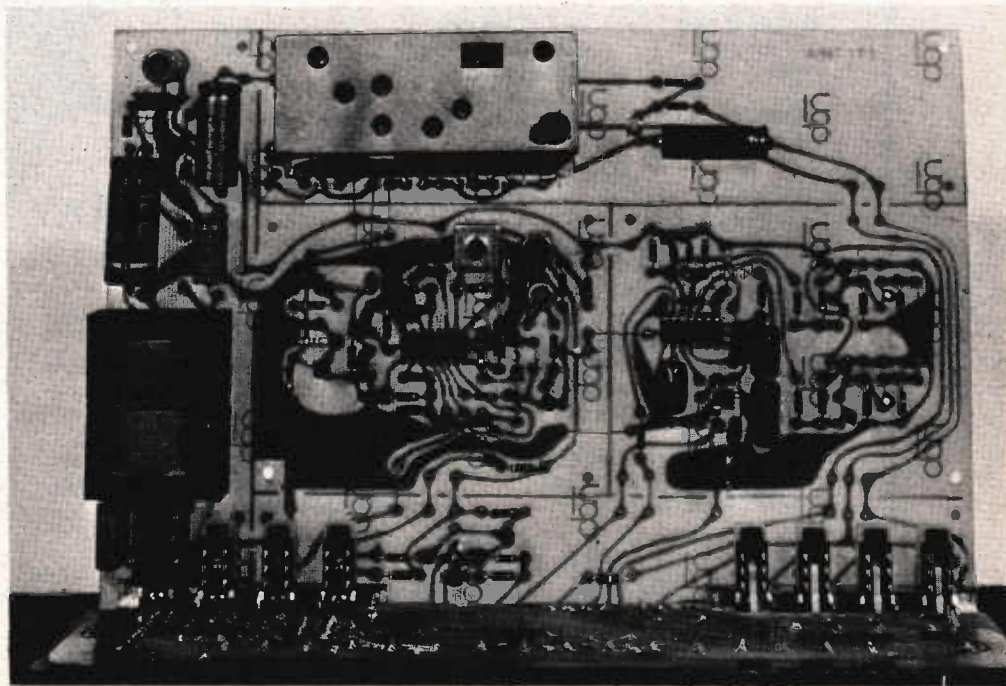
An LED driven by the decoder indicates when the loop is locked indicating also when a stereo signal is being received. A front panel push button provides a stereo-defeat facility by detuning the loop oscillator beyond the capture range of the loop thus forcing the decoder to provide a mono output.

## POWER SUPPLY

The power supply provides via an IC regulator, +15 volts for the general circuitry of the tuner. A voltage doubler provides a supply to a special voltage stabiliser, a TA 550, which in turn provides a temperature stable supply of +32 volts as the reference source for the tuning potentiometer.

Full constructional details will be given next month.

We would like to thank Owen Hill, B.E., M.B.A., and Applied Technology Pty Ltd, for their very valuable assistance with the design and development of this unit. Full kits of parts will be available from Applied Technology Pty Ltd and details of these kits will be published in ETI next month.

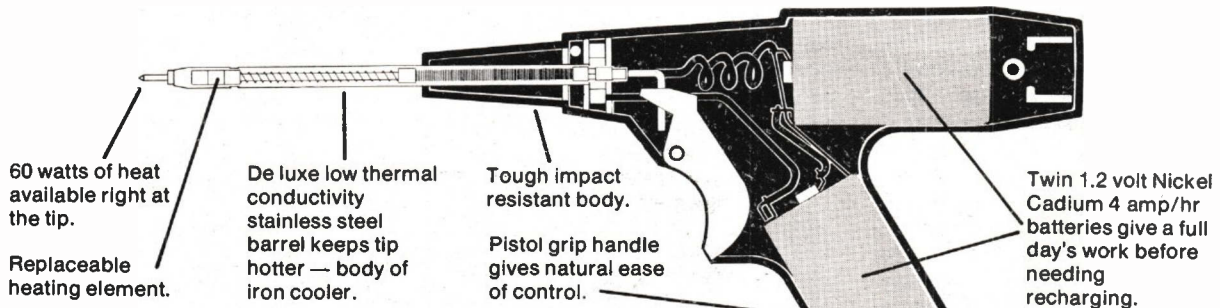


Internal view of the main printed circuit board which houses most of the electronics.



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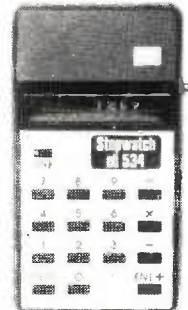
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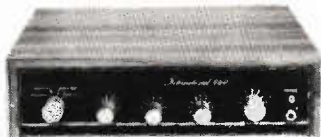
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## ETI 440 SIMPLE 25 WATT AMPLIFIER



Designed by the ETI Team the International 440 is a remarkable combination of high performance, easy construction and low cost.

We offer our own exclusive step-by-step assembly manual, the choice of buying individual packs or the full kit and a really good looking Walnut Veneered Cabinet that guarantees you a professional finished product anyone would be proud to own. For pack prices, see December ETI.

With our full Technical support and Warranty Service (see below) you just can't fail to build this kit!

**\$85.00** Delivered Free Anywhere in Australia.  
nett Assembled and Tested \$115 nett

## MR 25 SCORPIO CD1

Based on one of the most popular CDI projects in the world, this proven design has been updated and re-engineered to ensure that the kit can be readily assembled by anyone from a novice to an expert design engineer. The kit comes complete in every detail including all components and hardware; screened, etched and drilled PC Board, machined and finished metal work, pre-wound and tested transformer and a unique, easy to follow assembly manual that converts the assembly task to sheer pleasure.

If you have any problems before, during or after assembly — just call on our exclusive Technical support and Warranty Service.

**\$28.50** nett

(Assembled and tested \$36.00 nett)

## ETI 704 CROSS HATCH/DOT GENERATOR

**\$27.50** nett



This incredibly popular project now given the HOBBY KIT treatment.

- Pre drilled/screened front panel.
- Fibreglass PC Board with screened Component Overlay.
- Pre-wound coils.
- Sockets for all IC's.

Complete to last detail including solder and hook up wire. Full warranty support applies. (Doesn't include battery.)

### FULL TECHNICAL SUPPORT AND WARRANTY SERVICE

All Applied Technology HOBBY KITS are covered by our exclusive 90 days warranty against faulty components and packaging (full details with each kit).

Yet another exclusive is the full technical support service. If you are unable to make your HOBBY KIT operational, help is just a phone call or a letter away. If you do have to return any KIT for factory attention, it will be repaired for a nominal service fee.

All kits are on display at our Factory Showroom. Personal callers welcome — weekdays by appointment, or anytime Saturday Mornings. Phone 476 4758.



109-111 Hunter Street,  
HORNSBY, N.S.W. 2077  
Phone (02) 476-4758  
Open Saturday morning

Please supply .....

.....

.....

Delivered FREE anywhere in Australia

Enclosed is my Cheque/Postal Note/Money Order for \$.....  
made out to APPLIED TECHNOLOGY PTY. LTD.

(PLEASE PRINT CLEARLY)

NAME .....

ADDRESS .....

..... P/C .....

ETI 2/76

# EDGE ELECTRIX

31 BURWOOD ROAD, BURWOOD, TEL: 747 2931

MAIL ORDER SPECIALS

## SEMI CONDUCTORS

	\$	c
AF126	.98	each
BA219	.39	each
BA102	.60	each
BB105G	.45	each
BC107	.40	each
BC108	.40	each
BC109	.40	each
BC177	.50	each
BC178	.50	each
BC179	.50	each
BC548	.40	each
BC549	.40	each
BC558	.40	each
BC559	.40	each
BC639	.60	each
BC640	.60	each
BD139	1.00	each
BD266A	2.73	each
BD266B	3.26	each
BD267A	2.73	each
BD267B	3.26	each
BF115	.64	each
BF180	.90	each
BF199	.50	each
BFR84	1.44	each
C103Y	2.20	each
C106B1	2.16	each
C106D1	1.64	each
C106Y1	1.20	each
C122D	2.30	each
EM404	.30	each
ME2955	3.50	each
ME3055	3.20	each
MPF102	1.25	each
MPF105	.98	each
MPF106	.98	each
SC141D	2.00	each
SC146D	3.00	each
TT800	1.00	each
TT801	1.00	each
BD140	1.00	each

Prices subject to change without notice.

## MAGNAVOX 8-30

Speaker Special \$13.95

## 2N3055 TRANSISTOR

1 to 9	1.10	each
10 to 99	.95	each
100 plus	.80	each
NE555	.70	each
FUL 741 DIL	.72	each
LM3909	1.20	each

## 3 WATT WIRE WOUND POTS

1 to 9	\$1.96	ea
10 plus	\$1.50	ea
In values	100Ω, 1k, 2k, 3k, 10k	

## HITACHI CASSETTES

PRICED LOWER THAN EVER

Qty.		1 to	12 to	24
		11	23	plus
C60	Low Noise	1.50	1.35	1.25
C90	Low Noise	1.85	1.75	1.65
C120	Low Noise	2.45	2.30	2.20
C46	Ultra Dynamic	1.85	1.75	1.65
C60	Ultra Dynamic	2.05	1.95	1.85
C90	Ultra Dynamic	2.40	2.30	2.20
C120	Ultra Dynamic	3.20	3.10	2.90
C60	Ultra Dynamic	2.40	2.30	2.20
	Royal			
C90	Ultra Dynamic	3.00	2.85	2.70
	Royal			

## PLESSEY SPEAKERS

	\$	c
C6M	7.40	each
C60	12.20	each
C6MR	8.80	each
C8M	8.38	each
C80	13.67	each
C100	14.86	each
C12P	21.75	each
12U50	39.00	each
C60X	13.77	each
C80X	14.95	each
C100X	16.15	each
C12PX	23.30	each
12UX50	43.00	each

## VALVES

	1 to 9	MIXED
	EACH	10 EA.
1B3	1.63	1.48
1S2	1.03	.93
6AL3	1.04	.94
6AN7	2.27	2.06
6AQ5	1.25	1.13
6AU4	1.53	1.39
6AU6	1.08	.98
6AX4	1.53	1.39
6BA6	1.43	1.30
6BE6	1.67	1.52
6BL8	.94	.85
6BM8	1.11	1.01
6BQ5	1.45	1.32
6BQ7	1.94	1.77
6BX6	1.35	1.23
6CA7	3.32	3.02
6CM5	1.59	1.45
6DQ6A	2.56	2.33
6DX8	1.45	1.32
6EA8	1.46	1.33
6EB8	1.79	1.63
6EJ7	1.24	1.13
6EH7	1.24	1.13
6ES8	1.68	1.53
6GV8	1.58	1.44
6GV8	1.56	1.42
6M5	1.91	1.74
6N3	2.45	2.33
6N8	2.10	1.91
6U8	1.45	1.32
6U9	1.94	1.77
6V4	1.17	1.07
6V9	3.13	2.85
6X4	1.12	.93
6X9	1.94	1.77
6Y9	2.14	1.95
12AU7	.81	.74
12AX7	1.81	1.65

## HURST /AIRHEAT ELECTRONIC IGNITION



### PROVIDES:

- Simple fitting to the coil/distributor
- Easier and quicker starts
- Increased point and plug life
- Increased time between tune-ups
- Improved ignition efficiency
- Better gas mileage (due to maintaining "tuned" condition longer and increasing point and plug life)
- Increased power to plugs
- Waterproof design (completely sealed unit)
- Failsafe design

**SPECIAL OFFER ONLY \$29.95**

## PHILIPS SPEAKER KITS

WITH LATEST 2" SQUAWKER SPEAKER KITS

2 x AD 12.100 W8  
2 x AD020 SQ8  
2 x AD 160 T8  
2 x 3 WAY CROSS OVER  
ADF 500/4500/8

**\$210**

### PHILIPS 7A

2 x AD 12-100W8  
2 x AD 5060SQ8  
2 x AD 160 T8  
2 x ADF 500/4500/8

**\$165**

### PHILIPS 4A

2 x AD 8066W8  
2 x AD 5060 SQ8  
2 x AD 160 T8  
2 x ADF 500/4500/8

**\$120**

### PHILIPS AD 8 K40

2 x AD 8066 W8  
2 x AD 160 T8  
2 x CROSS OVER NETWORKS  
TIMBER CABINETS  
WORK INCLUDED

**\$109**

## CORAL I2SAI \$77

2 x 12" DRIVERS  
2 x 5" MIDRANGE  
4 x 2 1/2" TWEETERS  
2 x CROSS OVER NETWORKS

CORAL 10SA1 \$55.00

CORAL 8SA1 \$33.00

## E.A. AND ETI KITS

P/M 146 FM AND AM TUNER WITH FRONT PANEL LESS CABINET \$135

ETI 440 INCLUDING METAL WORK \$99

PLEASE RUSH ME

ENCLOSED IS MY CHEQUE FOR \$..... (+P&P \$3.00) SPEAKER KITS ONLY OTHERS PREPAID

NAME .....

ADDRESS .....

P/Code .....



# CALCULATOR TO WIN!

A calculator to be won each month in our regular monthly contest.

EACH MONTH, for the next 12 months or so, Electronics Today International will be publishing a contest, the prize for which will be one or more Unitrex calculators. This month's contest involves that most useful device — the financial calculator.

Unitrex's financial model (901F) has dual functions. Firstly it may be used as a straightforward four-function plus percentage device. Secondly it has a large number of pre-programmed functions which provide virtually instantaneous solutions to complex financial calculations.

Facilities include —

- \* Three addressable memories
- \* Sell, cost and margin calculations
- \* Figure amount of loan payments
- \* Present value of annuity
- \* Loan amortization table
- \* Future value of compounded sum
- \* Bond value calculations
- \* Depreciation calculations
- \* Summation and averaging calculations
- \* Trend line computations
- \* Standard deviation and standard error of the mean.

All in all it's a great little unit of enormous value to anyone even remotely involved with finance.



## CONTEST

The contest consists of an apparently straightforward calculation that most of us at some time or other need to make — and one that financial people have to perform all the time.

Here it is:—

*I have borrowed \$9387 at 11.25% interest over four years. What are the monthly payments and what is the interest payable each year? (Assume monthly rests and equal monthly payments).*

It is probable that we will receive many correct answers to this part of the contest — so we've included a tie-breaker. Here it is — in two parts.

A. Estimate how long it took our technical editor to obtain the correct answer using a basic four-function calculator (having previously worked out the correct routine).

B. Estimate how long it took our technical editor to obtain the correct answer on a Unitrex 901F.

Closing date for the contest will be February 20th, 1976. Entries postmarked February 20th will be accepted. Correct answer and the name of the winner will be announced in the first possible issue.

Another contest in this series will be published next month.

To Calculator Contest,  
Electronics Today International,  
15 Boundary St., Rushcutters Bay, NSW 2011.

The monthly payments are \$ .....

The interest payable each year is \$ .....

Time A/ ..... seconds

Time B/ ..... seconds

Name .....

Address .....

.....

..... Post Code .....

# TAX DO YOU REALLY KNOW THE BEST CALCULATOR FOR YOUR JOB?

## FREE CALCULATORS

WE HAVE THE ONLY GRADUATE CALCULATOR EXPERT IN CAPTIVITY

There is an enormous range of calculators now available on the Australian market and many people are confused. To overcome this problem and to help you, DICK SMITH has opened the FIRST SPECIALIZED CALCULATOR DEPARTMENT in Australia.

If you are considering buying a calculator for yourself, for your work, or as a gift for a member of your family or for a friend drop in and see STEVE BUNDRED B.Sc. for expert personal advice before you make your purchase.

This month we present a range of sophisticated scientific and statistical calculators from three leading manufacturers.

To ensure that you get the correct calculator for your particular requirement I have employed a BACHELOR OF SCIENCE - Steve Bundred - to help you make the right choice.



### How To Claim Tax Exemption

Simply get the whole of this declaration typed out & completed and forward with your order. Or if applicable quote your tax number. We will despatch INSURED by post for \$2.50. Fill in the relevant words or signature where brackets are used below.

I hereby certify that the (Make, Model) calculator purchased by me from Dick Smith Wholesale Pty. Ltd. on (date) is for use in (school, university or organisation etc.) in or directly and essentially in connection with the production of facts by means of observing, measuring, testing or otherwise experimenting with material phenomena or the purpose of proving or illustrating natural principles and laws or in the study of pure and mixed mathematics. Exemption is accordingly claimed under Item 63, 1 in the 1st section of the Sales Tax exemption and classification act. Signature of officer of school, university, or organisation: (sign and name in capitals). Designation: (job title) Name of school, university or organisation (name) Signature of student: (your signature) Name and address of student (yours in capitals) Date: (date).

We also stock the following SANYO calculators:

		Tax Free	Inc. Tax
CX 8145	Technical	\$46.05	\$49.95
CZ 8125	Scientific Notation	\$54.75	\$59.95
CZ 8109F	Financial	\$61.75	\$68.95

We can also supply details of the full range of the fabulous Sanyo DESK TDP calculators.

### SANYO CZ0111

Portable calculating machine for engineers, mathematicians, researchers, surveyors, scientists and students. Algebraic logic with double parenthesis Fully scientific '8 digit mantissa plus 2 digit exponent. Weights less than 10 oz. Power from 4 penlight cells or optional A.C. adaptor. Tax free - \$88.10 Inc. tax - \$96.95



\$88.10

A.C. Adaptor to suit: \$9.95 Inc. Tax \$9.00 Tax Free

### SANYO SCIENTIFIC 85

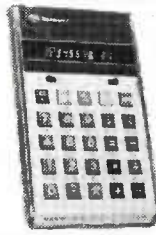
Versatile scientific calculator Functions include: Scientific notation Polar to rectangular co-ordinate conversions. 0 M S to decimal degrees. Double parenthesis - algebraic logic Triple powered - included in price. I.A.C. adaptor or 2 Dry cells. or 3 NiCd cells that can be recharged with A.C. adaptor Tax free \$101.55 Inc. Tax \$111.75



\$101.55

### ROCKWELL 63R

Scientific slide-rule for advanced calculations requiring scientific notation. Algebraic logic with double parenthesis \* x, y,  $\frac{x}{y}$ ,  $\frac{y}{x}$ , logs, trig, etc. Deluxe double injected, 3 colour keyboard. NiCds, recharger and padded vinyl case included. \$100.00 Tax Free \$110.00 Inc. Tax.



\$100.

### ROCKWELL 61R

An advanced slide-rule for engineers and higher maths students. Functions include: Trig, log powers. Large fluorescent tube display Direct accumulation of  $x^2$  into memory Complete with NiCds and recharger. \$80.45 Tax free. \$88.50 Inc. tax.



\$80.45

### ELCON SC 6010

\*10 Memories\* Advanced scientific/statistical calculator. Full Transcendental scientific and statistical functions. Algebra logic with double parenthesis. Includes NiCds recharger and carrying case. Tax Free \$132.65 Inc. Tax \$145.95



\$132.65

We are proud to be able to stock the full range of ELCON pocket calculators.

		Tax Free	Inc. Tax
KP 450	Super Memory	29.00	31.95
KP 460	Slide Rule	31.80	34.95
SC 33	Scientific	50.85	55.95
SC 44	Advanced Scientific	76.30	83.95
SC 60	Scientific/Statistical	99.95	109.95

ROCKWELL CALCULATORS Come to us for advice on the complete range of Rockwell desktop, print out calculators. Rockwells range of desktop, programmables allow programming either manually or with pre-programmed magnetic cards. Capabilities range from 192 programme steps with 10 memories to 448 steps and 41 memories. Price range from about \$1400.

## KITS FOR THE ENTHUSIAST!

**NEW CDI KIT** (see E.A. July 75) Build in an evening. The only kit with a PRE-PUNCHED HEAVY DUTY ALUMINIUM BOX (saves a lot of hard work!!!) We also give you a prewound secondary to simplify Transformer winding... Transistor sockets for easy servicing. \$22.50 ~~\$26.50~~ ~~\$28.50~~ KIT including Heavy Duty Ducon Capacitor

**200MHz Counter Kit** Special purchase of components enables us to REDUCE the price of this kit. Presented in two stages. Basic 200MHz Counter has 4 1/2 decade LED readout with leading zero suppression. Crystal timebase for self calibration or ext. cal. (M 50pf input impedance and 50mV to 10V rms sensitivity. There can't be a better, cheaper instrument anywhere. Now reduced to \$98.00 \$120.00

## PLAY YOUR OWN TV GAMES TONIGHT

**VIDEO GAME OLYMPIC** Play Tennis - Wallgame - Find the Gap - Rabbit - Trapper Moving Target..... ONLY \$99.50  
**VIDEO GAME Mk1** Play Squash - Tennis - Football with dribbling and tackling. Great fun for the whole family.....GOOD BUY AT \$139.50  
**Mk111 KIT**: Build your own for the low amount of \$89.50  
 \*SIMPLY PLUG INTO TV ANTENNA SOCKET. No modifications needed. Ideal for parties. Compact unit. Please include \$5.00 for Packing and Postage.  
**CALL IN FOR A DEMONSTRATION GAME!**

**SALE SPECIAL** see E.A. nov. 75  
**PROFORDS FANTASTIC ALARM CLOCK KIT** AN INCREDIBLE CLOCK, THE DC8 HAS EVERYTHING  
 \* HUGE 10mm FLURO READOUT  
 \* BRIGHT DISPLAY HOURS, MINUTES, AM, PM  
 \* ELECTRONIC ALARM TO THE MINUTE  
 \* 7 MINUT SNOOZE CYCLE \* 240 Volt OPERATION  
 \* MODERN CASE AND FILTER PANEL \$3.00 EXTRA IF REQUIRED.  
 only \$27.50 \$7.00 on regular price of \$34.50

**LIGHT UP YOUR HI FI WITH THIS MUSICOLOUR MKII COLOUR ORGAN** Add an optic dimension to your Hi-Fi. Enjoy the added effect of coloured lights varying in intensity and contrast in co-ordination with the frequency and beat of your music. The unit which runs off 240V divides the music into three broad frequency bands and there modulates three separate light channels of up to 1000w each. By changing the settings on each channel you can compose many different light concertos using the same piece of music. Can be used with any sound source capable of running phones. Works on voice too. Light up with your favourite radio announcer or commercial!  
 Kit 81 (ET 704) CROSSHATCH/DOT GENERATOR (see ET Aug 75) SPECIAL SCREENED FRONT PANEL \$21.50  
 Kit 83 ETI 438 'LED VU METER' only \$16.50 complete with wire solder and instructions. Beware of incomplete imitations as supplied suitable for use with following kits: PM 143 12.5WRMS/Channel ETI 422 50WRMS/channel and ETI 413 130WRMS Guitar AMP. Easily changed for other amplifiers or converted to a 'Power Meter'.

**200MHz Prescaler** extends the capability of the basic 200MHz by a factor of ten. Well worth buying the complete kit for just \$120.00  
 NOTE: All our kits use top quality components where possible to the specs given in articles. Occasionally we are forced to substitute alternative components because of availability problems, but these are checked out with magazines corroborated.  
**KIT 70 ET 702 Radar Intruder Alarm** Uses microwaves to detect movement within 10M range by the Doppler principle. Now you can build a unit that operates on the same principle as the professional's use. Even works through timber and plastic wall panels and screens!! Operates from mains or batteries (extra). Complete kit \$54.00 CL 8560 Radar module \$32.00 ET 702 PCB \$1.75 Kit for mains PSU (PS2VA) \$4.95  
**DON'T FORGET OUR AMP KITS** Playmaster-143 \$69.90 ETI 422 \$118.00 (no rear panels now)

**NEW 84 PAGE CATALOGUE IN THE APRIL ELECTRONICS AUSTRALIA** Yes a completely new and larger edition of the world famous catalogue will be presented FREE in April E.A. so book your copy NOW. The enlarged catalogue will feature many new products - Hi Fi - Kits - Tools - Books - Instruments - Amateur Gear - Components - Semiconductors etc. etc. They're all in the new catalogue. The issue must be a sell out and there won't be very many over runs.  
**SO ORDER YOUR COPY NOW.**

**DICK SMITH ELECTRONICS CENTRE** 162 Pacific Highway Gore Hill N.S.W 2065 tel:439 5311 telex: AA 20036 cables:DKSMIT Sydney  
 Head Office & Mail Orders  
 Shop hours: Mon-Fri 9-5.30 Sat 9-12  
 Also at **CITY I25 York St** tel:291126 (Nr Town Hall) and **BANKSTOWN** 361 Hume Hwy tel:709 6600 (Nr Chapel Rd)  
 NEW POSTAL CHARGES  

Order Value	Charge
\$5	\$9.99
\$10	\$24.99
\$25	\$49.99
\$50	\$99.99
\$100 or more	\$5.00

 By Courier Freight: Minimum packing and handling charge \$1.00 - we despatch 'freight on' and you pay when you receive the goods.  
 NEW MINIMUM CHARGE IS NOW \$1.00

# THE COMPLETE HI-FI SYSTEM FOR \$396

## DICK SMITH AMP Model 6000

**30+30 WATTS RMS**  
**100 WATTS MUSIC POWER**

Frequency Response: 20-30000 Hz ± 1dB  
(at normal listening level)  
Load Impedance: 8 ohm

DICK SMITH MODEL 6000 STEREO AMPLIFIER  
As reviewed this Issue E A  
Phono.....Better than 70 dB  
Hum and Noise (1HF)  
Aux.....Better than 75 dB



Harmonic Distortion: Less than 0.6% at rated output.

A professional high fidelity amplifier that is value packed. Similar powered units sell for around \$189.00. Inputs for microphone, turntable, tuner etc. Smart brushed satin finish, weighs in at 12 lbs and measures 36 x 9.5 x 25.5 cms. 240 volts AC

**Dicks Price \$129**

Buy the Components individually or buy the lot for \$396 and get a set of superb **ELEGA headphones**

**\*FREE\***  
**A SYSTEM AS GOOD AS THIS ONE WOULD NORMALLY COST AT LEAST \$600 SO DON'T MISS OUT GRAB ONE WHILE THEY LAST.**

Offer only lasts until March 31st

**ELEGA DR196C**  
COMPLETELY NEW DESIGN SUPER HIGH VELOCITY TYPE HEADPHONES  
SPECIFICATIONS:  
\*sensitivity 100dB SPL/mW  
\*frequency Range 18-22,000Hz  
\*matching Impedance 4-150  
\*maximum input 0.1W  
\*weight 130gr without cord.  
\*Newly Designed  
\*Compact & Light Weight  
\*Velocity Type  
\*Super Compact  
\*Drive Unit  
\*Young look Jeans type Headband

**Dicks Price \$29.50.**

## EXPO MX56 T/TABLE

SPECIFICATIONS:

TYPE: 2 speed, belt drive, auto return  
MECHANISM: Auto return Auto out  
TURNTABLE: 300mm diecast aluminium alloy  
MOTOR: One 4 pole synchronous motor  
SPEEDS: 33 1/3rpm & 45 rpm  
S/N RATIO: 45db  
WOW & FLUTTER: 0.1% (WRMS)  
DIMENSIONS: 442mm(W)x377mm(D)x185mm(H)  
WEIGHT: 9kgs (gross)



**Dicks Price \$129**

THIS UNIT IS PRESENTED TO YOU COMPLETE WITH MODERN BASE & MAGNETIC CARTRIDGE WITH DIAMOND STYLUS. SMOKED ACRYLIC COVER INCLUDED AT NO EXTRA COST.

## THE J.V.C. 3WAY SPEAKER KIT

SIMILAR 3 WAY SYSTEMS (WITHOUT JVC DRIVERS!) WILL COST YOU AT LEAST \$200 PAIR



COMPLETE EASY TO ASSEMBLE

SPECIFICATIONS:  
Power Handling.....25 Watts RMS  
Frequency Response.....40-20,000Hz  
Impedance.....8ohms  
Crossover Frequency: 3kHz-10kHz  
Dimensions: 435mm(H)x253mm(W)x205mm(D)  
Net Weight.....5.4kg

**Dicks Price \$69ea**

## Try these optional units with the above system or with your own present HI-FI equipment

### AM/FM STEREO~MONO TUNER



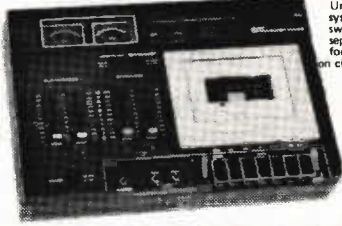
was \$75  
now \$65

The ECHOSOUND TUNER is incredible value for money with separate AM and FM front ends, 10 transistors and 14 diodes. Covers FM 88 to 108MHz AFC, 60db S/N, 35 db separation, 600mV output AM 535 to 1605kHz ferrit rod antenna. Features multiplex adaptor complete with built in stereo indicator. 240V AC operation. Complete in walnut case.

R&R FREE

Guaranteed for 12 months.

### STEREO CASSETTE DECK EXPO SX~101



Unit has twin Vu meters Piano key control system with auto shutoff and review cue. Chrome switch and noise filter built in playback level and separate record level. Plus many features only found on more expensive units. Frequency response on chrome 40-15kHz and measures 370 x 255 x 90 mm

looks \$200 worth  
**Dicks Price \$159.00**

### RECEIVE YOUR FAVOURITE FM BROADCAST on a SONICS MR7000 STEREO RECEIVER

Ideal complement to your system this receiver has AM/FM Stereo/Mono plus a healthy 17 watts RMS per channel. Has all features of a top unit including tape in and out mic input, push button controls and a truly great design. For AC use it has a total of 37 semi conductors and two ceramic filters.

SAVE \$64 ON MANUFACTURERS PRICE  
our \$ price **179**



SPECIAL SPECIAL

Decca Brush - clean your records the professional way. No liquids needed everything is done by the 1 million yes 1 million conductive bristles, a truly remarkable way to rid your records of dust.  
Dicks price only \$11.00. Save 95c. on R/R. \$11



### EXPO 1212 STEREO AMP

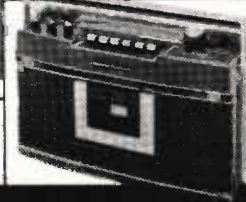
EXPO DX 1212 12 + 12 WRMS STEREO AMPLIFIER



Full control amplifier - smart design with switches for loudness - tape monitoring - stereo/mono and high filter. Will take your Goldring ES705 through its magnetic phono input. Frequency response from 20Hz to 25kHz - S/N ratio better than 60dB on phono. Also accepts stereo Headphones 8-16 ohms.

SAVE \$20 at DICKS price of **\$99**

GOLDRING ES705 SPECIAL PRICE \$4.75



### NEW "Go any where" Portable Radio Cassette from NATIONAL

NATIONAL RS-4605 Stereo Portable Cassette with AM radio and FM Stereo radio. AC/DC or car boat use via adaptor - built in microphone (2 per stereo) - 2 x 1 watt RM/Speakers - has auto stop function - 2 x 3" dynamic speakers and of course FM stereo radio (a must for audiophiles) and AM radio. Record direct from radio onto tape or connect the RS4605 into your home audio for even more dynamic use.  
Dicks Price \$179 save \$10 on P/P

**\$179**

**DICK SMITH ELECTRONICS CENTRE**  
Head Office & Mail Orders  
162 Pacific Highway Gore Hill N.S.W 2065 tel:439 5311  
telex: AA 20036 cables: DIKSMIT Sydney  
Shop hours: Mon-Fri 9-5.30 Sat 9-12

Also at **CITY I25 York St** tel:291126 (Nr Town Hall)  
and **BANKSTOWN** 361 Hume Hwy tel:709 6600 (Nr Chapel Rd)



NEW POSTAL CHARGING SYSTEM  
Our new system can save you money! The larger you order the cheaper the packing and postage! Minimum charge is now \$1.00. Remember it doesn't just cost us stamps to send out mail orders. If you want your order sent by Air mail, C.O.D. or Collect - it will cost extra.  
POSTAGE and PACKING CHARGES  
Order Value Charge  
\$5 - \$9.99 \$1.00  
\$10 - \$24.99 \$1.50  
\$25 - \$49.99 \$2.50  
\$50 - \$99.99 \$3.50  
\$100 or more \$5.00  
By Collect Freight Minimum packing and handling charge \$1.00 - we despatch freight on and you pay when you receive the goods.  
NOTE: To avoid damage, all bulky or fragile articles will be sent by Collect. Freight on Collect is freight paid by you on delivery.



# SPECIAL SCOOP PURCHASE

# DICK SMITH DOES IT AGAIN SANYO TRANSCEIVERS

### Powerful 5W 6-Channel Hand-Held Transceiver TA 395

**\$75** TAX INCLUDED

6 channel capacity, 27.880 fitted large 2 - 1/4" P.D. speaker, squelch control and RF power meter. Also external speaker, power, mike, antenna and earphone jacks. Power from 10 penlight batteries or rechargeable Ni-Cd batteries. Comes in handsome, easy-to-hold, weatherproof cabinet with 50" whip antenna.

**SPECIFICATIONS**

Receiver	
Receiving system	Crystal-controlled superheterodyne
Sensitivity	0.5µV at 10 dB S/N
Squelch sensitivity	0.3µV
Transmitter	
Modulation	100% (with over modulation limiter)
RF input power	5W
General	
Semiconductors	12 transistors, 2 IC, 18 diodes
Frequency control	Crystal
Channels	6 channels (1 ch. crystal supplied)
Speaker	2-1/4" (dia.) 8 ohms, mylar cone
Weight	1.4 kg
Dimensions	75 x 280 x 87 mm

### All-Weather 1W 2-Channel Handy Type Transceiver TA 303A

**\$49** TAX INCLUDED

Easy to use, easy to own. A handy, all weather model. Ideal for construction sites, camping, other outdoor activities. Power is from 8 tiny penlight batteries or through a plug-in power source socket. Comes in an attractive, lightweight cabinet with controls on top and a telescopic whip antenna. Complete with battery indicator, self-contained mike, squelch control and earphone jack.

**SPECIFICATIONS**

Receiver	
Receiving system	Crystal-controlled superheterodyne
Sensitivity	0.7µV
Squelch sensitivity	0.5µV
Transmitter	
Modulation	100% (with over modulation limiter)
RF input power	1W
General	
Semiconductors	11 transistors, 1 IC, 8 diodes
Frequency control	Crystal
Channels	2 channels (1 channel fitted)
Connectors	Earphone jack
Speaker	2-7/8" 8 ohms, permanent dynamic speaker
Dimensions	50 x 250 x 76 mm
Weight	680g

### All-Weather 1 Channel Transceiver with 300mW Power, Squelch Control TA 222A

**\$37-50** TAX INCLUDED

A simplified model with performance-proven circuitry and a rugged, all weather cabinet. Comes fully equipped with battery condition indicator, squelch control, earphone jack and is powered from 8 penlight batteries. Equipped with sensitive superheterodyne receiver and P1 network for optimum RF output.

**SPECIFICATIONS**

Receiver	
Receiving system	Crystal-controlled superheterodyne
Sensitivity	0.7µV
Squelch sensitivity	0.5µV
Transmitter	
Modulation	100% capability
RF input power	300mW
General	
Semiconductors	10 transistors, 1 IC, 7 diodes
Frequency control	± 800Hz
Channels	1 channel - 27.24 MHz
Speaker	2-7/8", 8 ohms, permanent dynamic speaker
Dimensions	50 x 250 x 76 mm
Weight	640g

### JUST RELEASED

**25c**

**NEW DICK DATA SHEETS**

Just out our 741 DATA SHEET gives the basic information on this popular IC and some experimenter's circuits - Integrator, Notch filter, op-amp checker, resistance checker, cassette and RIAA amps. If you've got some 741's in the junk box send 25c and you can put them to good use!

**T.V. ANTENNA DATA SHEET**

gives all the installation info for the do-it-yourselfer. Gives simple installations, and all the technical terms. You could save a fortune by fitting your own antenna and we can supply the parts. 25c each.

**STILL AVAILABLE 25c**

**POWER SUPPLY SHEET AND DIGITAL SHEET**

Still available and packed with useful circuit information. Only 25c each.

### Latest 'Dick Smith' 5 watt Base Station

• 240V a.c. mains or 12V battery operated.  
• Ideal club set - maximum power allowed.  
• 6 channel capacity - 27.88 MHz fitted.

The versatile B-5060 Transceiver gives the advantage of both mobile and base station in one unit. As a base station you simply plug into 240V mains - no adaptors are necessary. Plus you can have a battery for emergency stand-by!! As a mobile unit you simply connect up your 12V battery. Could any set be more versatile?

**\$140**

**SPECIFICATIONS** 15 transistors, 15 diodes; 6 channel capacity; 50cm antenna; 12 to 16V nominal power supply or 240V a.c.; 500-2000ohm mic impedance; 8ohm speaker; 1µV receiver sensitivity; Selectivity 50db down at 10kHz; Automatic Noise Limiter; 1.5W audio output; 455kHz IF; Power consumption Ra 200mA @ 13.8V; TX 900mA without mod; Transmitter output 5W; Frequency tolerance 0.005%; Signal strength and power meter; Mic has in built matching transformer.

Model B4050 AC/DC unit is supplied complete with handbook, circuit, installation instructions, mic and one set of crystals for 27.88MHz; for Additional Channels \$6.50 each. Specify frequency

### ANTENNA COUPLER

The unit is solidly constructed ceramic double bearing tune and load capacitors and band switch.

**\$147.50**

Antenna Tuning Unit Model HC 500  
Bands: 80,40,20,15,11-10 Meters  
Input Impedance 52 Ω  
Output Impedance 100 to 600Ω

### Books for the "HAM"

A GUIDE TO AMATEUR RADIO ★  
by Pat Hawker G3VA

A guide to Amateur Radio is intended to assist newcomers to learn more about the hobby, and to help him or her to obtain an Amateur licence. The book gives details on building aerials, transmitters, receivers and associated equipment, plus licence details. Every budding ham or novice must have this book and at only \$2.60 plus \$1.00 P & P, why not?

AMATEUR RADIO TECHNIQUES ★  
by Pat Hawker G3VA

A Fantastic book for the home constructor, there are sections on semiconductors, Receivers, Transmitters, Aerials and fault finding. An interesting article on the 'Polyphase' methods of SSB generation is given, this method is cheap and easy to get top results with the minimum of parts. This book is excellent value at only \$6.50 plus \$1.00 P&P.

P&P EQUIPMENT FOR THE RADIO AMATEUR ★  
by H.L. Gibson G8CGA

This book would be the best value we presently stock. It covers everything from basic meters to frequency counters, decade boxes, capacitance meters, oscilloscopes and many many others. At only \$5.90 this book should be in every shack!

TELEVISION INTERFERENCE MANUAL ★  
by B. Priestly G3UGO

After reading this book and carrying out the 'good oil' nobody should have any TVI problems. Get one before the neighbours force you into it! Tremendous value at only \$2.60

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Now Only \$1.75

### Experimenters Crystals

We have a large range of 'odd' frequency crystals that could suit numerous applications. Crystal frequencies are 27,320, 27,330, 27,340, 27,390, 27,400, 26,865, 26,875, 26,885, 26,935 and 26,945. These crystals are \$2.50 each or \$4.00 per pair plus \$1.00 P & P.

### LOOK FOR MY NEW 84 PAGE CATALOGUE IN APRIL E.A.

### No more Mess with Solder Sucker

EL-1 SOLDER SUCKER Full metal construction - better than plastic! With Teflon tip. Simple push/release thumb mechanism. Complete with nozzle sweeper! Only \$7.50 (Spare Teflon Tips \$1.50)

**\$7.50**

### Save \$2 Only \$7.50

### Lightning Protectors Type SH-6

Replaces standard SO.239 on electronic equipment. This arrestor has the following specs.

Impedance - 52ohm  
Spark Gap - 0.6mm to 2mm  
Number of Discharges - unlimited  
Passable Frequencies - up to 400MHz  
Power rating - 1.5KW PEP  
Ground resistance - 100ohm  
SWR - less the 1.5 at 400MHz

**\$5.25**

### KAMODEN 360TR MULTIMETER

Transistor checker/multimeter  
34 ranges, 5" mirror scale, 8.5µA, 10A a.c. & d.c. Hfe to 500 ranges  
Vdc 0.0-5.2-5.10-50-250-1KV  
Vac 0.5-10-50-250-1KV  
I ac 0-10-25 500µA-5.50k-500mA-10A  
I ac 0-10A Ohms 0-5 50k-5.50M.  
Size, 180 x 140 x 80 mm. **\$45.**  
Complete with test leads.

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Also at CITY I25 York St tel: 291126 (Nr Town Hall) and BANKSTOWN 361 Hume Hwy tel: 709 6600 (Nr Chapel Rd)

**NEW POSTAL CHARGING SYSTEM**

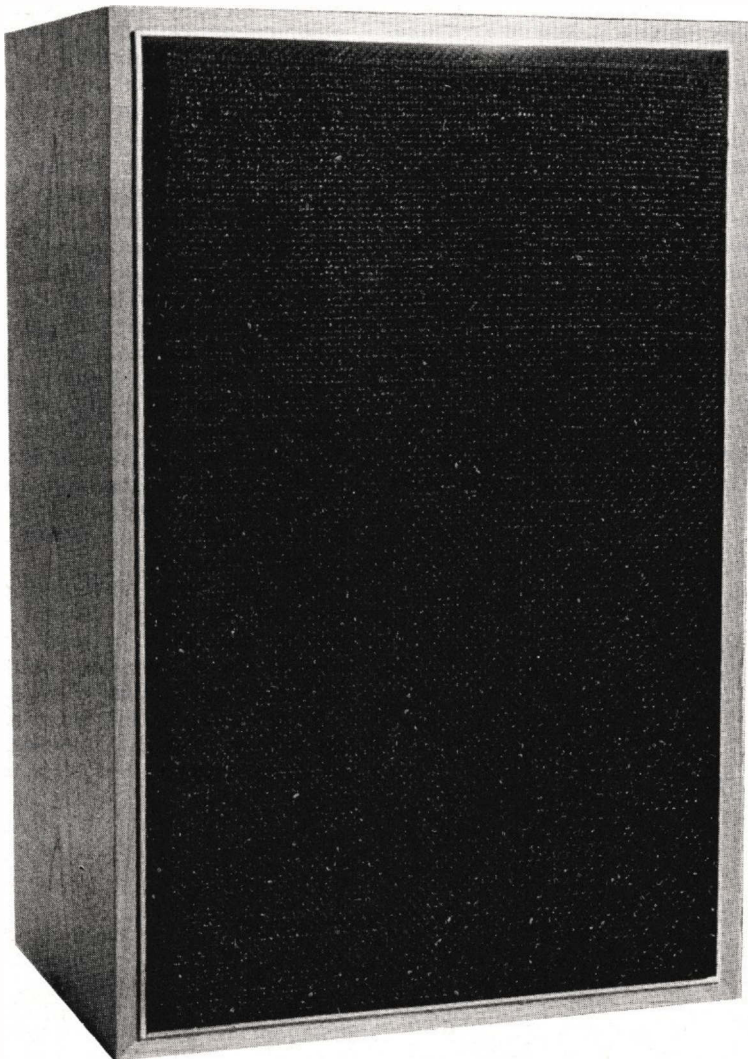
Our new system can save you money! The larger your order, the cheaper the packing and postage! The largest you order, the cheaper the packing and postage! Minimum charge is now \$1.00. Remember it does! It just cost us stamps to send out mail orders. If you want your order sent by Air mail, C.O.D. or Comet, it will cost extra.

POSTAGE and PACKING CHARGES	Order Value	Charge
	\$5 - \$9.99	\$1.00
	\$10 - \$24.99	\$1.50
	\$25 - \$49.99	\$2.00
	\$50 - \$99.99	\$3.50
	\$100 or more	\$5.00

By Comet Freight, Minimum packing and handling charge \$1.00 - we despatch 'freight on' and you pay when you receive the goods. To avoid damage, all bulky or fragile articles will be sent by 'Comet' freight on (i.e. freight paid by you on delivery).

NOTE: To avoid damage, all bulky or fragile articles will be sent by 'Comet' freight on (i.e. freight paid by you on delivery).

# MAGNAVOX MV-50 SYSTEM



A superb new loudspeaker system.

ONE OF THE BEST low-priced project loudspeakers ever designed was the Magnavox 8-30 unit first published in ETI in August 1971 and subsequently revised in August 1972. The 8-30 unit became extraordinarily popular and many thousands were built by our readers. The unit was also produced professionally and still

outsells many other loudspeakers in the same price range.

Now Magnavox appear to have done it again. The company has just released details of a new three-way system based on a completely new range of drivers.

The woofer for the new system is called the 10-40. It is a 254 mm (10")

driver very reminiscent of the 8-30. It has a long throw 38 mm voice coil and is designed for use in vented enclosures.

The mid-range driver is a 165 mm (6") unit rated at 25 watts. This unit is housed in its own 2.3 litre enclosure within the main cabinet. It has one of the heaviest magnets we have seen on a driver of this size.

Two type XJ3 tweeters are used in parallel. These are wide dispersion 25 mm (1") soft dome types. The XJ3 tweeters are excellent units having smooth frequency response and low distortion. These tweeters will handle up to 50 watts music power (with a 5 kHz crossover) and 15 watts continuous power.

The system is housed in a 60 litre vented baffle enclosure.

A lot of effort has been put into the design of the crossover network. Non-polarised electrolytics and ferrite-cored coils have been used and whilst we are generally not in favour of such components for crossover networks we were unable to detect any sign of coil saturation or holes in the response even at ear-shattering levels. A treble attenuator is included but we preferred to leave this at the full treble position. Some people may however welcome it as a means of reducing brightness of the response when the system is used to provide background music only.

Kits and components for the new Magnavox system will be available within a few weeks from most parts suppliers — built-up units should be available even sooner.

Note that in our drawings of the enclosure we have simplified the construction by removing rebates and adding cleats. This enables the home constructor to build the enclosure with a minimum of carpentry expertise. However, intending manufacturers and kit supplier should note that to comply with the Trade Practices Act all systems sold as, or

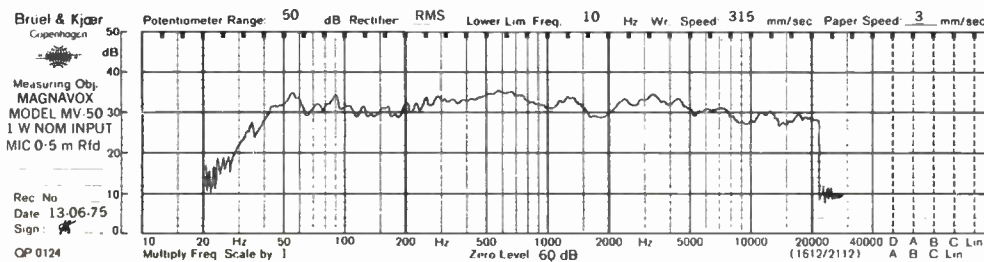


Fig. 1. Frequency response of the MV-50 system (manufacturer's graph).

# MAGNAVOX MV-50 SYSTEM

parts supplied for Magnavox MV-50 systems must fully conform to Magnavox' registered design and specification.

It should be noted that the Magnavox MV-50 system does not supercede the 8-30 system which will still be available. The MV-50 system is a better but also more expensive system, each has its place.

## CONSTRUCTION

As the crossover used is specially designed by Magnavox, and the complete readymade unit is quite inexpensive, we suggest that this unit be purchased complete. The crossover is mounted onto the rear of the terminal panel. Make sure that a good seal is obtained by applying a small

amount of putty or plasticine between the crossover panel and the rear surface of the box.

The main enclosure is constructed from 19 mm veneered particle board. If thicker material is used care must be taken to ensure that the internal dimensions are retained the same. Thinner material must not be used as the resultant flexing will badly colour the response.

The top, bottom and two sides may be cut from a 2.134 m by 305 mm (7 x 1 feet) sheet of veneered board. The front and rear panels are best cut from a sheet of unveneered board. Best appearance will be obtained if the corners are mitred and the side pieces are matched for veneer grain at the corners.

All corners should be a good fit, glued and airtight. All internal corners of the box should also be strengthened

by glueing in 19 mm cleats.

The mid-range enclosure is a 152 mm I.D. by 127 mm long tube closed at the rear by a hardboard disc. These will be available from Magnavox. The midrange enclosure should be lightly filled with Innerbond or similar bonded-acetate fibre and the hole for the cable to the driver should be sealed with putty or similar.

The vent tube is 99 mm I.D. by 230 mm long and has a wall thickness of three millimeters. This too is available from Magnavox if required.

The main enclosure should be lined with 25 mm Innerbond or 50 mm fibreglass on all internal faces with the exception of the front panel and the rear of the vent. The front panel should be painted matt black and the crossover mounted on the rear panel. The speakers may now be connected to the crossover and then mounted onto the front of the panel. Use a little putty or plasticine to seal the drivers to the front panel.

The grill-cloth frame should be constructed from 19 mm square timber and then covered with an acoustically transparent cloth. The specially made speaker cloths are best.

After veneering the front edges of the box to match, the enclosure may be stained and polished as required.

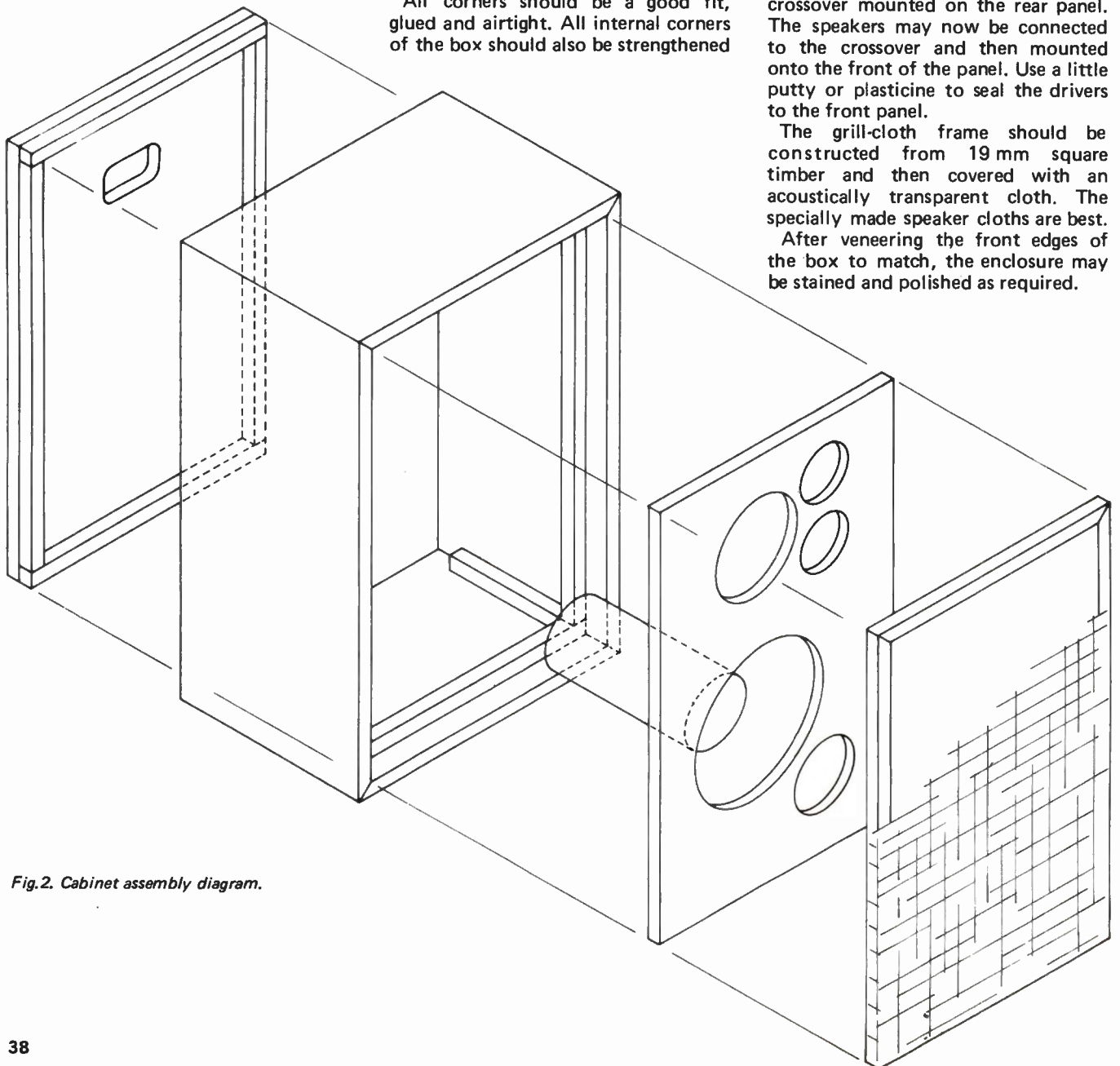
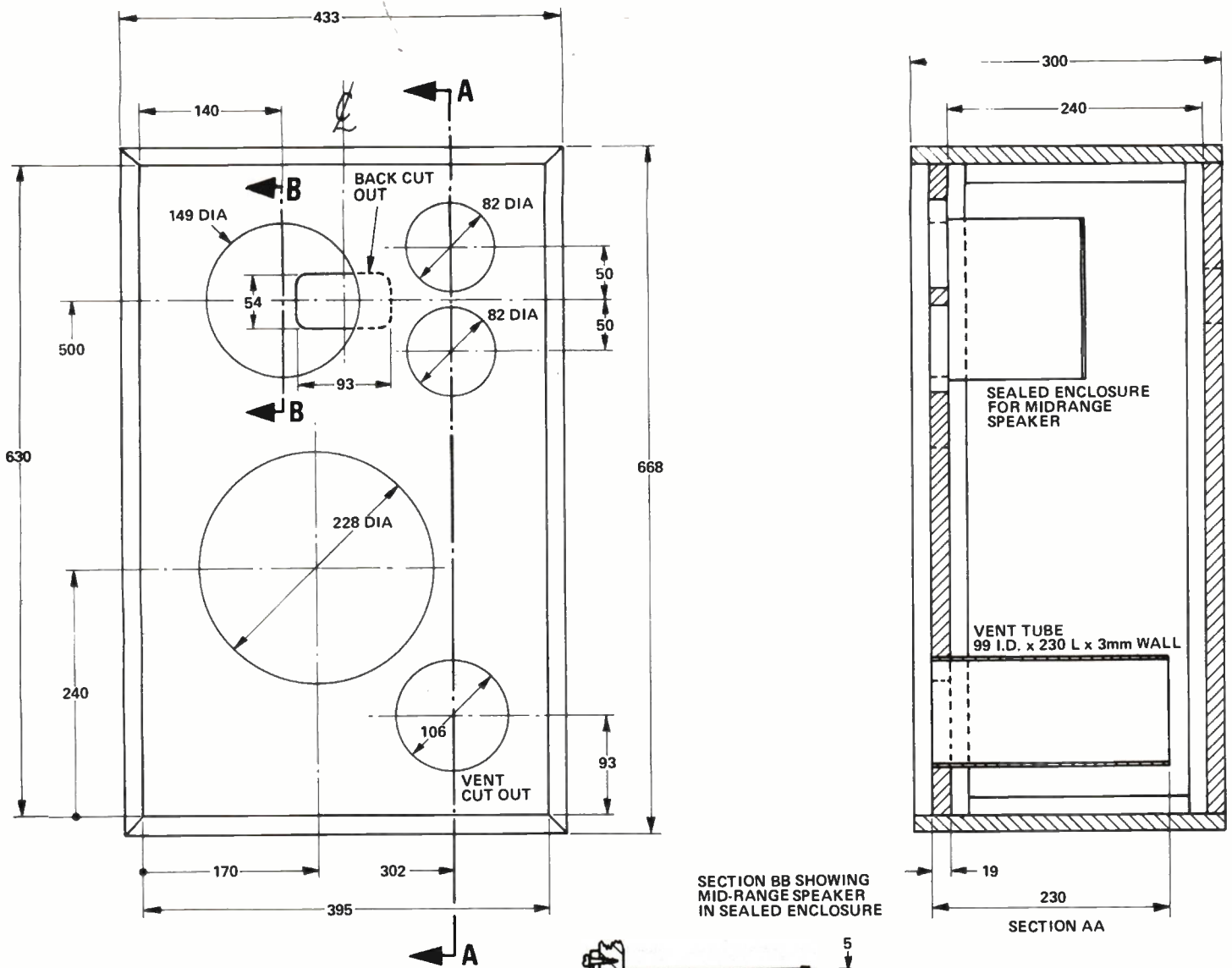


Fig.2. Cabinet assembly diagram.



**NOTES**  
 ALL OUTSIDE WOODWORK IS 19mm PARTICLE BOARD COVERED WHERE VISIBLE WITH THE DESIRED VENEER

19mm x 19mm CLEATS AROUND ALL EDGES

LINE ALL INSIDE SURFACE WITH 50mm FIBREGLASS (EXCEPT FRONT AND OPPOSITE VENT)

FRONT GRILLE NOT SHOWN

ALL DIMENSIONS IN MILLIMETRES

Fig.3. Cabinet dimensions.

The crossover network, together with a treble level control is fitted to the terminal panel. The terminal panel is screwed to the inside of the back cut-out.



# MAGNAVOX MV-50 SYSTEM

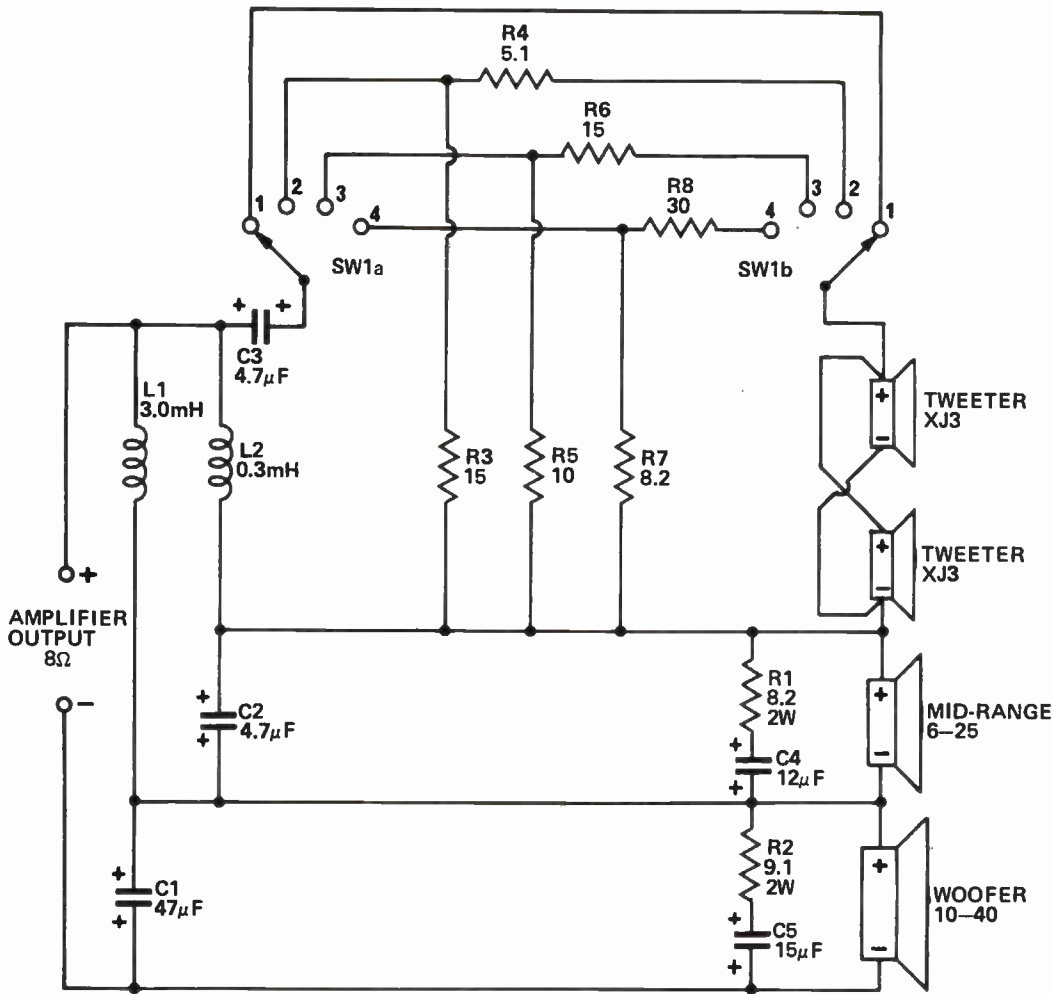
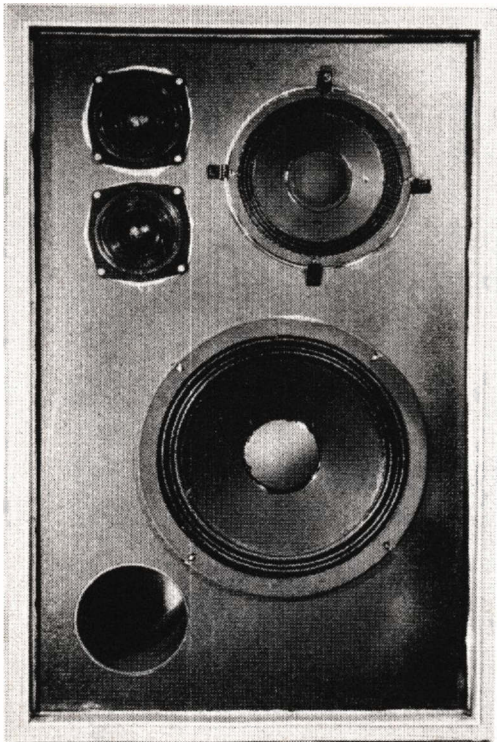


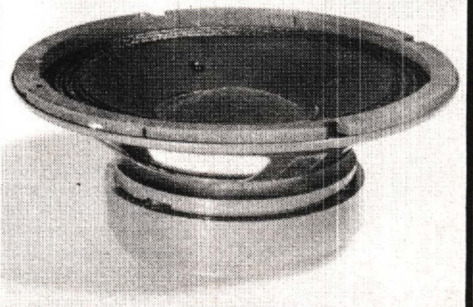
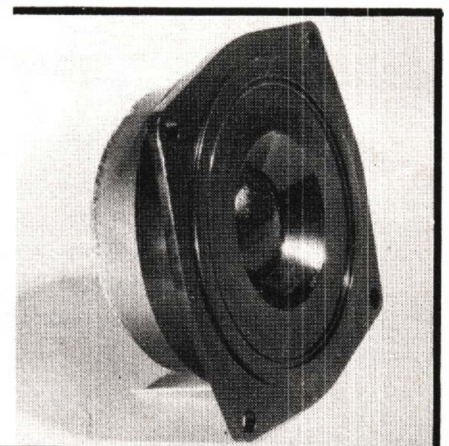
Fig.4. Circuit diagram of the crossover network.



▲ The bass driver has a cast aluminium frame and a resonant frequency of 20 Hz.

▶ The XJ3 tweeter is a 25 mm soft dome type. It has excellent thermally limited power handling of 15 watts. It has a very smooth response and is destined to be very popular.

▶ The six-inch mid range appears to have the same magnet as the 8-30 and has an excellent frequency range of 45 Hz to 6 kHz.





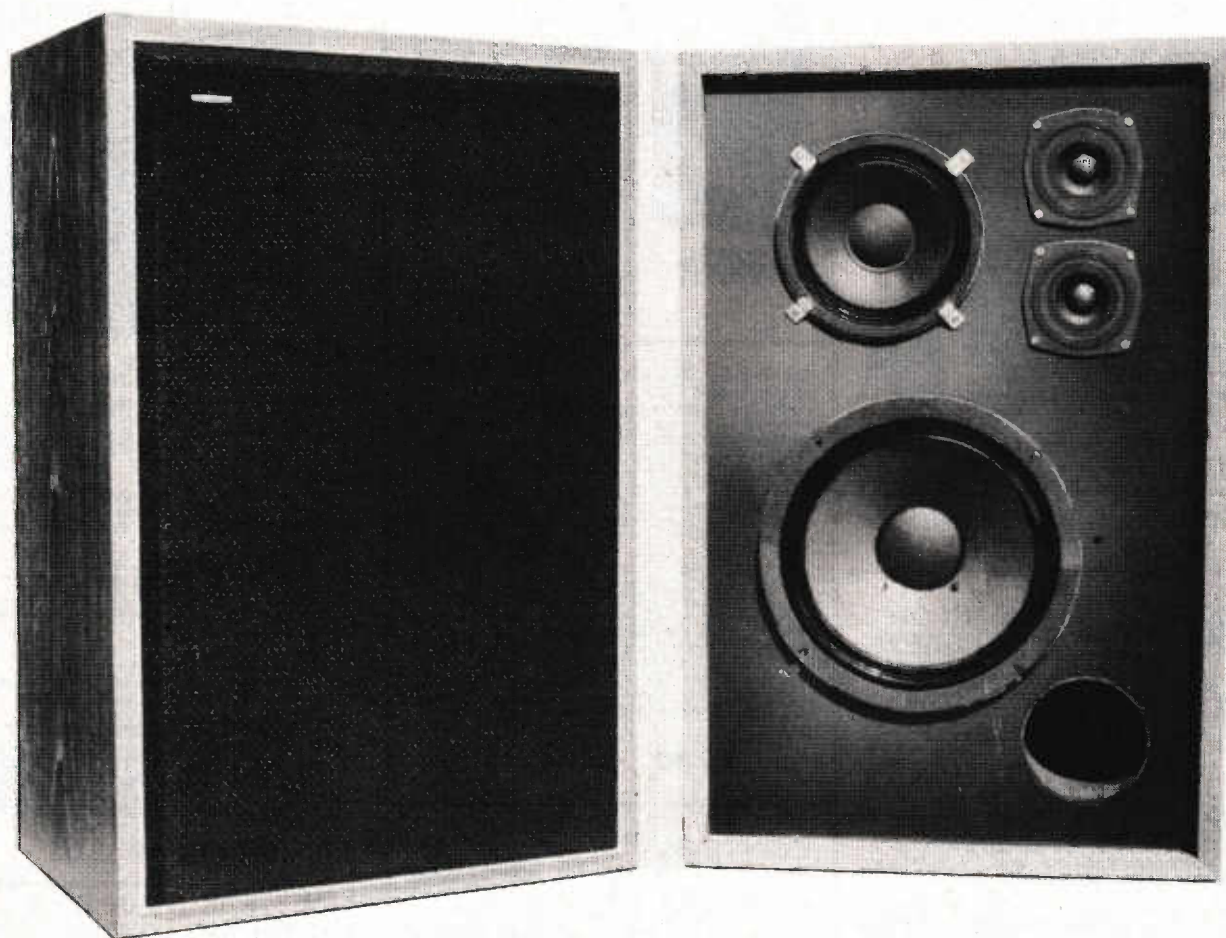
NEW FROM



**MAGNAVOX**

**MV-50 LOUDSPEAKER SYSTEM**

with full 50 WRMS Power Rating containing 10" woofer, 6" mid range, 2 Dome Tweeters.



*FOR FURTHER INFORMATION*

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# HAM RADIO SUPPLIES

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## MODEL NC-310 DE LUXE 1 WATT 3 CHANNEL C.B. TRANSCEIVER

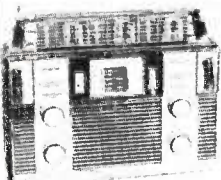
● WITH CALL SYSTEM  
● EXTERNAL AERIAL CONNECTION  
SPECIFICATIONS, NC-310  
Transistors: 13  
Channel Number: 3, 27.24 OMHZ  
Clitz. Band  
Transmitter Frequency Tolerance:  $\pm 0.005\%$   
RF Input Power: 1 Watt  
Tone Call Frequency: 2000 Hz  
Receiver type: Superheterodyne  
Receiver Sensitivity:  $0.7\mu V$  at 10 dB S/N  
Selectivity: 45 dB at  $\pm 10$  kHz  
IF Frequency: 455 kHz  
Audio Output: 500 mW to External Speaker Jack  
Power Supply: 8 UM-3 (penlite battery)  
Current Drain: Transmitter: 120-220mA  
Receiver: 20-130mA.

**\$49.00 each or \$95 a pair.**  
Post & pack \$1.50 per unit.

1 watt 2 channel transceiver with call system. 27.240 MHz. 12 transistor. PMG approved type.

SPECIFICATIONS:  
Transmitter — Crystal Controlled: 1 Watt input power to RF stage. Operating frequency — Any 2 channels in the 11-meter Citizens Band.  
Receiver — Crystal-controlled superheterodyne circuit with 455 Kc IF. Antenna — Built-in 60" telescopic whip antenna.  
Audio Output — 0.8 Watt maximum. Power supply required — 12 volts DC (Eight 1.5 volt DC battery cells).  
Loudspeaker —  $2\frac{1}{4}$ " PM type (built-in) function as microphone on transmit.

**\$45.50 each or \$89 a pair.**  
Post & pack \$1.50 each unit.



## BARLOW-WADLEY XCR-30

a truly portable communications receiver, based on the WADLEY LOOP principle, the same principle as applied in the

DELTAHET and RACAL receivers. A truly crystal-controlled highly sensitive multiple-heterodyne portable receiver of exceptional stability with continuous, uninterrupted coverage from 500 kHz to 31MHz.

BARLOW-WADLEY XCR-30 features include: Selectable USB/LSB, CW & AM reception, frequency read-out 10kHz throughout the entire range, calibration accuracy within 5kHz, antenna resonator, tuning signal-strength meter, zero-set control, clarifier-vernier tuning, MHz & kHz tuning controls, telescopic antenna. Power source: 6 type D dry cells; provision for external DC power supply. Weight 9 lbs; size  $11\frac{1}{2}$  x  $7\frac{1}{2}$  x 4in.

All for **\$275 F.O.R.**

When not in use or for carrying, the top meter/megahertz scale flips down flush with the case and clear of the handle.

## NEW REDUCED PRICE THIS MONTH ONLY



MODEL C1000M MULTIMETER  
Compact, handy and versatile, the C1000M is the ideal low cost pocket meter. Mirror Scale.  
Specifications: 1,000 Ohm/Volt DC; 1,000 Ohm/Volt AC; DC volts — 10; 50; 250; 1,000; AC volts — 10; 50; 250; 1,000; DC amps — 1 mA; 100 mA; Ohms — 150 K $\Omega$ ; Centre scale — 3 K $\Omega$ ; Decibel — 10 dB to 22 dB; Dimensions —  $3\frac{1}{2}$ " x  $2\frac{3}{8}$ " x  $1\frac{1}{8}$ " 90 x 60 x 30 mm.

**\$6.95**  
Post Free.



MODEL C-7077/P MULTIMETER  
Specifications: 100,000 ohms/volt DC; 10,000 ohms/volt AC; DC volts — 5; 25; 50; 250; 500; 1,000; AC volts — 10; 50; 250; 500; 1,000; DC amps — 10 $\mu$ A; 2.5 mA; 25 mA; 500 mA; Ohms — 10 K $\Omega$ ; 1 M $\Omega$ ; 10 M $\Omega$ ; 100 M $\Omega$ ; Centre scale — 150 $\Omega$ ; 1.5 K $\Omega$ ; 150 K $\Omega$ ; 1.5 M $\Omega$ ; Decibel — -20 to +22 dB. Dimensions — 151 x 102 x 48 mm  
Diode protected movement. Carrying case available Model C.

**\$27.95**  
P&P \$1.50.

MODEL OL64 D/P MULTIMETER. Very ruggedly constructed this model is particularly suitable for workshops. It features special scales for measurement of capacitance and inductance. Diode protected movement.  
Specifications: 20,000 Ohm/Volt DC; 8,000 Ohm/Volt AC. DC volts — 0.25; 1; 2.5V; 10; 50; 250; 1,000; 5,000; AC volts — 10; 50; 250; 1,000; DC amps: 50 $\mu$ A; 1 mA; 50 mA; 500 mA; 10 A. Ohms — 4 K $\Omega$ ; 400 K $\Omega$ ; 4 M $\Omega$ ; 40 M $\Omega$ ; Centre scale — 40 $\Omega$ ; 4,000 $\Omega$ ; 40,000 $\Omega$ ; 400,000 $\Omega$ ; Decibel — -20 to +62 dB; Dimensions: 6" x  $4\frac{1}{5}$ " x 2"; 152 x 107 x 51 mm. Capacitance: 250 pF to 0.02  $\mu$ F. Inductance — 0/5000H Carrying case available Model C.

**\$22.50** P&P \$1.50.

MODEL AS100 D/P MULTIMETER. This meter features double zener diode meter protection and  $3\frac{1}{2}$ " full view easy to read 2 colour scale. It is fitted with polarity reversing switch and housed in a strong moulded case with carrying handle. Specifications: 100,000 ohm/volt DC; 10,000 ohm/volt AC. DC volts — 0.3; 12; 60; 120; 300; 600; 1,200; AC volts — 6; 30; 120; 300; 600; 1,200V; DC amps — 2 K $\mu$ A; 200 K $\mu$ A; 20 M $\mu$ A; 200 M $\mu$ A; Centre scale — 20 $\Omega$ ; 2,000 $\Omega$ ; 20,000 $\Omega$ ; 200,000 $\Omega$ ; 20 M $\Omega$ ; Decibel — -20 to +57 dB. Dimensions —  $7\frac{3}{5}$ " x  $5\frac{2}{5}$ " x  $2\frac{3}{5}$ " 193 x 137 x 66 mm. Carrying case available model I.

**\$37.50**  
P&P \$1.50.

## SCOOP PURCHASE



200-H, p.p. 75c. 90 quadrant meter. Pocket size. AC V: 10V, 50V, 100V, 500V, 1000V (10,000 ohm/V). DC/V: 5V, 25V, 50V, 250V, 500V, 2500V (20,000 ohms/V). DCA/A: 50 $\mu$ A, 2.5 mA, 250 mA. OHM: 60k ohm, 6M ohm. Capacitance: 100pF to 0.1  $\mu$ F, .001 $\mu$ F to .1 $\mu$ F. dB: -20 dB to +22 dB. Audio Output: 10V, 50V, 120V, 1000V AC. Approx. size:  $4\frac{1}{2}$ " x  $3\frac{3}{4}$ " x  $1\frac{1}{8}$ "

**\$13.50** With FREE leather carry case. \$1.50 Postage.

## THIS MONTHS SPECIAL SOLID STATE 19 TRANSISTOR MULTI-BAND RADIO — 9 RANGES



AM, SW, FM, VHF, AIR, PB

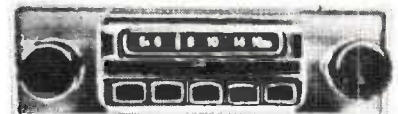
BATTERY/OPERATED  
COLOUR CODED 9 BAND DIAL

1..AM 535 to 1600 kHz, 2. Marine 1-5 to 4 MHz, 3 & 4. combined SW 4 to 12 MHz, 5. 30 to 50 MHz, 6. 88 to 108 MHz, 7, 8 & 9 combined VHF Aircraft 145 MHz-174 MHz incorporating weather band.  
Slider controls, Dial light, Fine tuning control, Flip-up Time Zone map, Telescope antennas complete with batteries

**SPECIAL PRICE \$59** Post Pack \$3.00

## SPECIAL

8 transistor, push-button car radio. 12 volt neg or pos earth switching. With large 7 x 5 inch speaker and lock down aerial.



**\$29.50 P&P \$2.00**

## A M / F M / V H F / T V . MULTIBAND RADIO. NEW MODEL AC/DC.

Latest military design, multi-band radio, 30 transistors and diodes. With exclusive (LED) light emitting diode tuning indicator for positive station selection. Battery and electric covers all popular AM and FM bands.



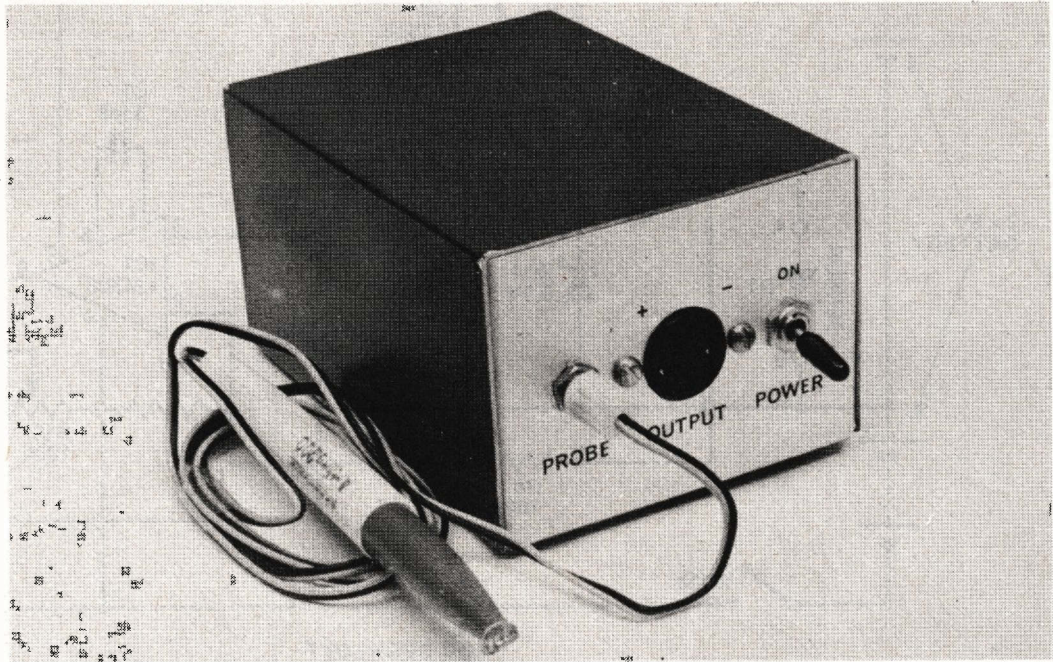
**NEW PRICE \$41.90**  
P&P \$2.50

APPROVED BY ELECTRIC SUPPLY DEPT. BEWARE OF MORE EXPENSIVE IMITATIONS.



PROJECT 130

# TEMPERATURE METER



Converter connects to any analogue or digital meter.

OUR original design concept for this unit was as a complete instrument based on our ETI 533 digital display using a forward biased diode as the sensor — this generating a temperature-proportional voltage which in turn is supplied to a voltage-to-frequency converter. We planned to use a timebase to generate the necessary strobe and reset pulses. However the cost and complexity of this arrangement was such that we decided against it.

What finally emerged was a simple temperature-to-voltage converter which can be used in front of any analogue or digital meter. The converter provides an output of 10 mV/degree which can be either Celcius or Farenheit depending on calibration. If a dedicated digital readout is required we suggest that you incorporate the converter with our ETI 118 digital voltmeter.

### CONSTRUCTION

Whilst a printed-circuit board is by no means essential, using one certainly makes construction easier and improves the appearance. The potentiometers as shown in our prototype are single turn presets which

are quite adequate if an analogue meter is to be used for the readout. However if a digital meter is to be used the extra accuracy of the readout would warrant ten-turn presets being used for RV1 and RV2, as setting accuracy is considerably improved.

The converter quite readily fits into a small aluminium mini-box. Two nine volt batteries are used to power the unit and battery drain is low enough to ensure a life of many months.

A 3.5 mm jack is used to connect the sensor to the unit and the output to the meter is provided via an inexpensive two-pin speaker socket.

The probe is constructed by mounting the sensor-diode into the tip of a ball-point pen casing, or similar. The method may best be understood by reference to the drawing.

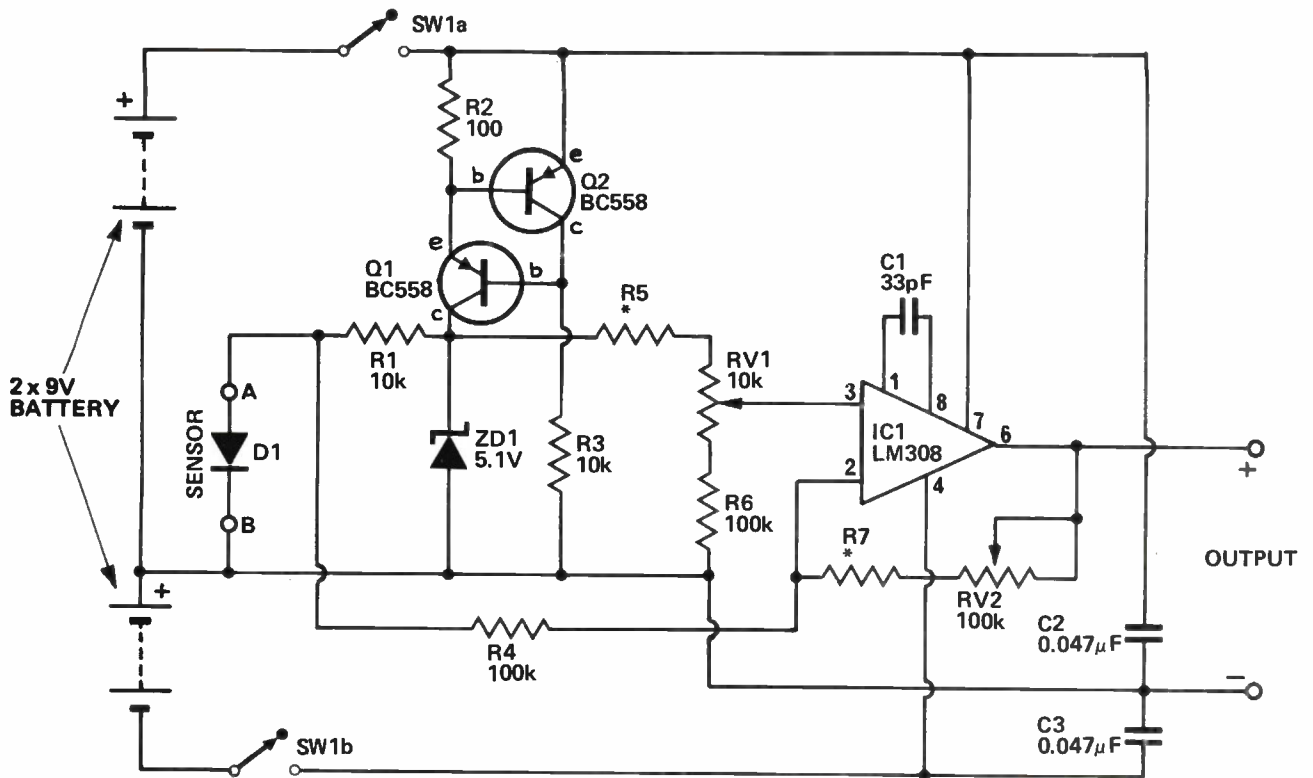
### CALIBRATION

To calibrate the instrument, two accurately known temperatures are required. One may be water or oil at room temperature (ice water should not be used as there the temperature may vary several degrees between different points in the solution). The high temperature is best obtained by heating oil or water and allowing it to stabilise at around 80°C. A second smaller heat conductive container filled with water is then immersed in the larger container. This simple procedure prevents errors due to circulating currents in the larger volume of water. An accurate mercury-in-glass thermometer should be used to measure temperatures during the calibration procedure as detailed below.

### SPECIFICATION

RANGE	0 to 100°C 32 to 212°F
OUTPUT ACCURACY	10 mV/degree ± 1°
RESPONSE TIME	3 seconds

# TEMPERATURE METER



**NOTE**  
 FOR DEGREES F  
 R5 = 750k  
 R7 = 820k  
 FOR DEGREES C  
 R5 = 910k  
 R7 = 470k

Fig. 1. Circuit diagram of the temperature meter.

1. Place the sensor and thermometer into the cool solution, allow a little time for stabilisation, and then measure the voltage from the converter and the temperature. Record these two readings.

2. Place the sensor and thermometer into the hot solution and measure the voltage and temperature as before. The voltage change between the first and second readings should be equal to the temperature change times 10 millivolts.

3. If the voltage versus temperature is not as specified in step 2 adjust RV2 and repeat steps 1 and 2 until it is. Note that varying RV2 changes the voltage at both the hot and the cold positions. It is the correct slope, or

rate of change that we are after at the moment.

4. When the correct rate of change has been set as above place the sensor and thermometer into the cool solution and adjust RV1 to obtain a reading of 10 mV per degree. That is if the solution is at 25° C adjust RV1 to obtain a reading of 0.25 V.

Due to the spread of diode characteristics from one device to another the necessarily small adjustment range of RV1 and RV2 may not allow all diodes to be calibrated with the resistor values specified. If this is found to be the case it may be necessary to change the value of R5, R6 or R7.

## PARTS LIST

R1,3	Resistor	10k	1/2W 5%
R2	"	100	1/2W 5%
R4,6	"	100k	1/2W 5%
R5,7	"	See Fig. 1 and test.	
RV1	Potentiometer	10k *	trim type
RV2	"	100k *	" "
*for digital readout a multitrans trim potentiometer is recommended.			
C1	Capacitor	33pF	ceramic
C2,3	"	0.047µF	polyester
D1	Diode	1N914	
ZD2	Zener Diode	BZX79C5V1	
Q1,2	Transistor	BC558, BC178	
IC1	Integrated Circuit	LM308	

Metal box  
 Two 9v batteries  
 Two pole toggle switch  
 PC board ET1 130  
 3.5mm plug and socket  
 Two pin plug and socket for output

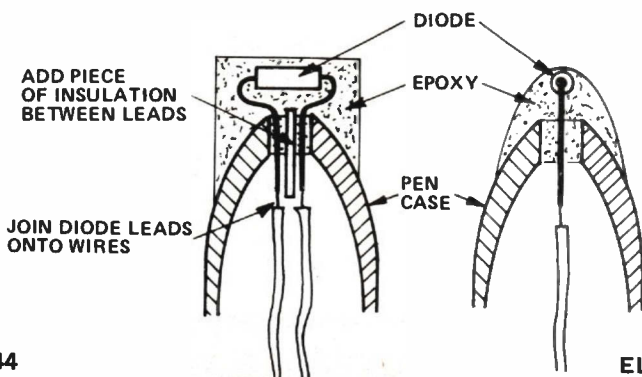


Fig. 2. This diagram shows how the sensor is mounted into a ball-point pen casing or similar.

### HOW IT WORKS – ETI 130.

A forward biased diode has a temperature coefficient of about  $-2$  mV/°C. That is the normal voltage across a silicon diode of nominally 0.6 volts will decrease by two millivolts for every degree C increase in temperature. This change with temperature is sufficiently linear over the range of 0 to 100°C to use it as a temperature sensor.

What the ETI 130 circuit does is to amplify this voltage and to provide offset compensation for the normal 0.6 volt drop across the diode.

Transistors Q1 and Q2 provide a constant-current source of about 5 mA into the zener diode ZD1 such that a very stable five volt reference is obtained which is independent of the battery supply voltage. (V supply greater than 6 V.) The forward bias current through the sensor diode is about 0.5 mA as provided by R1. This current is low enough to prevent errors due to self heating of the sensor diode.

The voltage across the sensor diode is amplified by IC1 (a very high input-impedance operational amplifier) whose gain is fixed at the ratio of  $(R7 + RV2)/R4$ . The necessary offset is provided by RV1 which is adjusted to cancel the normal 0.6 volt drop across the diode. By selecting the correct values for R5 and R7 as shown on the circuit diagram the indication of temperature in degrees C or F may be obtained.

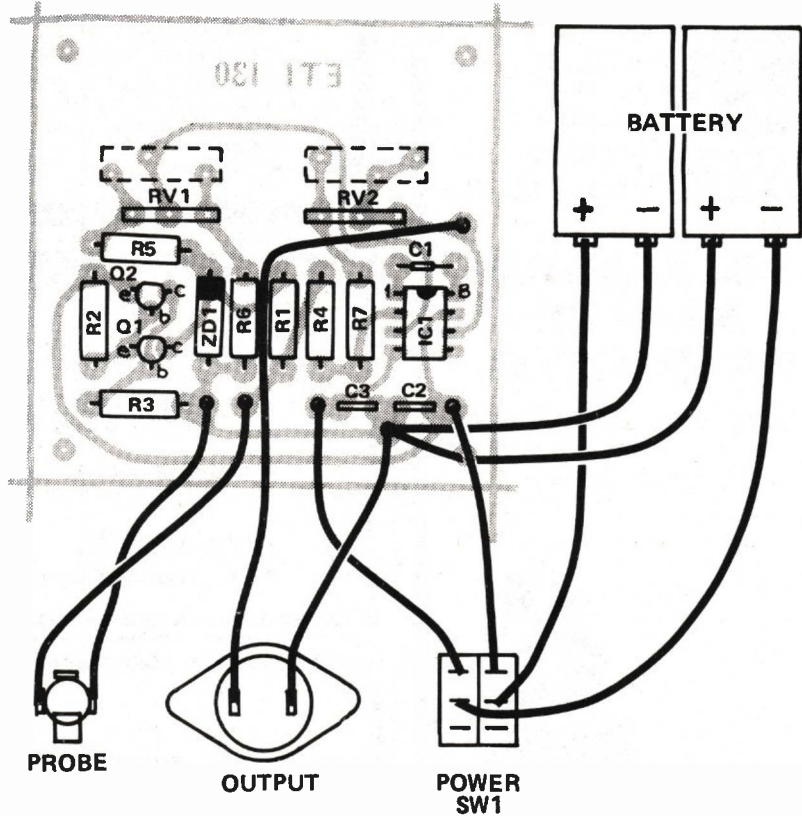


Fig. 3. Component overlay and interconnection diagram.

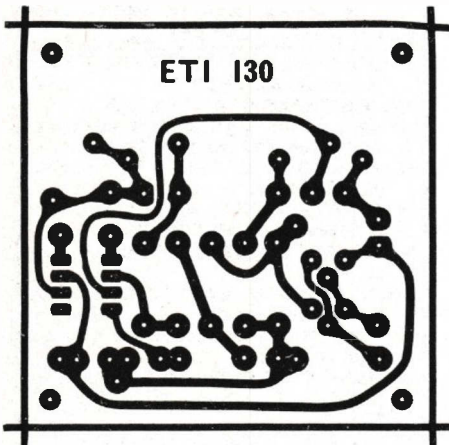
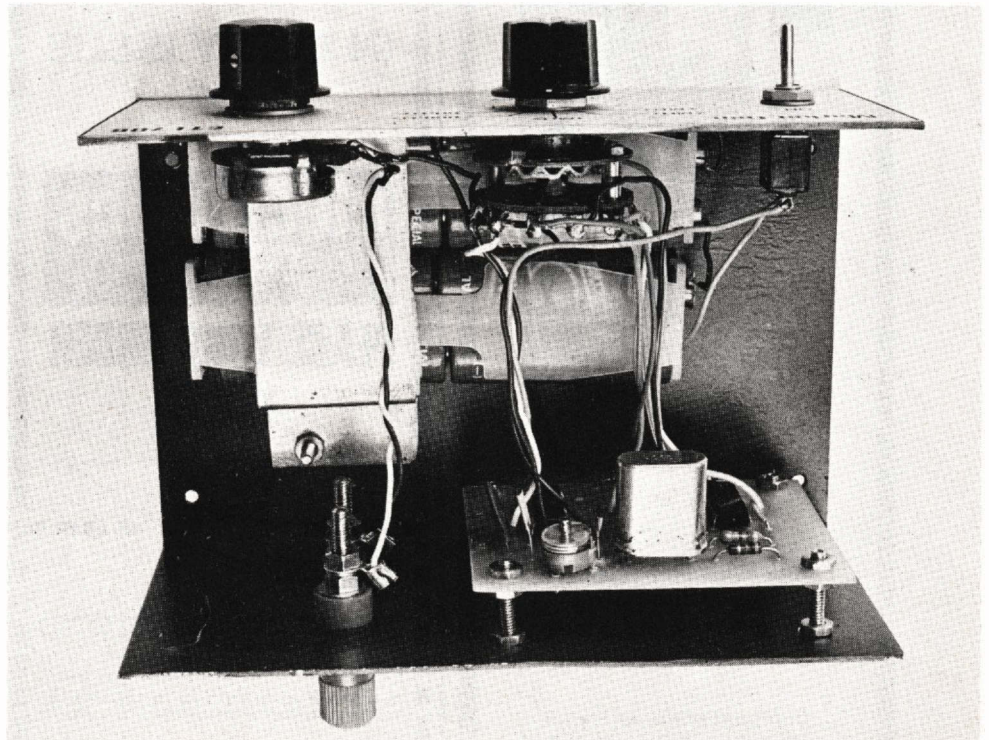


Fig. 4. Printed circuit pattern. Full size 63 x 63 mm.



Internal view of the completed temperature converter. Note also the probe at front.



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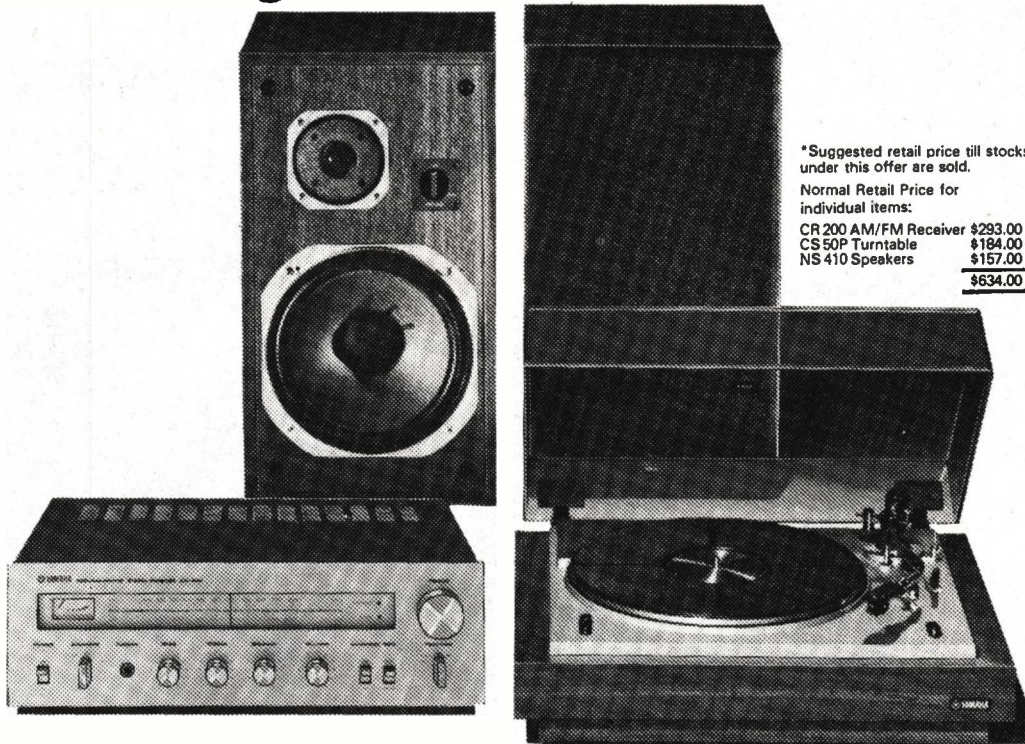


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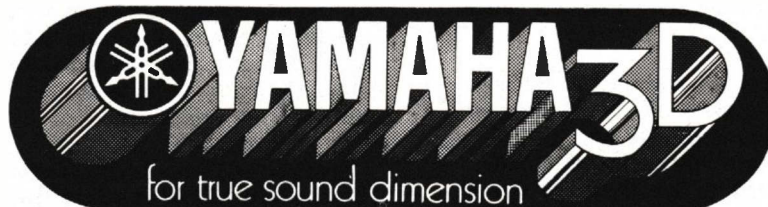
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RM06

**Special Reader Offer**

# SCOPE

## Cordless 60w Soldering Tool



**Use anywhere  
soldering iron  
heats in  
6 seconds**

ALTHOUGH hard to beat when used for their primary intended purpose, conventional mains operated soldering irons have a number of quite major limitations, particularly if they are to be used in the field — or even just a short distance away from a convenient power outlet. They are particularly dangerous when working from a ladder — many an electrician has tripped over the power cord and fallen heavily off the ladder.

Scope's cordless soldering iron is a compact lightweight soldering tool that is useable anywhere! It is powered by two rechargeable nickel-cadmium 'D' cells which store sufficient energy to enable about 100 typical electrical connections to be made per day. In fact tests have shown that between 200 and 400 joints *can* be made with light connecting wire and if the joints are close together.

There are three alternative ways of recharging the Scope iron. One very simple connector (supplied at no charge with all irons) is for people who already own a Scope soldering

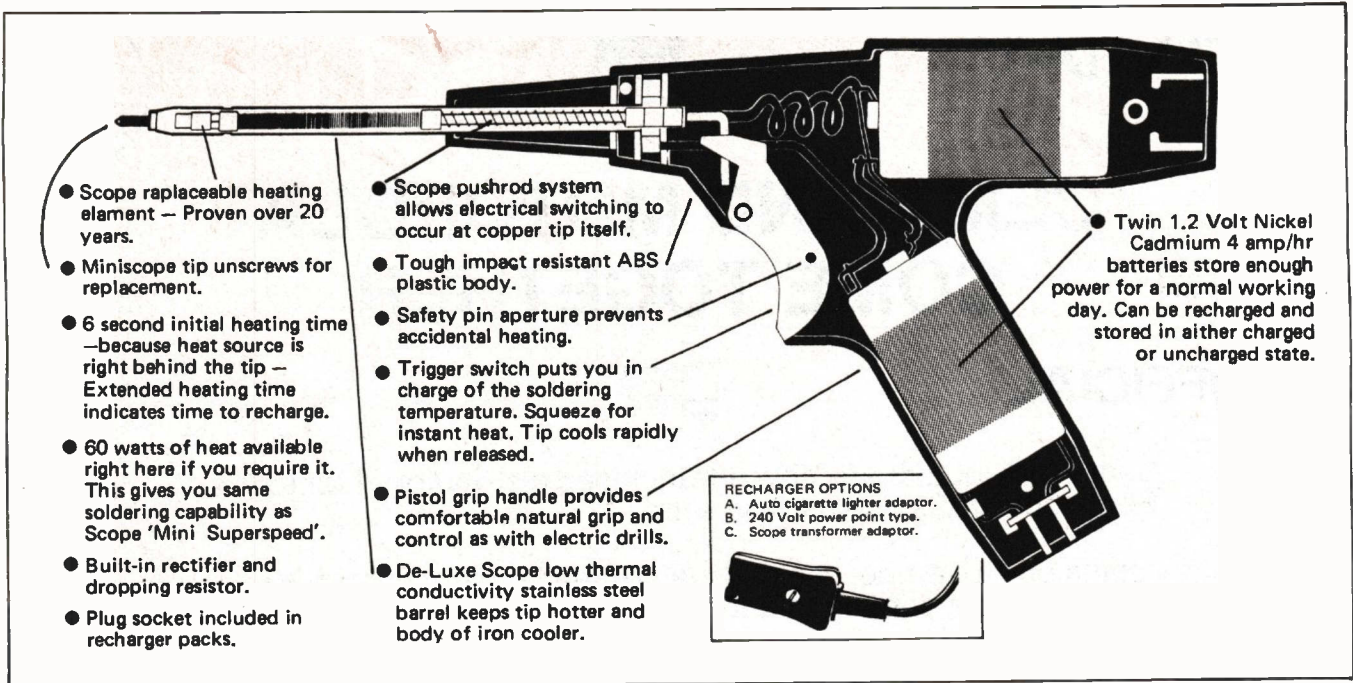
iron transformer. The second and very popular option is a transformer/power plug and cord which just plugs straight into any 240 volt ac outlet. A third optional charger plugs into the cigarette lighter socket in your car or ute.

The Scope Cordless Soldering Tool has just been released on the Australian market. In order to obtain the greatest possible publicity, the manufacturers (Scope Laboratories) and distributors have arranged for several publications to make the irons available to their readers at special low introductory prices.

Electronics Today International has arranged for the Scope iron to be available to our readers at the very low price of \$33 (less charging option) until February 28, 1976.

The manufacturers have advised us that adequate stock should be available to supply orders — however if demand greatly exceeds expectations there may be a delay of 14 days or so before delivery.





- Scope replaceable heating element — Proven over 20 years.
- Miniscope tip unscrews for replacement.
- 6 second initial heating time — because heat source is right behind the tip — Extended heating time indicates time to recharge.
- 60 watts of heat available right here if you require it. This gives you same soldering capability as Scope 'Mini Superspeed'.
- Built-in rectifier and dropping resistor.
- Plug socket included in recharger packs.

- Scope pushrod system allows electrical switching to occur at copper tip itself.
- Tough impact resistant ABS plastic body.
- Safety pin aperture prevents accidental heating.
- Trigger switch puts you in charge of the soldering temperature. Squeeze for instant heat. Tip cools rapidly when released.
- Pistol grip handle provides comfortable natural grip and control as with electric drills.
- De-Luxe Scope low thermal conductivity stainless steel barrel keeps tip hotter and body of iron cooler.

● Twin 1.2 Volt Nickel Cadmium 4 amp/hr batteries store enough power for a normal working day. Can be recharged and stored in either charged or uncharged state.

RECHARGER OPTIONS  
 A. Auto cigarette lighter adaptor.  
 B. 240 Volt power point type.  
 C. Scope transformer adaptor.



## QUESTIONS & ANSWERS

Q. How do I charge the iron?

A. Adaptor plugs in car cigarette lighter. Recharge time approximately 14 hours.

240V power adaptor. Plugs into 240 volt outlet. Recharge time approx 16 hours.

Scope Adaptor — for those already owning Scope iron transformers. Simple cord supplied as standard with iron. Recharging time 14 hours.

Readers may purchase either (or both) charging adaptors — note that the Scope adaptor is supplied in any case as standard.

Q. Can I use the iron whilst on charge?

A. Yes — but if car charger is used disconnect if working on same vehicle.

Q. Can I store the iron unused for long periods?

A. Yes the iron may be stored indefinitely without harm.

Q. How many joints can I make before recharging?

A. Approximately 100 normal joints — up to 400 light joints.

Q. How long does it take the iron to come up to working temperature?

A. About 6 seconds.

Q. Is the iron safe for CMOS and similar circuitry?

A. It's ideal! The complete freedom from a mains link ensures total safety.

Q. Are the units guaranteed?

A. The Scope Cordless Soldering Tool and accessories is guaranteed by the manufacturers for a period of 12 months including parts and labour. Faulty units should be returned either to Natronics IRH Pty Ltd, The Crescent, Kingsgrove, NSW or to Scope Laboratories, 93 Mathews Ave, Airport West, Vic 3042. Do not return faulty units to Electronics Today.

Q. Can I buy the iron without either adaptor option?

A. Yes, you can buy the iron on its own (but remember you've got to recharge it somehow!) or with either or both adaptors.

Q. I don't need the simple Scope adaptor — can I save money by buying the iron without it?

A. No — this adaptor is just a piece of wire and a plug — its cost is negligible and it's cheaper to

supply it with all irons sold rather than to complicate the supply arrangements.

Q. Can I save on sales tax — I have an exemption certificate.

A. No — there is no sales tax on soldering irons.

Q. How long will the batteries last — and can I obtain spares?

A. Batteries last about four to five years — new batteries are obtainable from Scope Laboratories at a special price. Contact Scope directly regarding this.

Q. Can you guarantee immediate delivery?

A. You should expect to receive the iron about three weeks after posting your order — unless demand is even heavier than we expect — in which case there may be some slight further delay.

Q. I employ half a dozen electricians — can I buy more than one iron using this offer?

A. Yes — but in fairness to our average reader we are limiting the offer to a maximum of five irons per order.

**NOTE:** The manufacturer's recommended retail price for the Scope 60W Soldering Tool at the time of publication is \$45 for the iron, \$12.25 for the 240 volt charger, and \$7.43 for the car cigarette lighter attachment. We understand from the distributors that the unit has been advertised and sold in many retail stores at this price, it has however been offered for \$38.50 (incld postage) by one of our advertisers.

We understand that the Scope Iron and accessories will be the subject of further special offers in other publications. It will also be available through our associated publications, Modern Motor and Revs Motorcycle News in approximately two weeks time and it may also be available through Modern Boating later in February. All our publications (i.e. those listed above) will offer the Scope Iron at the same price as offered in ETI.

Apart from the offers in our own publications we have been advised by the distributors that a similar offer may also be run by magazines other than our own. We do not know if these offers WILL appear or at what price the offers may be made — but feel it is only fair to advise our readers accordingly.

Send to — Scope Offer, Electronics Today International, 15 Boundary St., Rushcutters Bay NSW 2011.

Please forward . . . . . only Scope Soldering Irons

at \$33 each

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I also require . . . . . only

240 volt transformer charger/s at \$9.50 each

Total . . . . .

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Auto cigarette lighter plug adaptor/s

at \$6.50 each

Total . . . . .

Total . . . . .

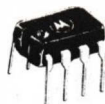
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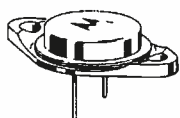
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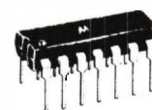
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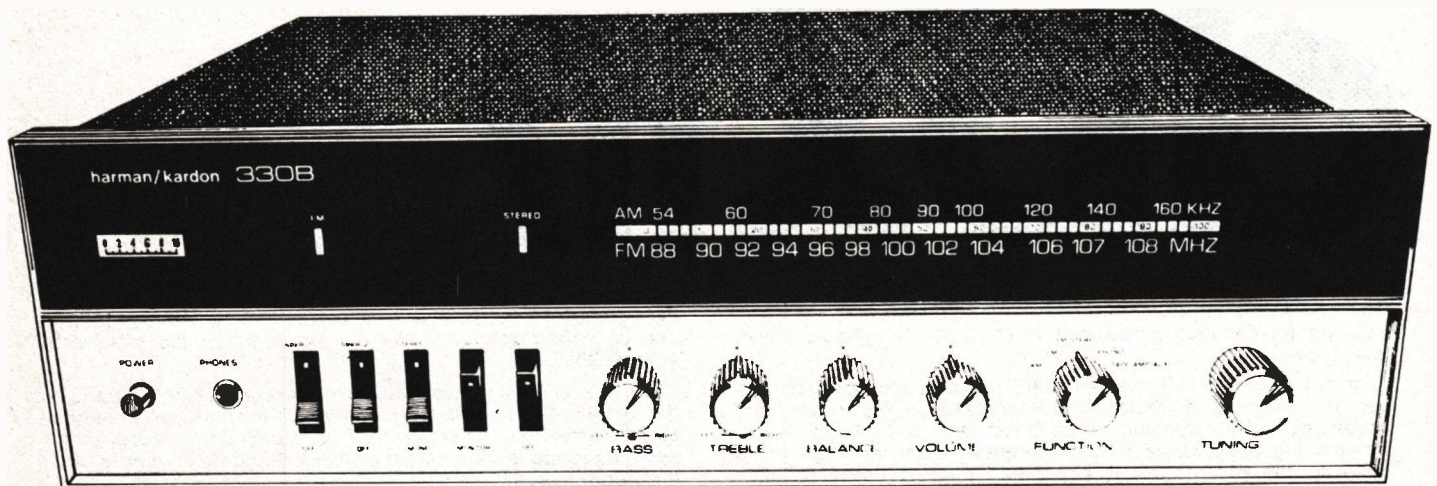
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Start with the 330B.

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Start with the 330B. The only thing that keeps it out of the higher priced category is the price.



18 real watts min. RMS per channel, both channels driven into 8 ohms from 20Hz to 20kHz, with less than 0.5% total harmonic distortion (anything less is pretend stereo).

**The 330B. Everything you need. Nothing you dont.**

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for the love of music



# dynamic range enhancer

# dbx 117

The dbx 117 is an incredible piece of equipment that will give you greater listening pleasure than you ever thought possible to achieve.

It does this in two extremely efficient ways; by literally expanding the material deliberately compressed in the recording studio, so that full dynamic range is restored, and by effectively limiting the background noise inherent in most recorded product to the extent that it becomes, in most cases, totally inaudible.

This is what Electronics Today said. "We first used the dbx unit by playing ordinary records with average background noise . . . and the background noise all but vanished. The music sounded far cleaner with a presence that was unquestionably better than the original unexpanded record."

"Our next evaluation involved a piece of newly recorded orchestral music . . . when played in the normal manner, tape hiss was quite prominent . . . when played through the dbx 117 . . . the problem all but completely disappeared . . . the music had a quality which could genuinely be described as sounding comparable with the original."

Australian Hi-Fi discusses the remarkable dbx 117 in detail. Here are a few direct quotes. "And it does work well, giving back a 'sparkle' to some recordings which have always sounded

over-compressed. Its action is particularly impressive during pauses—the disc's surface noise and any tape hiss disappear completely."

"The dbx 117 uses true RMS level sensors which respond to the overall level in **both** stereo channels even though the signal paths themselves are separate. This technique is necessary for dynamic range enhancement or there would be a wandering of the stereo image."

Hi-Fi Review expressed their findings of the dbx 117 this way: "Yet another way of 'quieting' noisy records is to use a clever little device called the dbx 117, dynamic range enhancer.

This device 'expands' the program material so it sounds more like the real thing, and reduces background noise so effectively, that it all but disappears. It's particularly effective with old or antique records."

dbx 117 restores up to 20 dB of the dynamic range missing from records, tapes and FM broadcasts.

Rediscover the beauty and excitement of an actual performance. Write for full details and list of stockists to

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# MARKER GENERATOR

**Accurate crystal-controlled markers for tuning and aligning communications receivers.**

A LIMITATION of most low priced communications receivers and conventional radios is that tuning accuracy cannot be guaranteed. This means that when waiting for a short-wave station to come on the air we may well miss the beginning of the transmission because we have been tuned to the wrong frequency. The traditional method of overcoming this problem has been to use a marker generator or crystal calibrator. Such instruments generate a series of accurately known and harmonically related signals which are tuned by the receiver in order to determine the accuracy of the dial. The marker generator may also be used to perform the periodic calibration and alignment required by most sensitive receivers.

Although it is possible to build a generator which could be set to any desired precise frequency this approach is uneconomical. The more practical method is to have an oscillator running at an accurately known frequency and to generate harmonics of this frequency. For example a basic frequency of 1 MHz would have harmonics at 2 MHz, 3 MHz, 4 MHz . . . and so on.

The marker generator must supply a stable and accurate signal without the necessity of elaborate initial setting up. This requirement leads to the obvious need for a quartz crystal as the basic frequency-determining element.

A slice of quartz crystal has the property that when a voltage is applied to either side of the crystal, the crystal will be mechanically strained and conversely, when mechanical strain is applied a voltage appears across the crystal. The crystal has a natural frequency of resonance and it is thus equivalent to a tuned circuit with a very high 'Q'.

The cheapest available crystals operate at 4 MHz and to obtain the frequency intervals that we require we used CMOS ICs to divide down from the higher frequency. To ensure maximum operating speed the CMOS ICs need to be operated from a 10 volt supply. Some exceptional devices will work on six volts but the level of higher harmonics is then reduced somewhat.

To cover as much of the dial as we can in an effective manner the

harmonics should be spaced reasonably close together and should extend to 30 MHz. Ideally a harmonic should fall within the pass-band of a receiver no matter what frequency is tuned. We therefore selected a minimum spacing of 10 kHz as being the most practical. Unfortunately the inaccuracies of many receivers can, in the high bands, exceed 200 kHz thus several harmonics may be within the pass-band at any one time making it impossible for the operator to determine to which harmonic he is tuning. To overcome this problem the marker generator is switchable to provide harmonics spaced at intervals of 4 MHz, 2 MHz, 1 MHz, 100 kHz and 10 kHz.

To produce the series of harmonics required it is necessary to generate a series of very narrow pulses at a repetition rate equal to the spacing required. That is, 10,000 narrow pulses per second will produce the harmonic series 10 kHz, 20 kHz, 30 kHz up through 29 990 kHz and 30 000 kHz.

## CONSTRUCTION

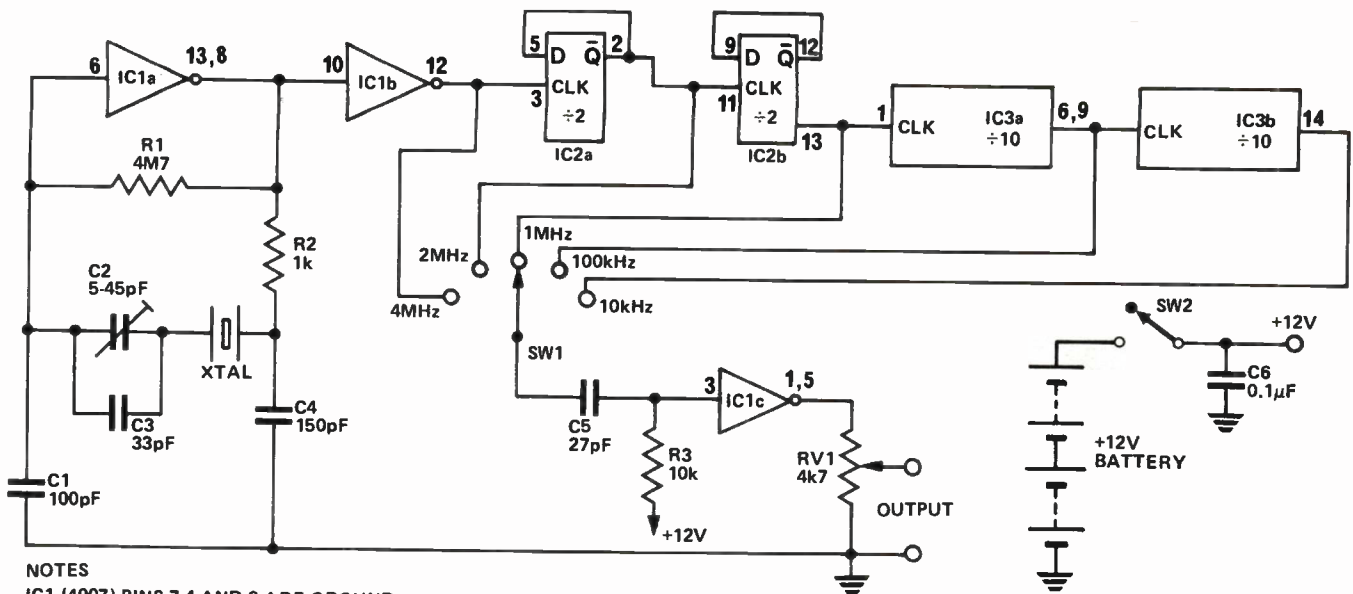
We mounted our unit in a commercially available aluminium box having dimensions of 150 mm wide by 75 mm high and 100 mm deep. The printed-circuit board is mounted on the rear panel of the box but spaced



## SPECIFICATION

Harmonic Spacing	Five switchable outputs 4 MHz, 2 MHz, 1 MHz, 100 kHz and 10 kHz.
Harmonic Range	useable to 30 MHz
Accuracy	dependent on calibration.

# MARKER GENERATOR



## NOTES

IC1 (4007) PINS 7,4 AND 9 ARE GROUND  
 IC2 (4013) PINS 6,4,8,10 AND 7 ARE GROUND  
 IC3 (4518) PINS 8,7 AND 15 ARE GROUND

IC1 PINS 14, 2 AND 11 ARE +12V  
 IC2 PIN 14, 1S +12V  
 IC3 PINS 2,10 AND 16 ARE +12V

Circuit diagram of marker generator.

## HOW IT WORKS — ETI 706.

The marker generator is a constant-frequency oscillator driving into a CMOS divider chain. Switchable outputs from the divider chain are selected to drive a pulse generator.

The oscillator is IC1a in which R1 biases the IC into linear operation. The crystal determines the basic frequency of operation at 4 MHz in conjunction with C1, 2, 3 and 4 which appear to the crystal as one parallel capacitor. The capacitor C2 is used to tune the oscillator exactly to frequency as explained in the text. The resistor R2 adds extra phase shift but also reduces the gain. Thus if the oscillator is slow in starting reducing R2 may help. The output of the oscillator is buffered from the rest of the circuit by IC1/b.

IC2 is a CMOS dual type D flip flop that divides the 4 MHz by four to provide an output of 1 MHz, the 2 MHz also being brought out.

A further dual division by 10 is provided by IC3 which therefore provides outputs of 100 kHz and 10 kHz.

The required output is selected by SW1 and applied to C5 and R3 which differentiate the squarewave output of the divider. The waveform is then amplified and squared by IC1/c to provide an output train of narrow pulses, the amplitude of which may be varied by means of RV1.

from it by four 19 mm long machine screws. Also mounted on the rear panel are the two output terminals. The two switches and the potentiometer are mounted on the front panel whilst the battery holders are clamped to the bottom of the box by means of a clamp made from a scrap piece of aluminium.

With the exception of the ICs, mount all components and fit all links to the printed-circuit board. After checking that all are correct, mount the ICs, double checking their orientation before soldering. Fit all flying leads to the board allowing about 150 mm of free length.

Drill the box with all the required holes and fit all the components such as the switches, the potentiometer and the output sockets. Fit the printed-circuit board to the rear panel with C2 to the top of the box and route the leads to their respective points as detailed in the component overlay. Note that one of the screws through the wafer of SW1 has an earth lug underneath it which is used as the common earth point.

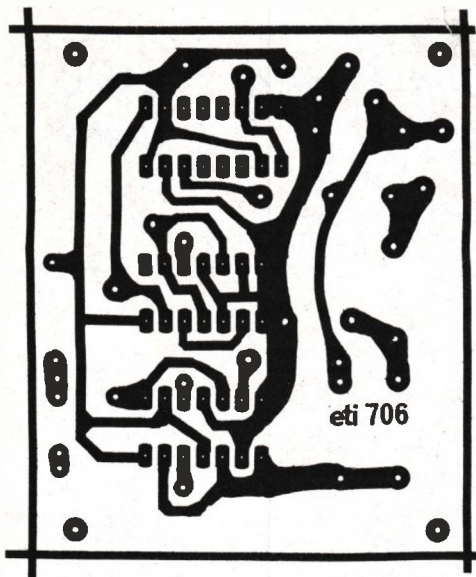
Fit the batteries and connect them up but do not switch on until a final wiring check has been carried out. Ten minutes of your time at this stage could save you the cost of a new set of ICs.

## USING THE GENERATOR

Say for example, that we wish to

PARTS LIST — ETI			
R1	Resistor	4M7	¼W 5%
R2	"	1k	" "
R3	"	10k	" "
RV1	Potentiometer	4k7	lin
C1	Capacitor	100pF	Ceramic
C2	"	5-45pF	Philips 2222 808 91503
C3	"	33pF	Ceramic
C4	"	150pF	Ceramic
C5	"	27pF	Ceramic
C6	"	0.1µF	Ceramic
IC1	Integrated Circuit	4007	(CMOS)
IC2	"	4013	(CMOS)
IC3	"	4518	(CMOS)
XTAL one 4.0000 MHz quartz crystal 30pF load			
SW1	Rotary Switch	1 pole 5 position	
SW2	Toggle Switch	SPST	
One pair of Terminals			
PC Board ETI 706			
Aluminium Box 150mm, 75mm, 100mm.			
Two knobs			
Eight AA size batteries			
Two 4xAA size Battery Holders			
Nuts and Bolts.			

tune a signal that we know to be on 13 250 kHz. First select 4 MHz on the marker generator and connect its output to the aerial socket of the receiver. Tune the receiver to the marker which will be found at 12 MHz (third harmonic of 4 MHz). Once located confirm that it is indeed coming from the marker generator by switching it on and off. Now switch to the 1 MHz markers and tune the receiver upwards to locate the 13th harmonic at 13 MHz. Now select 100 kHz markers and tune upwards through two markers to locate 13.2 MHz. Finally select the 10 kHz



Printed-circuit layout. Full size 70 x 58mm.

markers and tune up through a further five markers to locate 13 250 kHz. Note that if this tuning procedure is carefully carried out it is quite simple to locate any position on the dial with great accuracy.

### THE CRYSTAL.

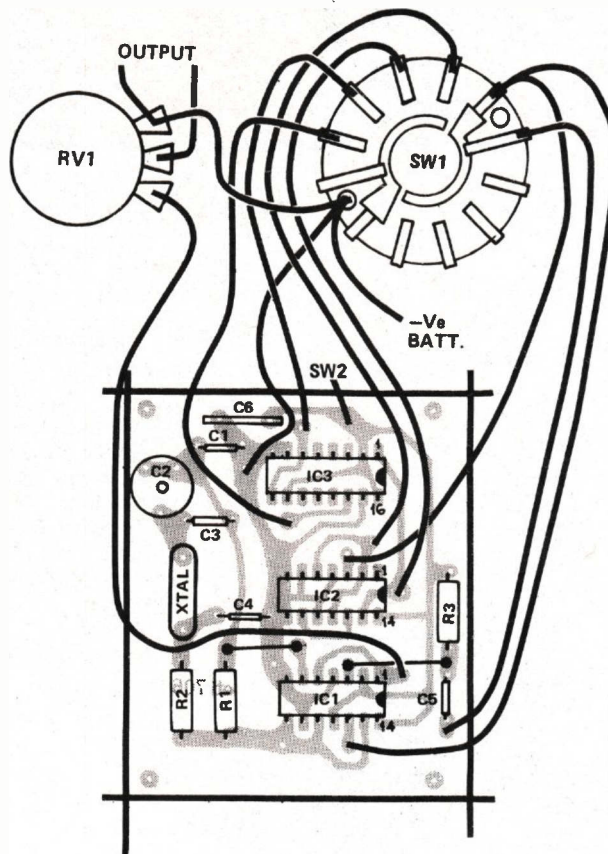
Crystals are supplied to work within specified tolerances. The tighter the tolerances the more expensive the crystal. However the crystal oscillator may be placed exactly on frequency (within small limits) by varying the amount of capacitance in parallel with it.

When purchasing a crystal you must tell the manufacturer what capacitance it will be working with and he will grind your crystal to be within the specified limits when it is used with that particular capacitance. This marker generator has been designed to work with crystals that are ground for 30 pF capacitance.

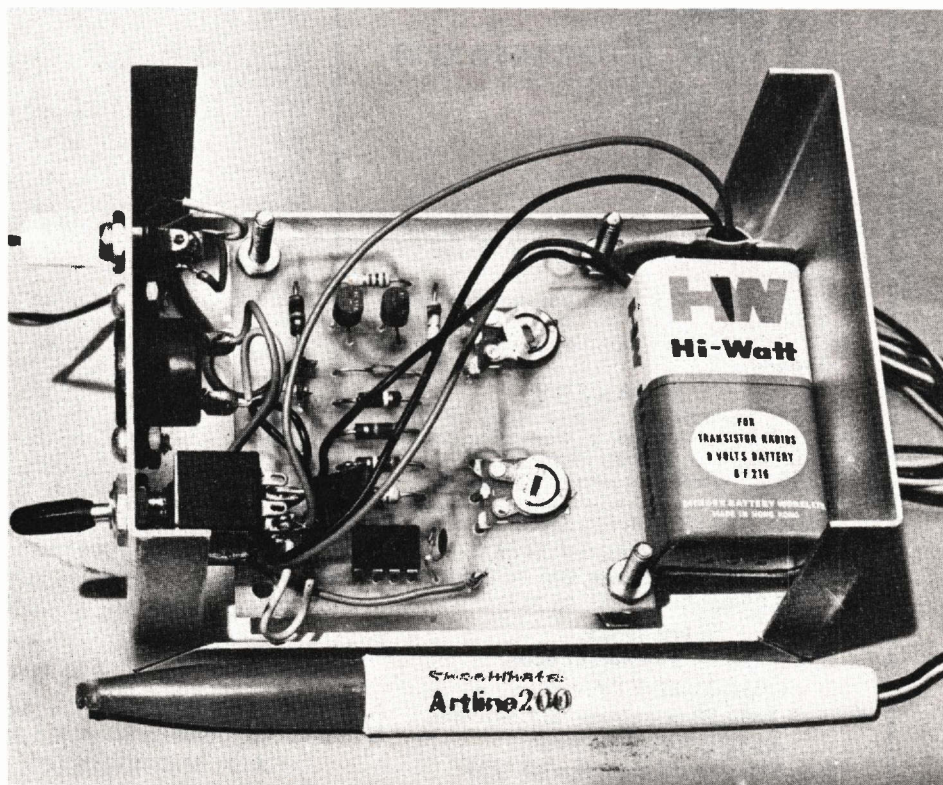
### CALIBRATION

The marker will be sufficiently accurate for most people with C2 set to half value. For those who want greater accuracy the generator must be calibrated against a signal of known accuracy. The PMG transmit a time signal precisely for this purpose and it can be found on 4.5 MHz, 7.5 MHz and on 12 MHz.

The generator may be aligned against one of these frequencies by the zero-beating technique. First tune in the PMG signal and then connect the generator. A whistle will now be heard and C2 should be tuned to the point where the beat frequency has dropped so low that it cannot be heard. The generator is now spot on frequency and it should be noted that this calibration is independent of the receiver accuracy. ●



Internal view of the completed marker generator. Note that the board is mounted with the crystal and C2 towards the top of the box.



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PM 143	Stereo, 15W.	\$ 69.00
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ETI 419	Preamp for ETI413	\$ 12.50
ETI 420	10W Quad, discrete decoder	\$139.00
ETI 420	20W Quad, discrete decoder	\$169.00
ETI 422	50W Stereo	\$115.00
ETI 424	Stereo, spring reverberation	\$ 65.00
ETI 427	Stereo, graphic equaliser	\$139.00
ETI 440	25W Stereo Amplifier	\$ 89.00

P&P on above is \$5.00 or 10%, whichever is the lower.

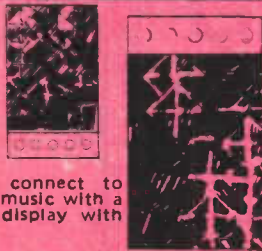
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ETI 704	\$25.00	\$2.50	ETI Strobe kit	\$22.50 \$2.00
ETI 120	\$13.95	\$1.00	EA Transistor tester	\$17.50 \$2.00
ETI 121	\$12.95	\$1.00	Glide tone generator	\$ 9.75 \$1.50
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47		\$3.75	25
100		\$4.25	25
220		\$6.25	25
330		\$2.75	10
470		\$3.00	10
1000		\$5.00	10
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22		\$3.66	25
33 (50V)		\$3.66	25
47		\$4.47	25
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330		\$4.05	10
470		\$5.00	10
1000 (35V)		\$5.00	10
CED 25V series (Double ended pigtail types. 25V. rating)			
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47		\$4.25	25
100		\$5.40	25
220		\$3.15	10
330		\$3.40	10
470		\$3.60	10
1000		\$5.80	10
2500		\$3.80	5
4700 (35V)		\$6.00	4
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22		\$4.25	25
33 (100V)		\$2.80	10
47		\$6.25	25
100		\$3.70	10
220		\$4.25	10
330		\$4.90	10
470		\$4.25	5
1000		\$5.00	5
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.0056µF 100	\$5.25
.0068µF 100	\$5.25
.0082µF 100	\$5.25
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.015µF 100	\$5.80
.018µF 100	\$5.80
.015µF 100	\$5.80
.018µF 100	\$5.80
.022µF 50	\$3.25
.027µF 50	\$3.25
.033µF 50	\$3.25
.039µF 50	\$3.25
.047µF 50	\$3.75
.056µF 50	\$4.00
.068µF 50	\$4.60
.082µF 25	\$2.75
.1µF 25	\$3.00
.12µF 25	\$3.25
.15µF 25	\$3.75
.18µF 25	\$4.00
.22µF 25	\$4.25
.27µF 10	\$2.50
.33µF 10	\$2.70
.39µF 10	\$3.00
.47µF 10	\$3.50
.56µF 10	\$3.56
.68µF 10	\$4.30
.82µF 10	\$5.25
1.0µF 5	\$2.75
1.2µF 5	\$3.25
1.5µF 5	\$3.25
1.8µF 5	\$3.25
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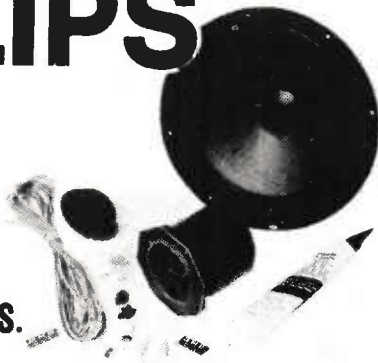
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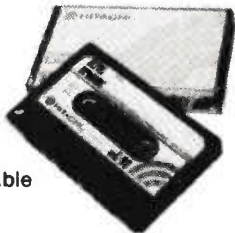
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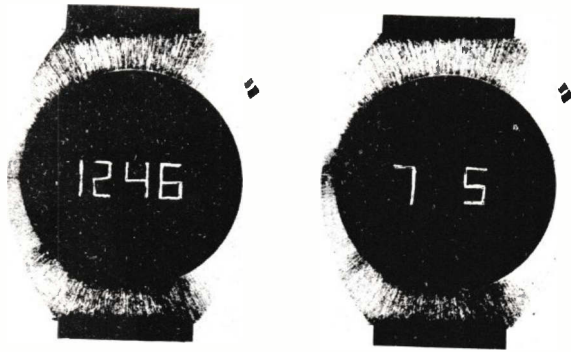
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# DIGITAL WATCH KIT

Under \$50 digital watch can be built in two hours.



DIGITAL WATCHES are currently falling in price almost as rapidly as did electronic calculators a year or so ago.

Now a good quality digital watch can be bought for somewhere between \$60 and \$150. These lower priced watches generally indicate the time only — in hours, minutes and usually (but not always) in seconds. Digital watches that include calendar indication are also available but generally more expensive.

It was with considerable interest then that we learnt that one of our advertisers — Euray Trading Inc — of Dallas, Texas, is offering ETI readers a Sabchron digital watch kit for only \$49, and that this watch includes month and date readout as well as hours, minutes and seconds. The company sent us one of these watch kits for evaluation, and we passed it on to our laboratory for them to assemble.

Our immediate reaction was surprise at just how few components there were — then further surprise at the minute size of some of those.

The instructions supplied with the watch are clear and very easy to follow. It is essential to be able to solder correctly and neatly — if you are not sure of your ability to do this then this kit is not for you! Apart from this however there are no major problems, in fact we assembled our unit in less than two hours using a standard 16 watt Adcola iron with the tip filed down to a square section point. It is essential to use the very fine gauge solder supplied with the kit. If your close vision is very good it is possible to assemble the watch without optical assistance, however most people will find it best to use a large free-standing magnifying glass better to see the quite minute components.

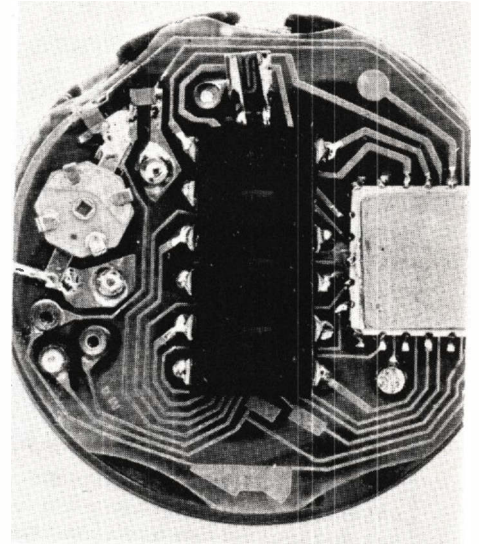
We were initially worried by the size of the main IC. This does not have leads attached as normal. Instead contact is made via a series of gold-plated pads on the sides of the device. These pads are only 0.05" apart — half that of a normal IC, and in some places a lead is actually run between the pads! The IC is first stuck

onto the board with a piece of double sided sticky tape, which acts as insulation, and then fillet soldered to the board. It's a tricky operation but not quite as difficult as it at first seems.

We found that the leads for the display itself are more readily soldered into position on the board if they are first tinned.

The photograph on this page shows the complete watch as seen from the front (display) side. The only components not visible here are the crystal and batteries both of which are located on the reverse face.

The completed watch has worked reliably and accurately since assembly. It is unquestionably excellent value for money and can be assembled by any reasonably experienced hobbyist — in our opinion it is not however for the complete novice.



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# SABCHRON DIGITAL<sup>T.M.</sup> LED Watch kit

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EXCLUSIVE TO ETI READERS**

## \$49.00



### SIX FUNCTIONS



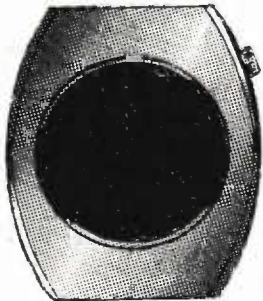
The Sabchron Digital is probably the only six-function LED watch kit available today. It offers more features than many other LED watches — At the touch of a single Command Button you get the exact hour, minute, second, month and day-of-month . . . PLUS an automatic date change memory which knows whether the month contains 28, 30 or 31 days. And, AM/PM indication during hours setting.

### 1500 TRANSISTOR CMOS INTEGRATED CIRCUIT

A single silicon slice measuring only 1/50th square inch contains the equivalent of 1500 transistors and over 10,000 interconnections. The IC chip contains all the logic, decoding, multiplexing, counting and display drive circuits, and has static-protected terminals for handling safety.

### QUARTZ CRYSTAL ACCURACY

The accuracy on the Sabchron Digital is controlled by a 32,768 Hz quartz crystal. This reference frequency is tuned to  $\pm 2$  parts per million via the trimmer capacitor and is divided in half 15 successive times through various stages within the IC to provide one accurate pulse per second. This means a timekeeping accuracy of within  $\pm 5$  seconds per month. Careful adjustment of the trimmer can bring this to within  $\pm 1$  second per month or  $\pm 12$  seconds per year!



### GOLD-PLATED CASE

Unlike many other watches which offer "goldtone" or "gold colour" watch cases, the Sabchron Digital offers a genuine gold-plated case. Made in Switzerland, it is water resistant and has a specially hardened ruby-red acrylic face. (Bracelet is not included). Elegantly styled and only slightly larger than a conventional watch, it is shown here actual size.

### AUTOMATIC LED DISPLAY BRIGHTNESS

The Sabchron Digital features a special light sensor circuit which automatically adjusts the LED display brightness according to varying light levels. In a bright room the display brightens; in a dim room or in darkness the display dims, thus conserving battery power.

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- Shock-protected, anti-magnetic.
- Long-life power cells provide power for up to one full year with normal use.
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- ALSO AVAILABLE READY-BUILT WITH A 12-MONTH GUARANTEE.

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postage ..... \$ .....

I enclose  Bank Cheque  International  
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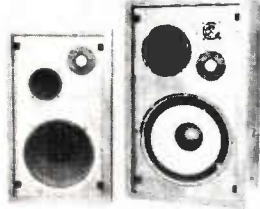
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# KITSETS



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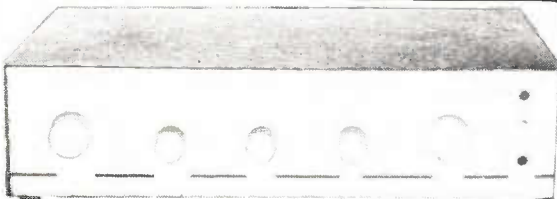
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## NEW ETI 440 KIT



ETI 440. Simple 25 Watt amplifier kit as featured in Electronics Today, July 1975.

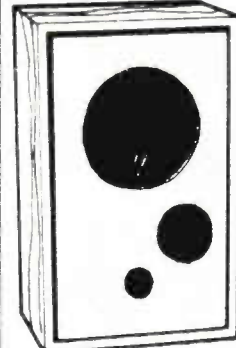
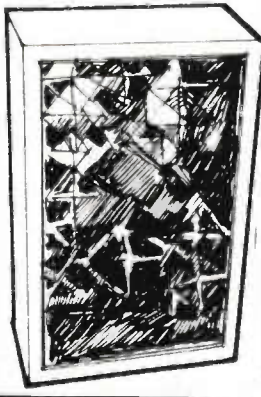
25 Watt R.M.S. per channel, distortion round 0.1% 6 Hz to 80 kHz., at -3dB. A full list of specifications and building instructions are in the July issue of Electronics Today. This is a magnificent amplifier which is not hard to assemble. It will suit those people who want a good amplifier at an economical price.

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Speakers available for all these kits.

## ETI 422 50 WATT PER CHANNEL AMP KIT.



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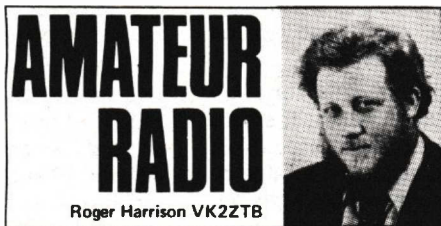
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## THE STATE OF THE ART

# MODERN SOLID STATE CONVERTERS

How to build converters for the 28, 52 and 144 MHz bands.

INTEREST and activity in the 52 MHz and 144 MHz VHF amateur bands, 'six metres' and 'two metres', has enjoyed a boom in recent years. This has been stimulated for the most part by the ready availability of commercial equipment, largely of Japanese origin, for both SSB and FM modes as well as cheap ex-commercial service FM equipment. Paralleling this boom, there has been an increase in homebrew equipment, sometimes as an inexpensive alternative to commercial equipment, or as a supplement. Many FM operators are now moving down to the 'tuneable' end of the bands. Also, many amateurs who have primarily operated on HF have sought ways of using their existing equipment for VHF operating. Transmitting and receiving converters is the solution that many amateurs adopt, rather than building 'from the ground up'. Operation via satellite translators that have the uplink and downlink in separate bands also necessitates the use of separate receiving converters.

Many suitable transmitting converters have been described over the past few years, but inexpensive, high performance receiving converters for home construction using locally available components, and to suit local requirements, are another matter.

The receiving converters presented here can be used for a variety of applications and are sufficiently flexible to suit individual

requirements. Also, as the Oscar 6 and one of the Oscar 7 satellite translators employ downlinks in the 28 MHz amateur band, details for modifying the 52 MHz converter for use on this band are included.

Design goals for both converters were simplicity, performance comparable to commercial equivalents, relatively simple alignment, simple non-critical construction and no evil habits. Experience has shown these goals have been achieved.

Few components have critical values. Components of a standard value either side of those indicated may be substituted without greatly affecting performance — if at all. The tuned circuit capacitors are an exception however. Standard 10% tolerance components may be used, but values different from those given should not be substituted.

A variety of FETs and transistors may be used without substantial variation in performance.

### GENERAL CONSTRUCTION

The converters are essentially similar in form. Each has an RF stage and a mixer employing dual-gate MOSFETs. An overtone crystal oscillator using a bipolar RF transistor provides local oscillator injection to the mixer. The circuit used in both converters is the impedance inverting oscillator which the writer has found to be reliable, stable and exhibit low harmonic

content. It is non-critical in operation and crystal-switching can be employed if desired. Only a single pole switch is necessary in this application as one side of the crystal is grounded.

The RF tuned circuits have been designed to provide a bandpass response over the desired band. The noise figure of each converter is less than 3 dB which is more than adequate considering the transmission line losses likely to be encountered and urban VHF noise levels. A low noise preamplifier, mounted at the antenna, is recommended where a lower noise figure is warranted.

Neutralisation of RF stages has long been regarded by the author as a nuisance, and the source of many evils in receiving converters and preamplifiers. Slight misadjustment results in a degraded noise figure in even the best of circuits and intermittent instability in other cases. These converter designs avoid neutralisation in the RF stage and are quite stable when correctly aligned, regardless of the weather, reactive antenna relays, spilt coffee or bad breath.

The converters are constructed on fibreglass printed circuit boards. One may use Veroboard (as was done with one prototype) but at risk to your own sanity! The layouts have been designed to make assembly easy and to avoid RF instability. A 6 mm margin around the edge of each board is provided to facilitate mounting.

# MODERN SOLID STATE CONVERTERS

## THE 52 MHz CONVERTER

The circuit is given in Fig. 1. The RF stage is quite conventional. A double-tuned input circuit (L1-L2) is used both to provide a flat bandpass response and good out-of-band attenuation. An MPF121 MOSFET provides RF amplification. The FET used for this stage is not critical and other types such as the 40673, 40841, MFE131, MPF131, 3N200, 3N209 have been successfully substituted

without major variation in performance. All these FETs have zener-protected gates and may be handled in the same way as transistors. The gate 2 bias may need to be increased for different types.

If the gain of this stage is too high for the intended application, the gate 2 bias voltage may be decreased. This is best done by decreasing the value of R2. AGC may be applied by removing R1 and R2 and applying the AGC

voltage direct to gate 2. A positive AGC voltage is required which decreases with increasing strength of the received signal so as to decrease the RF stage gain.

Another double-tuned circuit (L3-L4) couples the RF stage to the mixer. Local oscillator injection is applied to gate 2. The gate 2 bias resistor (R4) is tied to the source. This technique improves the operation of the dual-gate FET as a mixer. The mixer also uses an MPF 121 although an MPF132 or any of the FETs suggested for the RF stage may be substituted.

The IF output tuned circuit, L5, is tuned to the centre of the IF range and effectively "fills-in" the dip in the centre of the RF tuned circuits' response. L1-L2 and L3-L4 form inductively-coupled RF transformers. The physical construction results in overcoupling, producing the desired 'double-humped' bandpass response. An overall response, RF input to IF output, of 3 MHz (-3 dB) with a ripple of less than 2 dB over the bandpass is obtained.

Experience has shown that the RF stage can be unstable where some devices are in the upper range of their characteristic spread. The RF stage will oscillate at some settings of the tuned circuit slugs in such cases. Correct alignment obviates this problem. Lowering the gain by decreasing the gate 2 voltage may be tried if so desired. Some converters may be simply peak aligned — resulting in less bandwidth, but others may oscillate if this is done. The alignment procedure as set out is *proven* and recommended. Problems are usually caused by a galloping diddle-stick or congenital illiteracy.

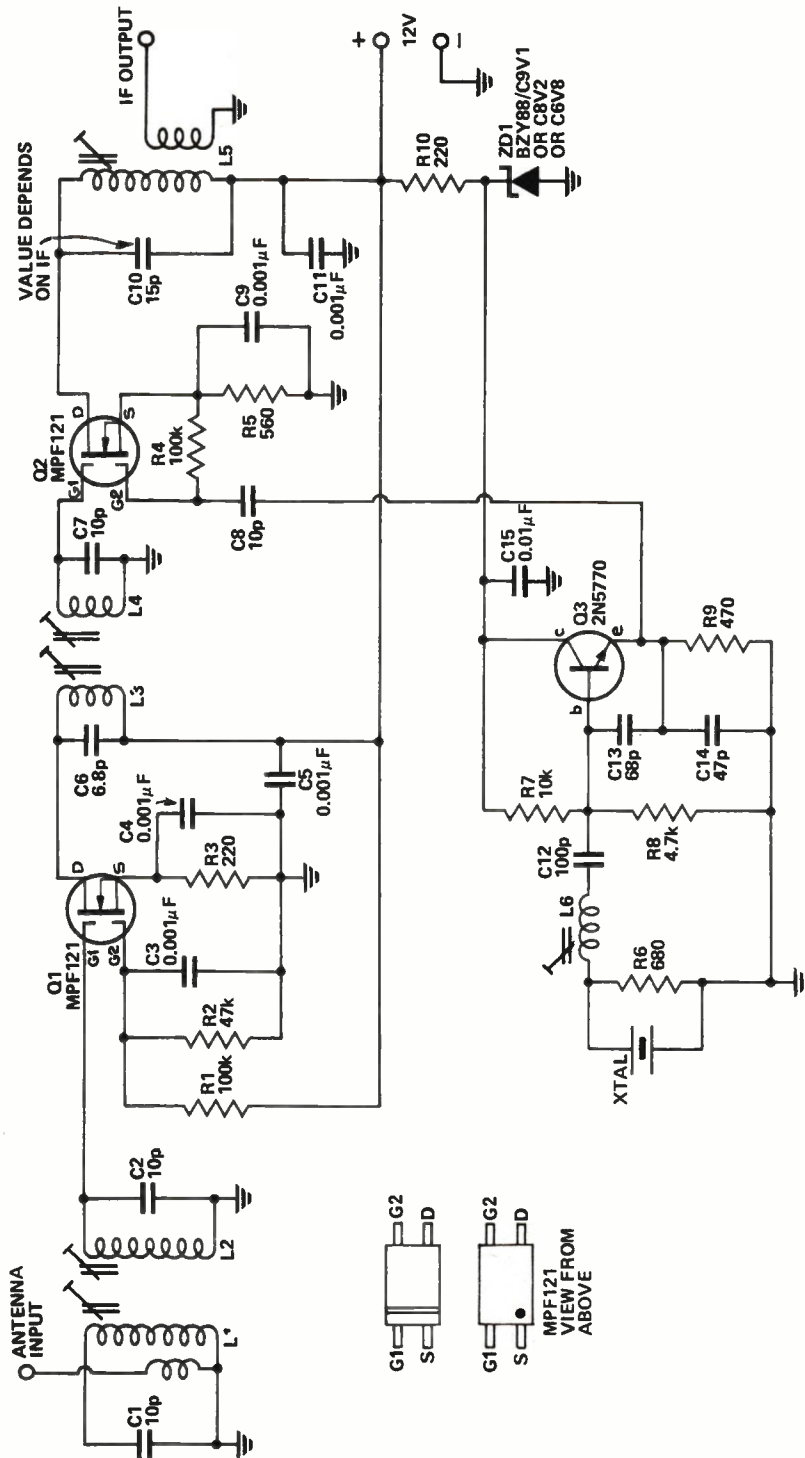


Fig. 1. Circuit of 52 MHz converter.

### PARTS LIST - 52 MHz

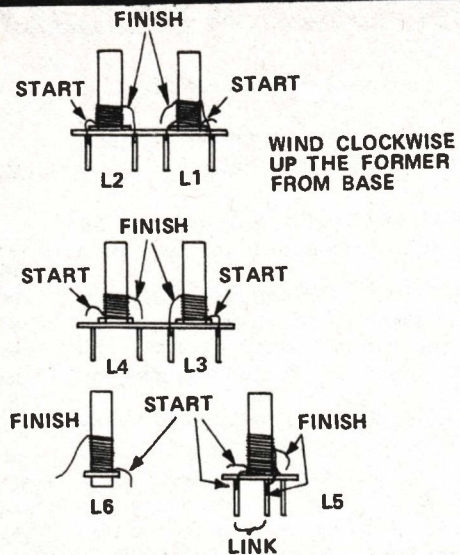
C1,2,7,8	10pF ceramic
C3,4,5,9,11	.001μF poly or ceramic
C6	6.8pF ceramic
C10	15pF ceramic — see coil details
C12	100pF styrene or ceramic
C13	68pF styrene or ceramic
C14	47pF styrene or ceramic
C15	.01μF poly
R1,4	100 k
R2	47 k
R3,10	220 ohms
R5	560 ohms
R6	680 ohms
R7	10 k
R8	4.7 k
R9	470 ohms
Q1,2	MPF121 or substitute see text
Q3	2N5770 or substitute see text
Z1	B2V88 C9V1 or C8V2 or C6V8
6 x 722/1 Neosid formers	
2 x 5027/8PLD bases	
1 x 5027/6 PLD base	
6 x slugs, 4 x 5 x 10/F29	
2 x 7300 cans	
1 x 7100 can	
coil wire	
1 x p.c. board	
1 x crystal — see table of frequencies	



## COIL DETAILS 52 MHz CONVERTER

All coils wound with enamelled wire, 25 to 28 B & S. Each coil has an F29 slug inserted.

L1, L2, L3, L4	10 turns closewound. L1 has a one turn link at the top of the coil.
L5 (28 MHz IF)	15 turns closewound, 2 turn link at the top of the coil, 15 pF capacitor to resonate (as per circuit diagram)
L5 (14 MHz IF)	22 turns closewound, 2 turn link at the top of the coil, 100 pF capacitor to resonate.
L5 (9 MHz IF)	same as above
L6 (for 24 MHz crystal)	18 turns closewound
L6 (for 38 MHz crystal)	15 turns closewound
L6 (for crystals over 40 MHz)	12 turns closewound.



The crystal oscillator uses third overtone, series resonant crystals. A stability and tolerance specification of 20 parts per million is quite adequate.

The crystal frequency is *below* the signal frequency. The crystal is trimmed onto exact frequency by adjusting the slug in L6. This can be done by loosely coupling a digital frequency meter to the emitter of the oscillator transistor or by injecting the signal from a crystal calibrator into the antenna input once the converter is operational.

Almost any general purpose RF transistor can be used in the crystal oscillator. Types such as the 2N5770, 2N3563, 2N3564, etc. can be readily substituted for the BF115.

A crystal socket for style D crystals will fit on the printed circuit board or crystals having pigtail connections may be soldered into the board. If a crystal socket is used, jumpers from each pin to the appropriate point on the printed circuit board will be necessary. Output for a transverter mixer can be capacitively coupled from the emitter of the oscillator transistor.

Neosid coil components are used for all tuned circuits. They are readily available and reasonably priced. All coils, with the exception of L6 are shielded. Inductor L6 is wound on a Neosid type 722/1 former which is glued into a hole on the p.c. board. Coil winding details are given in Fig. 2.

## IF FREQUENCIES

For 'tuneable' operation, the most popular IF is the 28 MHz band. Second choice would be 14 MHz. This suits most amateur HF transceivers and receivers. However, if a general coverage receiver is used as the tuneable IF, any convenient frequency range above 9 MHz or 10 MHz is suitable. Coil data is shown in Fig. 2.

Coil data for the commonly used 10.7 MHz and 9 MHz IF frequencies is also supplied for operation into a fixed

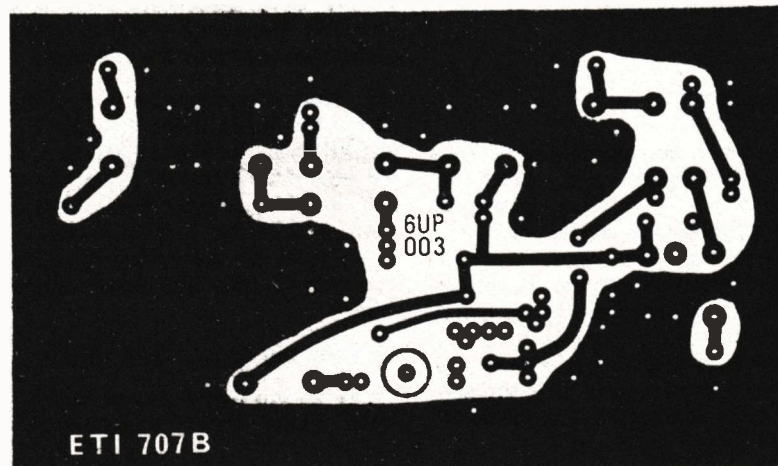


Fig. 3. Printed circuit board layout for 52 MHz converter.

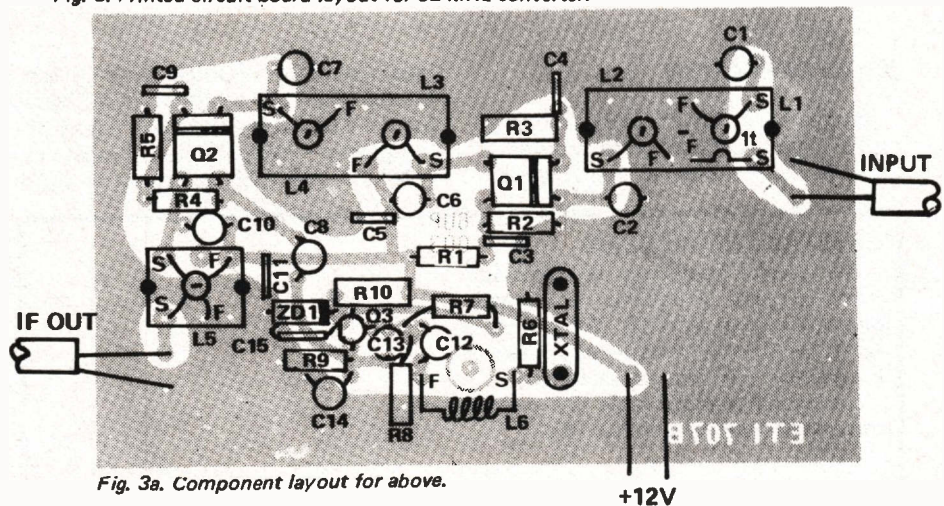


Fig. 3a. Component layout for above.

IF (i.e. for an FM receiver on fixed channels).

If operation below 9 MHz is contemplated, L5 should be replaced with a wideband RF transformer or a 500  $\mu$ H RF choke and capacitive output coupling.

## CONSTRUCTION

The first thing to be done is gluing the coil formers to the bases. Tarzan's Grip, Kwik Grip, Super 5000, Araldite, etc. are all suitable, but use sparingly. Put the completed coil

former-base assemblies aside for the glue to set properly.

Next, mount all minor components including the semiconductors. These should all be mounted right down on the board to minimise lead length. The FETs have protected gates and may be treated in the same manner as transistors. The p.c. board layout and component overlay appears in Figs 3 and 3a.

Now the coils may be wound. Note that *all* coils are wound *clockwise* up the former from the base. The wire

# MODERN SOLID STATE CONVERTERS

may be any gauge between 25 or 28 B & S enamelled wire or SWG equivalent. The accompanying table gives coil winding details.

Clean and tin the coil leads but do not solder them into the base pins.

Next mount the completed coils on the printed circuit board. Check for correct placing and that the coil connections are as per the diagram.

The pins may now be soldered to the p.c. board. Insert the slugs using 20 mm or 30 mm of rubber string (usually supplied with slugs) to prevent them being loose. Last of all, mount the shield cans and solder their pins in place.

## ALIGNMENT

Alignment is best carried out with a sweep generator and CRO or panadaptor. If you have access to these instruments it is presumed you know how to use them. Use the procedure below as a guide. If you do not have these instruments on hand, the following procedure is recommended. Exercise care and you will achieve good results. It is actually simpler than it sounds. A tuneable IF

covering the chosen IF frequency range, with an S-meter, and a power supply delivering between 12 V and 15 V at 50 mA is necessary.

1. Connect power supply and tuneable IF. The converter should produce some increase in the IF noise level. Tune L5 to see if some peak can be obtained. If the converter does not respond, check the circuit for correct parts placement and coil connections. Check that the crystal oscillator is working. Use a digital frequency meter, a GDO-wavemeter or tuneable VHF receiver. When the crystal is removed from circuit the noise level in the IF should decrease.

2. Using a signal generator or some variable frequency signal source, peak L5 at the centre of the IF range.

3. Now commence with the slugs for L1,2,3,4 flush with the top of the shield cans. Set the signal source to 53 MHz and tune the IF to the signal. At all times, the output level of the signal source must be kept at a reasonably low level so that the tuneable IF remains within its linear operating range.

4. Peak the slug in L1 (53 MHz).

5. Move the signal source to 52 MHz AND TUNE THE IF to the signal.

6. Peak the slug in L2 (52 MHz).

7. Move the signal source to 54 MHz and tune the IF to the signal.

8. Peak the slug in L4 (54 MHz).

9. Move the signal source to 53 MHz again and tune the IF to the signal. Screw in the slug in L3 so that the signal level rises somewhat, two to three turns is ample. Then, move the signal source and IF to tune 52 MHz where you should find that the gain has increased enormously.

10. Now screw the core in L1 further into the coil so that the gain at 52 MHz drops to about that elsewhere in the band.

11. Finally, tune the signal source and IF across the band and check that the gain is fairly flat across the band. Any irregularities may be touched up by slight adjustments of L1 and L4 only.

The above alignment results in a bandpass with the -3 dB points at about 51 MHz and 54.2 MHz. To move the roll-off frequencies up or down, simply alter the alignment frequencies by the desired amount.

Overall gain of the converter will exceed 25 dB which should be more than adequate for most applications.

## 28 MHz OPERATION

For operation on 28 MHz, only the tuned circuit data need be modified. Crystals *above* the signal frequency are

recommended, resulting in a reverse tuning IF if the converter is followed by a tuneable receiver. (Crystal Frequency = Highest Signal Frequency + IF). If you wish to have a forward

tuning IF, the output frequency will need to be 8 MHz or less as third overtone crystals are not normally obtainable below 20 MHz. (Crystal Frequency = Lowest Signal Frequency - IF). All coils wound *clockwise up* the former.

The coil data is as follows: Each coil has an F29 slug inserted.

L1 15 turns, 28 B & S enamelled wire,  
L2 closewound. Use 22 pF capacitor  
L3 to resonate L1, L2 and L4. L3  
L4 requires an 18 pF capacitor.  
L5 see details for 52 MHz.

L6 \* For crystals in the range 20 MHz to 25 MHz, 21 turns closewound, 28 B & S enamelled wire.

\* For crystals in the range 33 MHz to 42 MHz, 15 turns closewound, 28 B & S enamelled wire.

The alignment frequencies are now 28 MHz, 29 MHz and 30 MHz, using the alignment procedure given for 52 MHz operation. The resulting bandwidth however, is a little over 2 MHz for this band.

### CRYSTAL FREQUENCIES

The crystal frequency is calculated from: Crystal Frequency = Lowest Signal Frequency - IF (for tuneable IF's) or Crystal Frequency = Signal Frequency - IF (for net channels)

The accompanying table lists crystal frequencies for the popular IF's.

Signal Frequency	IF	Crystal Frequency
50 MHz to 52 MHz	28 MHz to 30 MHz	22.000 MHz
52 MHz to 54 MHz	28 MHz to 30 MHz	24.000 MHz
50 MHz to 52 MHz	14 MHz +	36.000 MHz
52 MHz to 54 MHz	14 MHz +	38.000 MHz
52.525 MHz	10.7 MHz	41.825 MHz )
52.656 MHz	10.7 MHz	41.956 MHz )
52.700 MHz	10.7 MHz	42.000 MHz )
52.525 MHz	9.0 MHz	43.525 MHz )
52.656 MHz	9.0 MHz	43.656 MHz )
52.700 MHz	9.0 MHz	43.700 MHz )

FM Net frequencies

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# MODERN SOLID STATE CONVERTERS

## THE 144 MHz CONVERTER

The circuit is shown in Fig. 3. Dual gate MOSFETs are also used in the mixer and RF stages of the converter. The RCA type 40841 has been specified as it is inexpensive and gives excellent performance on this band. Suitable substitutes for the RF stage would be MPF 1000, 3N200, 3N 209, 3N210, MFE131, as first choice or 40673, 3N140, 3N141 as second choice. Any of these may be substituted in the mixer.

The RF stage is quite straightforward. A low Q single tuned circuit is used between the antenna and gate 1 of the 40841. The antenna input impedance is mismatched to the input impedance of gate 1 to optimise noise figure. The drain of the RF stage is coupled to gate 1 of the mixer via a double-tuned bandpass RF transformer employing a combination of inductive coupling and common-capacity coupling to achieve the desired bandwidth.

Gate 2 of the RF stage requires a bias of +6 V for full stage gain. A link between gate 2 decoupling and junction of R2 and R3 allows for AGC or a gain control potentiometer to be connected if required. A negative bias of about 6 V applied to gate 2 can cause the RF stage to exhibit up to 20 dB of attenuation. Very handy for fox hunts or close proximity mobile-to-mobile operation.

The mixer in this converter has increased forward bias (about 1.5 V) applied to gate 2 by a 1 M (R5) resistor from the supply rail. The gate resistor is returned to the source as in the 52 MHz converter. This improves the mixer conversion gain at this frequency. An additional bias resistor could be added to the 52 MHz converter if desired but overall gain is more than adequate already.

In dual gate MOSFET mixers where local oscillator injection to gate 2 is employed, conversion gain increases with increasing injection voltage. Mixer noise figure remains fairly constant up to a certain value of local oscillator injection voltage and then begins to increase rapidly. In this circuit, and using a 40841, mixer noise rises above about 500-700 mV (RMS) injection voltage at gate 2. Output from the local oscillator is a little below this to avoid degrading mixer performance.

Both the mixer and RF stage were designed with cross modulation and overload performance in mind — a necessary requirement these days with Oscar 7 downlink frequencies near active FM channels, close spaced FM

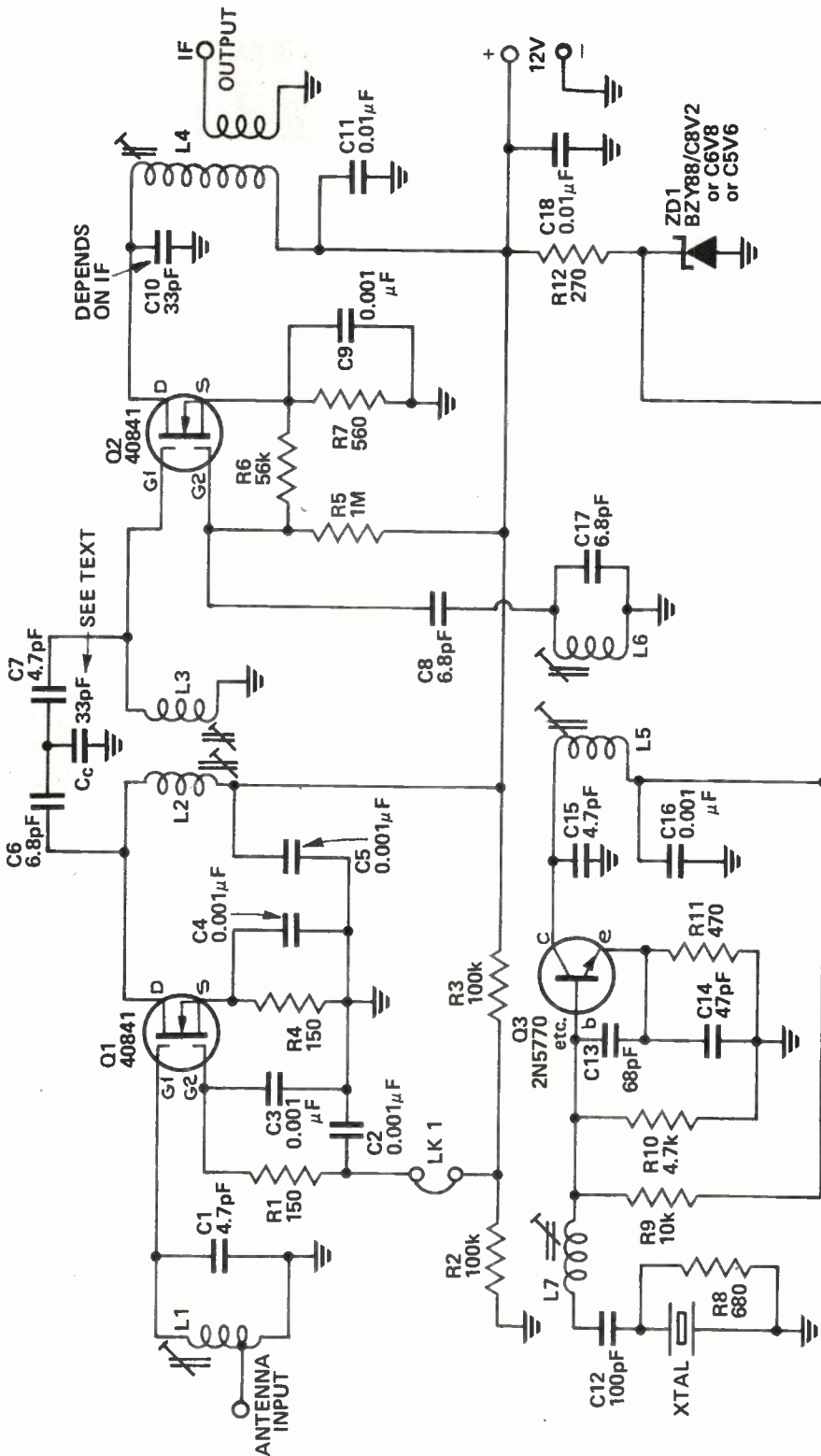


Fig. 3. Circuit diagram of 144 MHz converter.

### PARTS LIST 144 MHz

C1,7,15	4.7pF ceramic
C2,3,4,5,9,16	.001μF poly or ceramic
C6,8,17	6.8pF ceramic
C10	33pF ceramic — see coil details
C11,18	.01μF poly or ceramic
C12	100pF poly or ceramic
C13	68pF poly or ceramic
C14	47pF poly or ceramic
R1,4	150 ohms
R2,3	100 k
R5	1M
R6	56 k
R7	560 ohms
R8	680 ohms
R9	10 k
R10	4.7 k
R11	470
R12	270
Q1,2	40841 or substitutes see text
Q3	2N5770 or substitutes see text
Z1	B2Y88 C8V2 or C6V8 or C5V6
7 x 722/1 Neosid coil formers	
3 x 7100 Neosid cans	
2 x 7300 Neosid cans	
7 x slugs, 4 x 5 x 10/F29 coil wire	
1 x p.c. board	
1 x crystal — see table of frequencies	

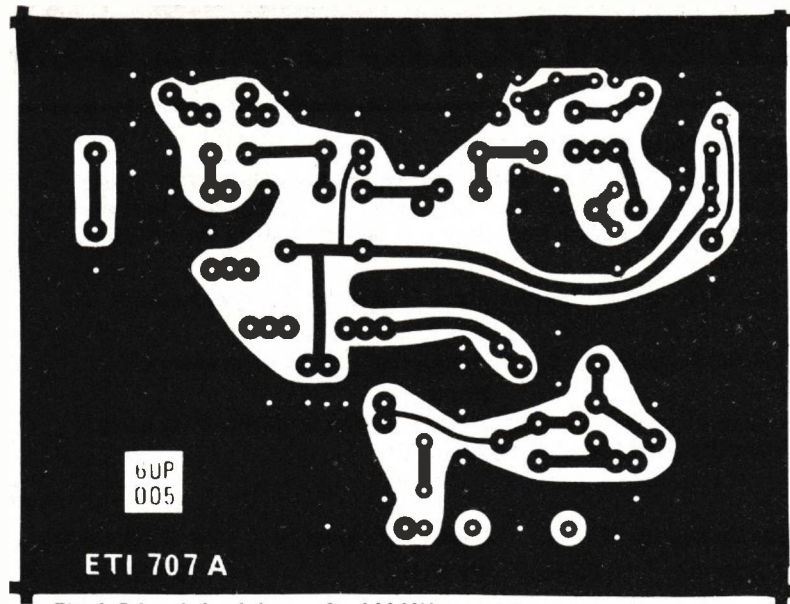


Fig. 4. Printed circuit layout for 144 MHz converter.

channels with high activity and increasing use of high power.

There are three signal tuned circuits — L1, L2 and L3, and associated capacitors. L1 is the input tuned circuit. It has a relatively low Q and consequently broad bandwidth. If out-of-band crossmodulation proves to be a problem, a two or three stage helical filter or coaxial filter is recommended. Noise figure will be degraded but this is a small sacrifice to gain freedom from interference.

L2 and L3 comprise a bandpass tuned circuit as previously explained. They are wound on Neosid type 722/1 formers and accommodated in a double shield can (type 7300). The bandpass is simply altered by changing the coupling capacitor C. A bandwidth in excess of 1 MHz is obtained with a 33 pF capacitor. This can be increased by reducing C to 22 pF. To decrease the bandwidth C can be increased to 47 pF or 56 pF. If C is replaced by a shorting link, a bandwidth of about 500 kHz results.

The IF output coil L4 may require resistive loading, depending on the load presented by the IF, to reduce Q if found necessary.

The coils in this converter do not require bases as the formers are glued either directly onto the printed circuit board or to holes in the p.c. board.

The oscillator circuit is a modification of the impedance inverting overtone oscillator and was originally described by the author in E.T.I., January 1975 ('Modern Crystal Oscillators', p. 46). Normally, the collector is grounded for RF and output is capacitively coupled from the emitter, as in the 52 MHz converter. Here however, the collector is tuned to a multiple of the crystal overtone frequency. The multiplication is limited to 2 or 3.

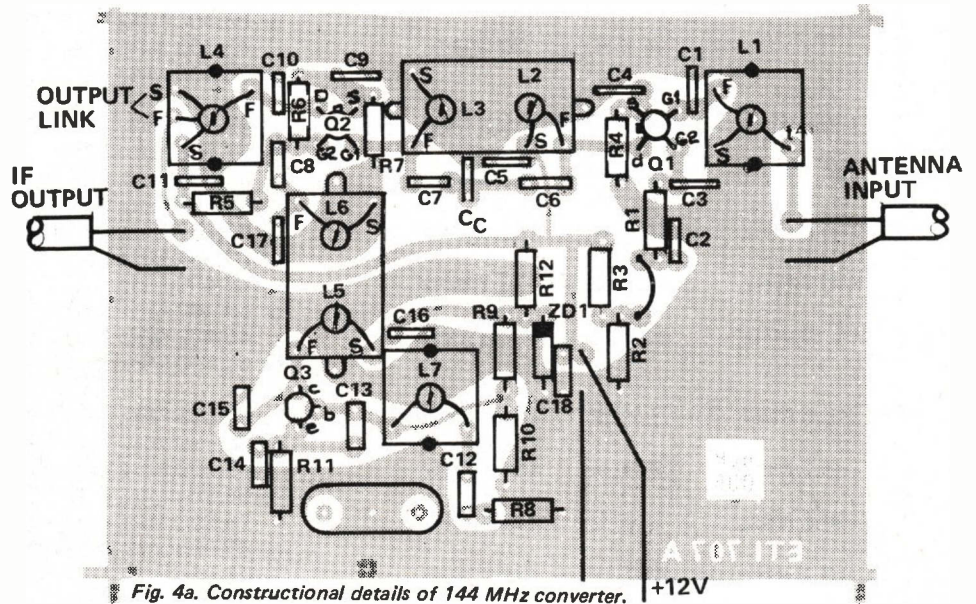


Fig. 4a. Constructional details of 144 MHz converter.

Coils L5 and L6 form a bandpass RF transformer on the injection frequency. Considerable attenuation of unwanted harmonics results. Some slight 'pulling' of the crystal can be noticed when tuning L5 and L6. This is normal and of little consequence as L7 can be adjusted to remove any shift. If desired, output for a transverter mixer may be capacitively coupled from L6. An amplifier or buffer may be necessary.

Coil L7 is used to trim the crystal to the correct frequency. Lightly couple a digital frequency meter to L5 or L6 when trimming the crystal. Alternatively, a crystal calibrator coupled into the antenna input can be used once the converter is operational. Make sure your IF receiver is correctly calibrated.

The oscillator will require either third or fifth overtone crystals depending on the IF chosen. Crystals up to 45 MHz or so are usually third

overtone, those between 45 MHz and 65 MHz are usually fifth overtone. Overtone crystals operate in the series mode and no load capacitance need be specified. A stability and tolerance specification of 20 ppm is quite adequate for these frequencies.

A crystal socket for a style D crystal may be mounted on the board. Alternatively, crystals having pigtail connections may be soldered in place. Leads from the crystal pins to the appropriate place on the p.c. board are necessary.

The coil winding details, p.c. board layout and component overlay are given in Fig. 4.

It is best to commence by mounting the coil formers. They may be glued on the board over the pilot holes or the board drilled and the formers glued in the holes. Use the shield cans to locate and/or hold the formers on the p.c. board when glueing them directly to the board. It is wise to

# MODERN SOLID STATE CONVERTERS

## CRYSTAL FREQUENCIES

The local oscillator is *below* the signal frequency. The crystal frequency is multiplied by 2 or by 3 to obtain the injection frequency. The crystal frequency can be found from the following formula.

$$\text{Crystal Frequency} = \frac{\text{Lowest Signal Frequency} - \text{IF (for tuneable IF)}}{2 \text{ or } 3}$$

$$\text{or Crystal Frequency} = \frac{\text{Signal Frequency} - \text{IF (for Net channels)}}{2 \text{ or } 3}$$

A table of crystal frequencies and injection frequencies for various IF's and input frequencies is given below.

Input Frequency	IF	Injection Frequency	Crystal Frequency
144 MHz +	52 MHz +	92 MHz	30.666 MHz (x3) or 46.000 MHz (x2)
	28 MHz +	116 MHz	38.666 MHz (x3) or 58.000 MHz (x2)
	14 MHz +	130 MHz	43.333 MHz (x3) or 65.000 MHz (x2)
146.5 MHz	10.7 MHz	135.8 MHz	45.266 MHz (x3) or 67.900 MHz (x2)
146.7 MHz	10.7 MHz	136.0 MHz	45.333 MHz (x3) or 68.000 MHz (x2)
146.8 MHz	10.7 MHz	136.1 MHz	45.366 MHz (x3) or 68.050 MHz (x2)
146.9 MHz	10.7 MHz	136.2 MHz	45.400 MHz (x3) or 68.100 MHz (x2)
147.0 MHz	10.7 MHz	136.3 MHz	45.433 MHz (x3) or 68.150 MHz (x2)
146.5 MHz	9 MHz	137.5 MHz	45.833 MHz (x3) or 68.750 MHz (x2)
146.7 MHz	9 MHz	137.7 MHz	45.900 MHz (x3) or 68.850 MHz (x2)
146.8 MHz	9 MHz	137.8 MHz	45.933 MHz (x3) or 68.900 MHz (x2)
146.9 MHz	9 MHz	137.9 MHz	45.966 MHz (x3) or 68.950 MHz (x2)
147.0 MHz	9 MHz	138.0 MHz	46.000 MHz (x3) or 69.000 MHz (x2)

FM Net Channels

insert the slugs in the formers after glueing to avoid accidentally glueing them to the formers. Insert 20 mm or 30 mm of rubber string with the slugs to prevent them being loose.

Next, wind the coils according to the coil data. Take careful note of winding direction and start and finish connections. Do not mount the cans until all the minor components have been soldered in place.

When mounting the minor components, take particular care with orientation of the zener diode and the transistors. Mount all components right down on the p.c. board to minimize lead length.

## ALIGNMENT

If you have access to a sweep generator and CRO, alignment is quite straightforward and can be done to suit individual circumstances. Use the following procedure as a guide.

If narrow bandwidth is desired,  $C_c$  should have a value greater than the 33 pF specified as mentioned previously. Simple peak alignment at the centre of the passband is all that is required in such cases.

For broadband alignment, the following procedure is recommended. A tuneable IF covering the chosen IF range, with an S-meter, and a power supply delivering between 12 V and 15 V at 50 mA is necessary.

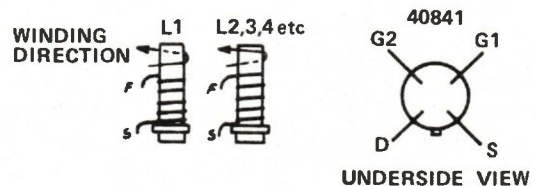
Connect power supply and IF. If the converter is working, some increase in the IF noise level should occur at switch-on. Check that the crystal oscillator is working. Removing the crystal produces a decrease in the IF noise level. A digital frequency meter, wavemeter or general coverage VHF receiver could also be used. Tune the slug in L4 to obtain a peak in the IF

## COIL DATA

Wind L2, L3, L4, L5, L6 and L7 *clockwise up* the former. L1 is wound *anti-clockwise up* the former. The start of each coil is the 'cold' or 'earthy' end. All slugs are F29 type ferrite.

L1	5 turns, 22 B & S tinned copper wire spaced over 10 mm, tap at 2 turns from cold end.
L2, L3	6½ turns, 22 B & S enamelled wire, spaced over 10 mm.
L4	closewound with enamelled wire, any gauge between 25 and 30 B & S
	28 MHz 12 turns 33 pF to resonate
	14 MHz 22 turns 68 pF to resonate
	10.7 MHz 25 turns 100 pF resonate

- L5, L6 5½ turns, 22 B & S enamelled wire, closewound.  
L7 \*10 turns, 28 B & S enamelled wire, closewound, for crystals in the range 30 MHz to 50 MHz.  
\*7 turns for crystals in the range 50 to 70 MHz.



noise level. Set all the other coil slugs flush with the top of each other.

2 Using a signal generator or some variable frequency signal source, peak L4 in the centre of the IF range.

3 Set the signal source to a frequency close to 144 MHz and tune the IF to the signal. Now tune the slugs in L2 and L6 for a peak. Use a low input level from the signal source for each adjustment.

4 Set the signal source to about 145 MHz and tune the IF to the signal. Tune the slug in L1 at this frequency. the same frequency, tune L5 for a peak.

5 Now set the signal source close to 144.5 MHz (i.e. about halfway between the two previous frequencies) and tune L3 and L4 for a peak.

7 Return to the lowest frequency and peak L2 again.

8 Repeat the procedure, just 'touching up' each slug.

If there is an appreciable increase in gain at the centre of the IF range L4 will need to be damped with a resistor. Commence with a value of 47 k, re-peaking the slug in L4 for each different value until gain is flat across the IF range.

This alignment procedure results in a bandwidth somewhat in excess of 1 MHz. Overall gain will be 25 dB or greater which is more than adequate for most applications.

If this converter is used as a net channel receiver front end, using

switched crystals, the following alignment procedure applies. A signal source for each channel is necessary. Again use a low level when carrying out the alignment. Other remarks also apply in this case.

1 Commence with all slugs flush with the top of each former.

2 Switch to the centre channel and peak L4.

3 Switch to the highest channel and peak L1 and L5.

4 Switch to the lowest channel and peak L2 and L6.

5 Switch to the centre channel and peak L3 and L4.

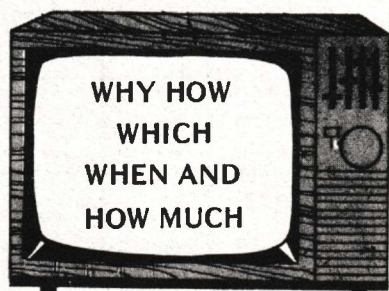
6 Return to the lowest channel and peak L2 again.

7 Repeat, touching up the slugs. ●

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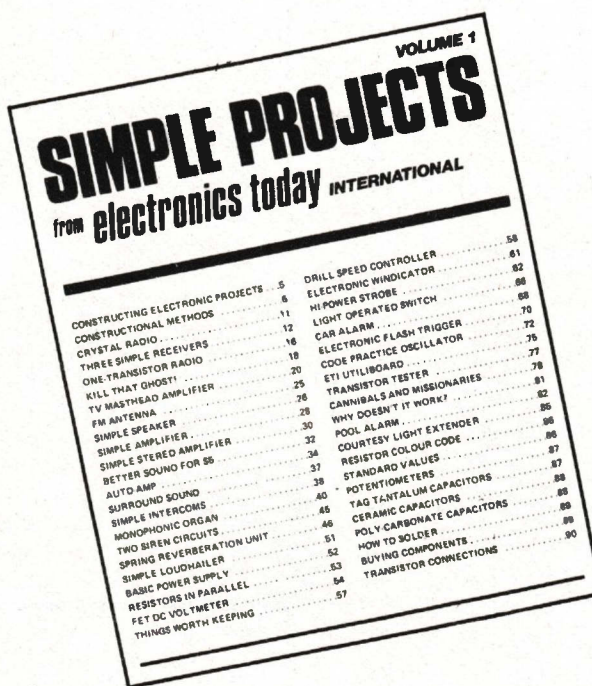
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7400	.14	7451	.17	74154	1.25
7401	.16	7453	.17	74155	1.07
7402	.15	7454	.17	74156	1.07
7403	.16	7460	.17	74157	.99
7404	.16	7464	.35	74158	1.79
7409	.19	7465	.35	74160	1.39
7405	.19	7470	.30	74161	1.25
7406	.35	7472	.30	74162	1.49
7407	.35	7473	.35	74163	1.39
7408	.18	7474	.35	74164	1.59
7409	.19	7475	.57	74165	1.59
7410	.16	7476	.39	74166	1.49
7411	.25	7483	.79	74170	2.30
7413	.55	7485	1.10	74173	1.49
7416	.35	7486	.40	74174	1.62
7417	.35	7489	2.48	74175	1.39
7420	.16	7490	.59	74176	.89
7422	.26	7491	.97	74177	.84
7423	.29	7492	.71	74180	.90
7425	.27	7493	.60	74181	2.98
7426	.26	7494	.94	74182	.79
7427	.29	7495	.79	74184	2.29
7430	.20	7496	.79	74185	2.29
7432	.23	74100	1.30	74187	1.95
7437	.35	74105	.44	74190	1.35
7438	.35	74107	.40	74191	1.35
7440	.17	74121	.42	74192	1.25
7441	.98	74122	.45	74193	1.19
7442	.77	74123	.85	74194	1.25
7443	.87	74125	.54	74195	.89
7444	.87	74126	.63	74196	1.25
7445	.89	74141	1.04	74197	.89
7446	.93	74145	1.04	74198	1.79
7447	.89	74150	.97	74199	1.79
7448	1.04	74151	.79	74200	5.90
7450	.17	74153	.99		

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74L02	.25	74L55	.33	74L91	1.45
74L03	.25	74L71	.25	74L93	1.69
74L04	.25	74L72	.39	74L95	1.69
74L06	.25	74L73	.49	74L98	2.79
74L10	.25	74L74	.49	74L164	2.79
74L20	.33	74L78	.79	74L165	2.79
74L30	.33	74L85	1.25		
74L42	1.49	74L86	.69		

### HIGH SPEED TTL

74H00	\$.25	74H21	\$.25	74H55	\$.25
74H01	.25	74H22	.25	74H60	.25
74H04	.25	74H30	.25	74H61	.25
74H08	.25	74H40	.25	74H62	.25
74H10	.25	74H50	.25	74H72	.39
74H11	.25	74H52	.25	74H74	.39
74H20	.25	74H53	.25	74H76	.39

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8092	.53	8220	1.49	8812	.89
8095	1.25	8230	2.19	8822	2.19
8121	.80	8520	1.19	8830	2.19
8123	1.43	8551	1.39	8831	2.19
8130	1.97	8552	2.19	8836	.25
8200	2.33	8553	2.19	8880	1.19
8210	2.79	8810	.69	8261	5.79
				8267	2.59

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4000A	\$.26	4017A	1.19	4066A	.89
4001A	.25	4020A	1.49	4068A	.44
4002A	.25	4021A	1.39	4069A	.44
4006A	1.35	4022A	1.10	4071A	.26
4007A	.26	4023A	.25	4072A	.35
4008A	1.79	4024A	.89	4073A	.39
4009A	.57	4025A	.25	4075A	.39
4010A	.54	4027A	.59	4078A	.39
4011A	.29	4028A	.98	4081A	.26
4012A	.25	4030A	.44	4082A	.35
4013A	.45	4035A	1.27	4528A	1.60
4014A	1.40	4042A	1.47	4585A	2.10
4015A	1.49	4049A	.59		
74C00	\$.22	74C74	\$1.04	74C162	\$2.93
74C02	.26	74C76	1.34	74C163	2.96
74C04	.44	74C87	1.13	74C164	2.96
74C08	.88	74C151	2.61	74C173	2.61
74C10	.35	74C154	3.15	74C195	2.66
74C20	.45	74C157	1.76	80C45	1.35
74C42	1.61	74C160	2.48	80C97	1.13
74C71	1.84	74C161	2.93		

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MM5330 - P channel device provides all logic for 4 1/2 digit voltmeter, 16 pin DIP with data \$14.95

### MEMORIES

1702A	14.95
2102	2.95
2102-1	3.25
2102-2	3.25
F93410	
256 bit RAM	2.19

### POCKET CALCULATOR

5 function plus constant - addressable memory with individual recall - 8 digit display plus overflow - battery saver - uses standard or rechargeable batteries - all necessary parts in ready to assemble form - instructions included.



Kit with AC adaptor included \$14.95  
Set of Alkaline batteries (disposable) \$2.50

### UNIVERSAL BREADBOARD

Silver plated copper circuit board 3-3/16" x 5-1/16". 2 rows of 27 holes for DIP IC's + space for transistors, resistors & capacitors. Versatile and simple for breadboarding IC circuitry \$1.50 ea. 50 pcs. 1.00 ea.

### LINEARS

308	mDIP	.69	TTL'S	
310	mDIP	.89	7441	.75
319	DIP	.92	7442	.59
320T-5v	TO-220	1.39	7443	.69
320T-12v	TO-220	1.39	7445	.69
			7446	.75
			7448	.79
			7483	.65
			7485	.79
			7496	.59
			74123	.69

### AFTER CHRISTMAS SPECIAL

### PULTRON V.I.P. QUARTZ REGULATED LED WATCH

MEN'S 5 function—hours, minutes, month, day and seconds. Latest slim-line design (prox. 1" thick) hour year calendar—requires setting only on February 29th. One year warranty against all defects in material and workmanship. Built-in phototransistor adjusts intensity of display. Gold tone—with adjustable mesh strap.



\$79.50

-\$1.50 Shipping & Handling

### USUAL DISCOUNT APPLIES

### RESISTOR ASSORTMENTS



Carbon film resistors (±5%) supplied in a convenient storage unit. Ideal for experimenters, industry and schools.

### RESISTANCE VALUES INCLUDED

1.0	22	470	10K	220K
1.5	33	680	15K	330K
2.2	47	1.0K	22K	470K
3.3	68	1.5K	33K	680K
4.7	100	2.2K	47K	1.0M
6.8	150	3.3K	68K	1.5M
10	220	4.7K	100K	2.2M
15	330	6.8K	150K	3.3M

### RS 11-25 \$114.50

4000 resistors, 100 each value ± watt ±5% tolerance  
40 different values  
.095" dia. body x .250" length  
.024" dia. wire x 1.10" length  
temp. range -55 to 155 °C

### RS 11-50 \$69.50

2000 resistors, 50 each value ± watt ± 5% tolerance  
40 different values  
.146" dia. body x .354" length  
.031 dia. wire x -55 to 155 °C

### SHIPPED SURFACE MAIL

CARBON FILM RESISTORS 1/4 or 1/2 watt 5%

QTY	PRICE (EACH)	PRICE (Minimum 10 per value)	PRICE (Minimum 1 per value)
0-10	\$.10ea		
10-100	.07ea	\$.05ea	
100-1000		.04ea	\$3/100
1000-			2.25/100

### LED's

MV10B	Red TO 18	\$.22
MV50	Axial leads	.18
MV5020	Jumbo Vis. Red (Red Dome)	.22
	Jumbo Vis. Red (Clear Dome)	.22
ME4	Infra. red diff. dome	.54
MAN1	Red 7 seg. .270"	2.19
MAN2	Red alpha num. .32"	4.39
MAN4	Red 7 seg. .190"	1.95
MAN5	Green 7 seg. .270"	3.45
MAN6	.6" high solid seg.	4.25
MAN7	Red 7 seg. .270"	1.19
MAN3	Red 7 seg. .127"	
	straight pins	.29
MAN8	Yellow 7 seg. .270"	3.45
MAN66	.6" high spaced seg.	3.75
MCT2	Opto-iso transistor	.61

### 6 DIGIT LED CLOCK KIT \$12.95

INCLUDES:  
MM5514 clock circuit  
6 FND70 LED displays (.250" red 7 segment)  
All necessary transistors, resistors & capacitors  
1 double sided PC board accommodates LED's & clock circuitry  
Schematic & instructions  
Does not include 12V-300 ma transformer, switches & case

### MULTIPLE DISPLAYS

NSN33	3 digit .12" red led 12 pin fits IC skt.	\$1.79
HP45082	5 digit .11 led magn. lens	3.49
HP5082	4 digit .11 LED magn. lens com. cath.	3.25
FNA37	9 digit 7 seg led RH dec chr. magn. lens	4.95
SP-425-09	9 digit .25" neon direct interface with MOS/LSI, 180 VDC, 7 seg.	1.79

### SHIFT REGISTERS

MM5013	1024 bit accum. dynamic mDIP	\$1.75
MM5016	500/512 bit dynamic mDIP	1.59
S15-4025	QUAD 25 bit	1.29

### MEMORIES

1101	256 bit RAM MOS	\$ 1.50
1103	1024 bit RAM MOS	3.95
1702A	2048 bit static PROM UV eras.	17.95
2102-2	1024 bit static RAM	4.25
5203	2048 bit UV eras PROM	17.95
5260	1024 bit RAM	2.49
5261	1024 bit RAM	2.69
5262	2048 bit RAM	5.95
7489	64 bit ROM TTL	2.48
8223	Programmable ROM	3.69
74200	256 bit RAM tri-state	5.90

### CALCULATOR & CLOCK CHIPS

5001	12 DIG 4 funct fix dec	\$2.49
5002	Same as 5001 exc btry power	2.79
5005	12 DIG 4 funct w/mem	2.99
MM5725	8 DIG 4 funct chain & dec	1.98
MM5736	18 pin 6 DIG 4 funct	4.45
MM5738	8 DIG 5 funct K & mem	5.35
MM5739	9 DIG 4 funct (btry sur)	5.35
MM5311	28 pin BCD 6 dig mux	4.45
MM5312	24 pin 1 pps BCD 4 dig mux	
		3.95
MM5313	28 pin 1 pps BCD 6 dig mux	4.45
MM5314	24 pin 6 dig mux	4.45
MM5316	40 pin alarm 4 dig	5.39

Data sheets on request. With order add \$3.00 for items less than \$1.00 ea.

### TANTALUM CAPACITORS solid - dipped ±20%

.1 mfd	35V	\$.25ea.	2.2 mfd	35V	\$.25ea
.33 mfd	35V	.25ea	4.7 mfd	35V	.25ea
.1 mfd	10V	.25ea	10 mfd	25V	.40ea
.2 mfd	20V	.25ea	33 mfd	10V	.40ea

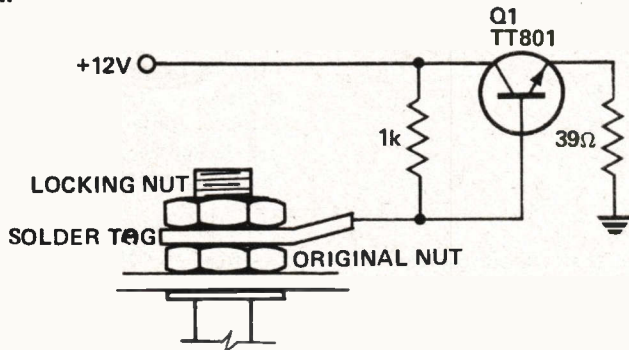
### LINEAR CIRCUITS

300	Pos V Reg (super 723) TO-5	\$.71
301	Hi Peri Op Amp mDIP TO-5	.29
302	Volt follower TO-5	.53
304	Neg V Reg TO-5	.80
305	Pos V Reg TO-5	.71
307	Op AMP (super 741) mDIP TO-5	.26
308	Micro Pwr Op Amp mDIP TO-5	.89
309K	5V 1A regulator TO-3	1.35
310	V Follower Op Amp mDIP	1.07
311	Hi Peri V Comp mDIP TO-5	.95
319	Hi Speed Dual Comp DIP	1.13
320	Neg Reg 5.2, 12, 15 TO-3	1.19
322	Precision Timer DIP	1.70
324	Quad Op Amp DIP	1.52
339	Quad Comparator DIP	1.58
340K	Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-3	1.69
340T	Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-220	1.49
372	AT-IF Strip detector DIP	2.93
373	AM/FM/SSB Strip DIP	.53
376	Pos V Reg mDIP	2.42
377	2w Stereo amp DIP	1.16
380	2w Audio Amp DIP	1.13
380-8	.6w Audio Amp mDIP	1.52
381	Lo Noise Dual preamp DIP	1.52
382	Lo Noise Dual preamp DIP	.71
550	Pre V Reg DIP	.89
555	Timer mDIP	



# IDEAS FOR EXPERIMENTERS

## CAR ALARM



This circuit may be used in conjunction with the ETI 313 Car Theft Alarm. It may be used to protect foglights and driving lights — other applications may also come to mind.

The ETI 313 alarm is triggered by any mechanism that causes current to be drawn from the battery.

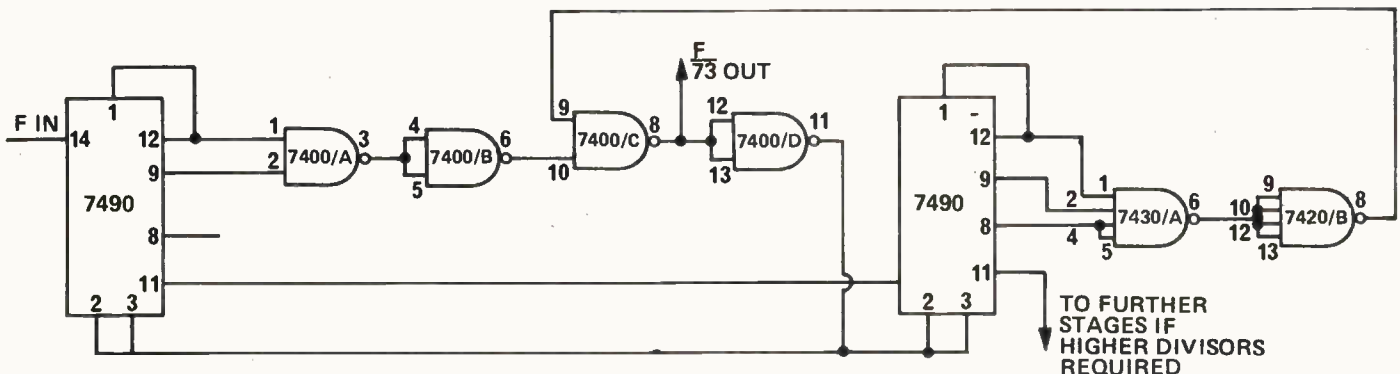
Here, the transistor is held off and removing the locking nut and tag will cause the transistor to be biased on, thus dropping the 12 volt supply via the 39 ohm resistor, and thus triggering the alarm.

Virtually any power transistor may be used in this circuit.

## LASH-UP PC BOARD

Quick breadboards or circuit lash-ups can be made with a large piece of p.c. board of suitable size with small, variously shaped, scraps or pieces cemented to it. Single or double-sided p.c. board can be used. Quick drying or 'instant' drying glues that can withstand heat are best, e.g. 'Super 500' or equivalent. It is an excellent form of construction for RF circuitry, particularly VHF-UHF circuitry. Small capacitors can be made in this fashion also. A 5 mm x 5 mm square of 2 mm thick fibreglass p.c. board stuck on a larger piece has a capacitance close to 5 pF.

## FREQUENCY DIVISION



Divisor	7490 PINS			
	11	8	9	12
0	-	-	-	-
1	-	-	-	X
2	-	-	X	-
3	-	-	X	X
4	-	X	-	-
5	-	X	-	X
6	-	X	X	-
7	-	X	X	X
8	X	-	-	-
9	X	-	-	X

This circuit is a means of frequency division by any prime number greater than ten (in this example 73). The need for this arose when I wished to experiment with a crystal controlled clock requiring a 50 Hz input. The only crystal I had available was a 1825 kHz which therefore required a divide by 10, divide by 10, divide by 5, and divide by 73.

The binary equivalent of decimal 3 on the first 7490 IC produces a logic 1 at the output of 7400B and the binary equivalent of decimal 70 produces a logic 1 at the output of 7420B. When both are present i.e. at every 73rd pulse IC 7400 D produces a reset pulse to the reset inputs of both 7490s. The pulse at the output of IC 7400C may

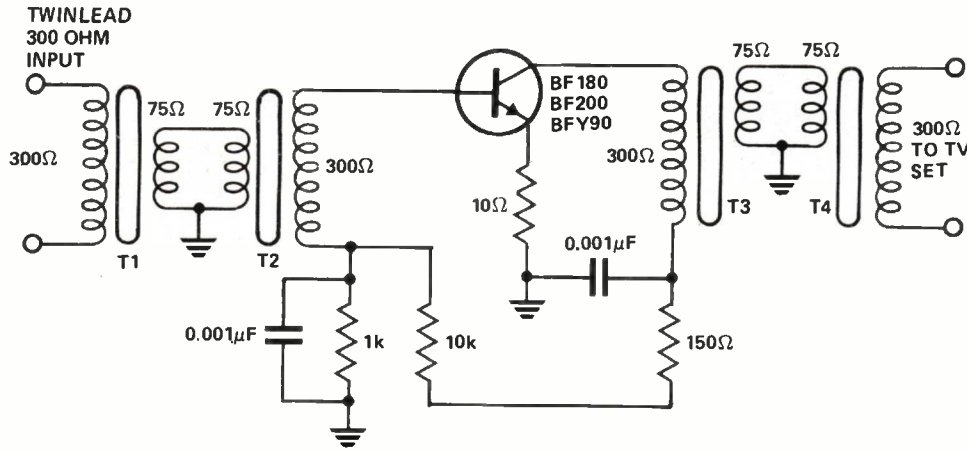
be used to drive further stages.

The connections for other dividing factors are shown as X in the table (left). The first IC in line counts the units, the second the tens, the third, if used, the hundreds etc.

It is suggested that leads be kept as short as possible, appropriate bypassing used and that the above stage be used after any other dividing stages to reduce the frequency at which it operates. The prototype operated successfully at 7 MHz — no higher frequencies have been tried.

Note that the configuration for BCD output must be used for the 7490s and that each must be connected for decade counting.

## WIDEBAND TV DX PREAMP

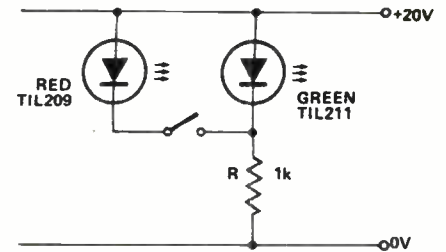


This little amplifier has a gain of more than 20 dB across the TV bands. The input and output transformers are inexpensive 300 to 75 ohm baluns. If 300 ohm balanced input and output is not required T1 and T2 can be omitted and coax cable used to connect to antenna and TV set. Some cross modulation may be experienced on other channels if used in a strong signal area of a local channel or other

VHF transmitter. A simple trap can cure this in many instances.

Use good VHF construction, keeping leads short. Orient the input and output transformers at right angles and keep them separated. A shield was not necessary but this may depend on construction. T1 and T4 may be mounted externally and connected to T2 and T3 via coax if desired.

## LED CHANGEOVER CIRCUIT

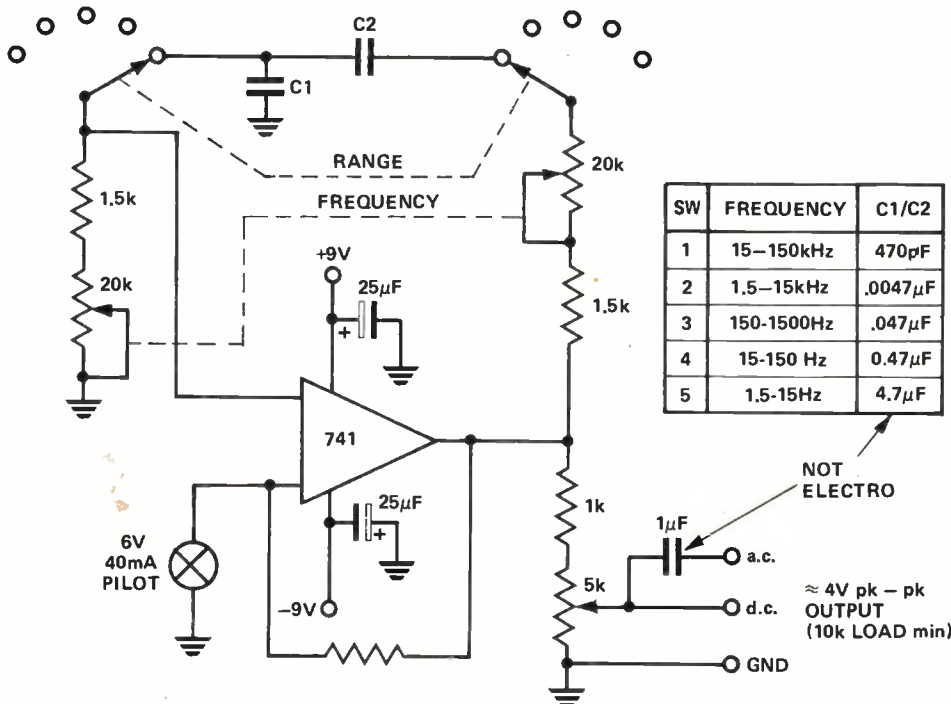


This configuration allows a green LED to be turned off and a red LED turned on by the operation of one "make" contact only, thus simplifying the design of circuitry to indicate, for example, safe/unsafe or standby/on states.

The circuit relies on the fact that a green LED has a slightly higher "on" voltage than a red LED of the same size, and hence is turned off when the red LED is paralleled with it.

For the diode types shown, R should be chosen to give a current drain of about 20mA from the chosen supply rail voltage.

## LOW COST AUDIO OSCILLATOR



This oscillator will cover the range from about 1 Hz to 150 kHz. It draws only 4 to 5 mA from two 9 V batteries and supplies about 4 V peak-to-peak output with 1% distortion or less.

All components are cheap and readily available. Note that the capacitors for the lowest frequency range should not be electrolytics, only

low voltages are encountered and small foil capacitors can be used. If more output is desired, the battery voltage can be increased to a maximum of  $\pm 18$  V but the 220 ohm feed-back resistor will need to be increased to reduce clipping of the output waveform. If clipping is encountered this resistor should be increased.

As the name of this section implies, 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.

Electronics Today is always seeking material for these pages. All published material is paid for - generally at a rate of \$5 to \$7 per item.

# ELECTRONICS IT'S EASY VOLUME II

We regret the delay in publishing this book. It should however be on sale in most areas by mid-January.

# WE TOOK THE TROUBLE TO FIND OUT WHAT YOU REALLY WANTED. THEN WE BUILT IT FROM THE GROUND UP.

At British Industries Co., we've been involved in Audio since 1936. We were agents for the manufacturers of some of the world's best equipment.

That meant we also dealt with the people who bought that equipment. We found out what they really wanted; but we weren't altogether satisfied with the way manufacturers met those wants — by adding on, or by altering, rather

than by starting over.

So, we decided to build our own. Our own turntables and our own speakers. We build them from the ground up. And we build them with one thing in mind. They must be what you want; they must have what you want; they must do what you want.

We offer them to you with the same very high degree of pride we're sure you'll feel in owning them.



## **We built a simpler machine to eliminate noise, vibration, and service problems.**

A modern multiple-play turntable is a complex, electro-mechanical device. To give acceptable performance it must operate at levels which approach perfection.

Every gear, cam, lever, pivot, spring and moving part that can be eliminated, eliminates a point of stress, wear, and possible malfunction.

Every part that isn't there eliminates a source of noise, vibration, resonance, and service problems.

Take a look underneath the finest, most expensive automatic turntables from other makers. And take a look underneath a B.I.C. When you do, bear in mind that it's fair to say . . . "the simpler the better".

## **We combined belt-drive with multiple play.**

Traditionally, automatics and changers have used the 'idlers' system — driving platters through a series of wheels called 'idlers'.

Unfortunately, many still do; and the distortion which results is simply not acceptable with today's sophisticated records and playback systems.

We chose to differ. We

chose to offer the benefits of multiple play; but to offer them with a belt drive — light years ahead in terms of distortion — and with a unique 300 RPM 24 pole motor which is inherently freer from noise and vibration than those which are found in even the best of conventional automatics.

You wanted the best of both worlds. So we built it.

And if anyone tells you it has to be manual to sound good, just ask them to close their eyes.

## **We built in a control panel to do what no turntable has ever done.**

The exclusive B.I.C. programme panel gives you 22 possible ways to play your records in automatic or manual modes. You can play a single side up to 6 times in a row, or play up to 6 records in a series.

If you want the second record to repeat once, fine. If you want it to repeat twice, still fine. You know what you want to hear, when you want to hear it, and how often.

And that's what we've got "built-in".

### *SPECIFICATIONS*

#### The Drive System

<i>Motor</i>	: 300 RPM, 24 pole synchronous impedance protected.
<i>Drive</i>	: Long life precision ground, elastomer belt.

- Pitch Adjustment* : Electronically controlled, approx.  $\pm 3\%$   
Built-in strobe (980 only)
- Turntable Speeds* :  $33\frac{1}{3}$  RPM, 45 RPM.
- Turntable Platter* : 12" Non Ferrous one piece machined die cast, balanced turntable.  
Weight kinetically matched to motor and drive system.
- Rumble* : DIN B better than — 65 DB
- Wow and Flutter (WRMS)* : Less than 0.05%
- Tone Arm* : Tubular aluminium construction, machined gimbals.  
Bearing friction less than 5 Mg. (Horiz.), 6-8 Mg (vertical).  
Pivot to stylus length — 8.6"  
Cueing system damped both directions.
- Dimensions* :  $17\frac{1}{16}$ " wide  
 $14\frac{11}{16}$ " deep  
 $6\frac{7}{8}$ " (cover closed)

## We're available in Australia:

Sole Australian distributors: International Dynamics (Agencies) Pty. Ltd., 23 Elma Road, North Cheltenham, 3192, Melbourne. 95 1820.

Available from: N.S.W.: M & G Hoskins Pty. Ltd., 37 Castle St., Blakehurst 2221, Telephone: 546 1464. QLD.: Stereo Supplies, 95 Turbot St., Brisbane 4000, Telephone: 21 3623. S.A.: Challenge Hi Fi Stereo, 96 Pirie St., Adelaide 5000, Telephone: 223 3599. TAS.: Audio Services, 44 Wilson St., Burnie 7320, Telephone: 31 2390. VIC.: Encel Electronics Pty. Ltd., 431 Bridge Rd., Richmond 3121, Telephone: 42 3762. W.A.: Albert TV & Hi Fi, 282 Hay St., Perth 6000, Telephone: 25 2699. A.C.T.: Duratone Hi Fi, Cnr. Botany St. & Aintree Crt., Phillip 2606, Telephone: 82 1388.



**WE TOOK THE TROUBLE TO FIND  
OUT WHAT YOU REALLY WANTED.  
THEN WE BUILT IT, FROM THE  
GROUND UP.**



The B.I.C.  
980

# We built a good big sound that doesn't need a \$4,000 amp. to get there. (But which won't waste it if you've already got one.)

Today's popular, low-efficiency speakers require about 50 watts per channel to deliver lifelike sound levels. Even our Formula 2 will deliver that same sound level with only 25 watts; the Formula 4 with 20 watts and Formula 6 with only 9 watts.

B.I.C. Venturi can handle lots of power, too. Feed a typical low efficiency speaker more than about 50 watts, and you're likely to push it into distortion — even self-destruction!

With B.I.C. Venturi you can turn up the power, without distortion or speaker damage. Even our compact Formula 2 can safely handle 75 watts per channel.

Formula 6 — 125 watts!  
So much for the loud. With

most speakers, turn down the volume slowly and you reach a point where the sound suddenly fades out.

That's where our Dynamic Tonal Balance Compensation circuit (pat. pending) takes over. As the volume goes down it adjusts frequency response, automatically, to compensate for the ear's deficiencies. The result: aurally "flat" response, always!

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Available from: N.S.W.: M & G Hoskins Pty. Ltd., 37 Castle St., Blakehurst 2221, Telephone: 546 1464. QLD.: Stereo Supplies, 95 Turbot St., Brisbane 4000, Telephone: 21 3623. S.A.: Challenge Hi Fi Stereo, 96 Pirie St., Adelaide 5000, Telephone: 223 3599. TAS.: Audio Services, 44 Wilson St., Burnie 7320, Telephone: 31 2390. VIC.: Encel Electronics Pty. Ltd., 431 Bridge Rd., Richmond 3121, Telephone: 42 3762. W.A.: Albert TV & Hi Fi, 282 Hay St., Perth 6000, Telephone: 25 2699. A.C.T.: Duratone Hi Fi, Cnr. Botany St. & Altree Crt., Phillip 2606, Telephone: 82 1388.



**WE TOOK THE TROUBLE TO FIND OUT  
WHAT YOU REALLY WANTED. THEN WE  
BUILT IT, FROM THE GROUND UP.**



### Digital to analogue and analogue to digital conversion.

IN ORDER to control or modify the physical world around us we must first measure what is happening. The measurement data is almost always in analogue form, as is the actuation required for control. Between measurement and control some kind of electronic system is needed to amplify and shape the data.

We have seen that electronic systems may be of either analogue or digital form and it would seem best to use an analogue system between inputs and outputs that are both of analogue form. But not necessarily so — analogue systems are plagued with problems such as noise, dynamic range limitations, accuracy and linearity. Digital systems, as well as offering improved performance in the above areas, offer more economical processing of data, the ability to store data as long as needed, and more readable displays of data held within the system.

Thus there is much to be said for converting primary analogue signals into equivalent digital forms that are processed and stored etc until conversion back to analogue form becomes a necessity. Electronic sub-systems that perform these conversions are called Digital-to-Analogue Converters (DAC's or D/A converters) and Analogue-to-Digital Converters (A/D converters).

We will see that these are quite complicated systems in themselves — their design a skilled task. Nevertheless, many such sub systems are now marketed as single, largish circuit blocks that are wired into the total system in the same way as other complicated system building-blocks we have already encountered. It is, however, important to understand the basic techniques used if not so much the refinement of actual practice.

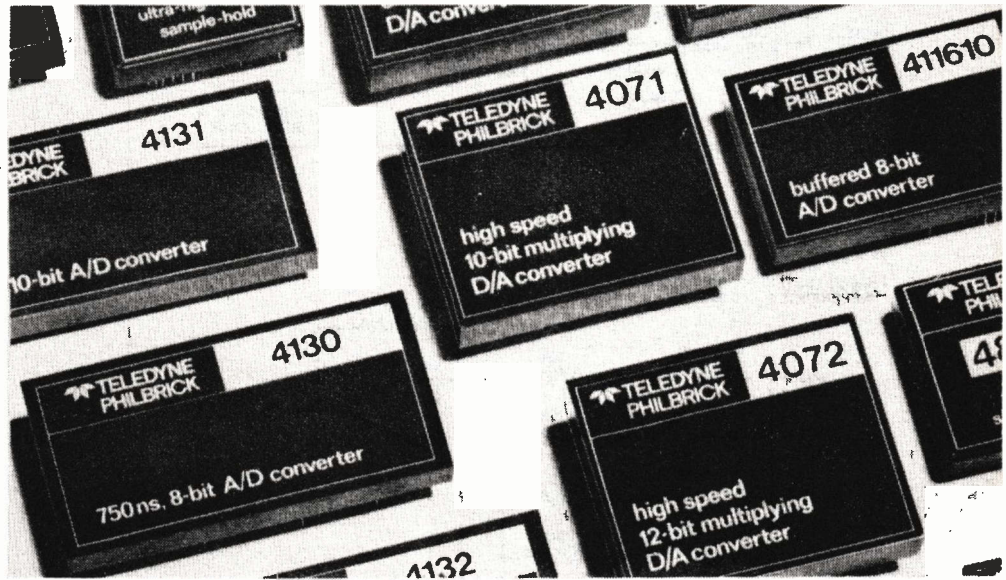


Fig. 1. Typical A/D converters.

By use of certain input combinations DAC's can also be used as multiplier/dividers of two signals and as summing/subtraction units. It is also relevant in this part to deal with multiplexers in a little more detail and with the so-called sample-and-hold circuit. These are often used in conjunction with DAC's.

Figure 2 illustrates the basic requirements of a typical data-acquisition system in which a number of physical variables are measured and processed to provide digital signals for storage. It uses multiplexer, sample-and-hold, and A/D converter sub-systems to form the whole.

Also pertinent, because similar techniques are involved, is the method for converting an analogue voltage to a signal of proportional frequency (which is a form of digital signal) —

the Voltage-to-Frequency or VF converter.

The uses for A/D and D/A converters are limitless. Their application is ever-increasing as the unit cost falls to undreamed-of prices. Extreme complication using digital techniques often costs far less than simpler but less accurate analogue alternatives. Hence D/A and A/D converters will be found in digital panel meters, digital multimeters and data acquisition systems. They are also found in industrial plant; in process control of chemical and other manufacturing plant; in telemetry systems and other data transmission applications; in the interfaces (units matching the output signal requirements of one system with the input requirements of another) found between sensors and computing units; between stages of hybrid computers; and the like. Although

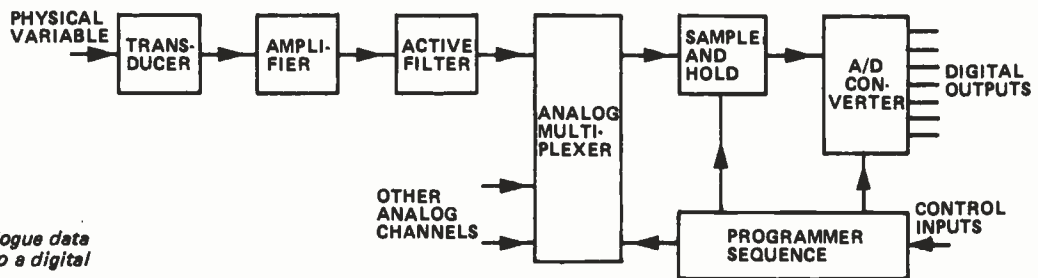


Fig. 2. Typical layout of an analogue data acquisition system interfacing to a digital output.

Fig.3. Schematic of a digital to analogue converter which provides a current or voltage output. To obtain a voltage output the current output is fed to an op-amp.

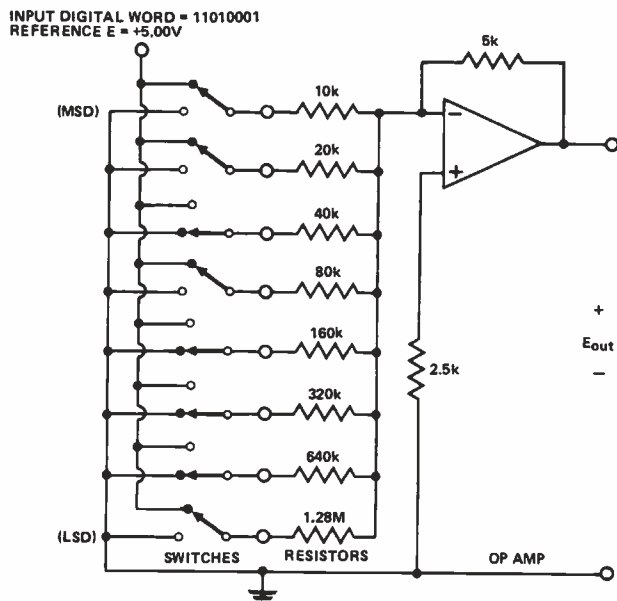
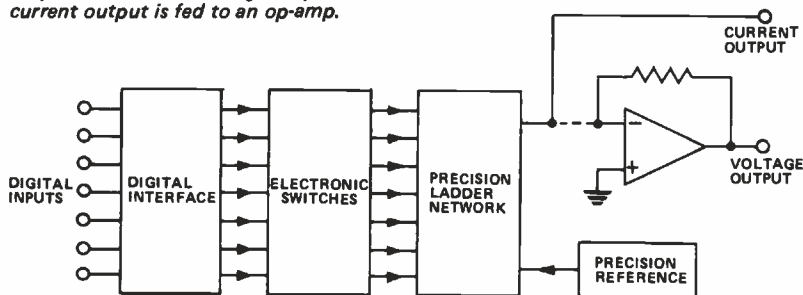


Fig.4. Switched resistor network of 8-bit, binary weighted D/A converter. 11010001 is being converted.

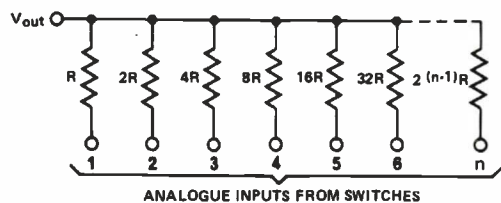


Fig.5. Basic binary-weighted resistance sequence.

highly accurate DAC's may cost as much as \$2000 the great universal demand has resulted in lower performance units being available for as little as \$10.

## DIGITAL-TO-ANALOGUE CONVERSION

We begin with Digital-to-Analogue converters because they are the simplest in concept and use only one basic technique.

You will remember that each digit position of a binary number (held in a register, counter or other form of storage) has a weighting factor, eg 1:2:4:8 etc. An analogue signal equivalent to the binary number can be obtained by using each digital digit position to switch an amount of current (proportional to the position weighting) to a common summing junction. This system concept is shown in Fig.3. When voltage output is

needed the currents feed an op-amp. The detail of a precision ladder network is shown in Fig.4 — it is set to convert the input digital number 11010001 by appropriate positioning of the digit position switches. When at 0 input the inputs to the summing op-amp are held to ground; when at 1 to an appropriate stabilized voltage.

The simplest form of ladder is used in the circuit of Fig.4. It arises from the use of a binary weighted resistor sequence shown in Fig.5. The actual values of resistors are selected to obtain adequately sized lowest and largest values, for at either end the op-amp loses accuracy due to imperfections of resistance ratios. It can be seen from the circuit of Fig.4 that resistors, even in a smallish capacity 8 bit converter, can extend to extreme values. The least significant bit must be clearly resolved when its switch operates, implying that all other resistors must have precision of absolute value and constancy with time that rises very rapidly with the number of bits required.

In practice this simple form of ladder is not used beyond about 8 bits conversion due to the cost of the precision resistors required.

The disadvantages of the simple ladder method are mostly overcome by the use of the R-2R ladder network shown in Fig.6. The through leg of the chain is permanently grounded, each spur is switched as needed to a reference stabilised voltage level. The features of this method are that only two values of resistors are needed (an easier practical problem) and that the absolute range seen by the op-amp varies much less than the above method for a similar bit capacity — it presents a virtually constant impedance regardless of the binary code sequence switched in. With the R-2R ladder it is routine to provide 12 bit conversion.

It is probably obvious that other forms of digital-coding conversion can be handled by the use of appropriate resistor weightings. For example it is often necessary to chart-plot the output of a digital instrument. Thus a BCD to analogue converter is required for such applications. Figure 7 shows the weighting sequences for the simple and the R-2R ladder DAC's needed to convert BCD inputs to an analogue output.

**Resolution and accuracy** — DAC's rarely go beyond 12 binary bits (or 3 digit BCD) because the output analogue signal for greater bit-ranges must be of high stability. A 16 binary bit (or a 4 digit BCD) unit could provide  $\pm 0.005\%$  full scale linearity and accuracy, a performance requirement that is best avoided where possible because of the high cost of



the DAC. By contrast 8 bit DAC's can be obtained with accuracies ranging from  $\pm 0.2\%$  full scale to  $\pm 0.01\%$  full scale. It is important, however, to realise that whereas analogue resolution, see Fig.8, is a function of the number of bits that are equivalent to full scale, the accuracy and linearity of DAC's depend upon the tolerances and stability of resistors used in the conversion networks, for these decide the value of the slope and straightness of the slope — Figs 9a, 9b. It is, therefore, possible to have a highly accurate converter that has quite coarse resolution — in which case the resultant analogue output signal will consist of very large step changes. This step form of signal defect is called quantum or quantization noise. In practice resolution and accuracy are tied together keeping quantum noise to an acceptable level.

**Conversion and settling times** — As both D/A and A/D conversion are dynamic processes, a finite amount of time is required for each conversion point to reach its final value. In DAC's the switching and settling times of the op-amp largely dictate the time for a bit change to finally appear as a steady-state analogue signal level. Early DAC systems using mechanical switches were slow indeed — today output settling times range from a slow  $25\mu\text{s}$  for very-low power consumption units to ultra-fast  $25\text{ns}$  units.

**Temperature coefficient** — Each subsystem of a DAC has a temperature coefficient; resistances alter with temperature and the op-amp characteristics deviate. Both the overall conversion gain and the dc zero will be affected.

Gain will be affected due to the temperature coefficient of resistors which is typically from 50 to 100 PPM/ $^{\circ}\text{C}$  (100 parts per million, PPM, is equivalent to 0.001% change per degree Celsius). The main op-amp characteristic which affects performance is offset-voltage drift — typically 30 microvolts per degree Celsius.

For each particular type of DAC it is necessary to consult the makers' specification sheets, for no general rules apply for these parameters.

DAC's are available as either current or voltage output systems. Typical outputs deliver around 3 mA and 10-20 V swings.

Further explanation of terms used is to be found in the articles listed in the further reading section.

**Glitches** — Certain digital input states, whilst in a transient state, can cause the output to produce noticeable transients to the smooth, stepwise analogue — signal progression. These are known as glitches; examples

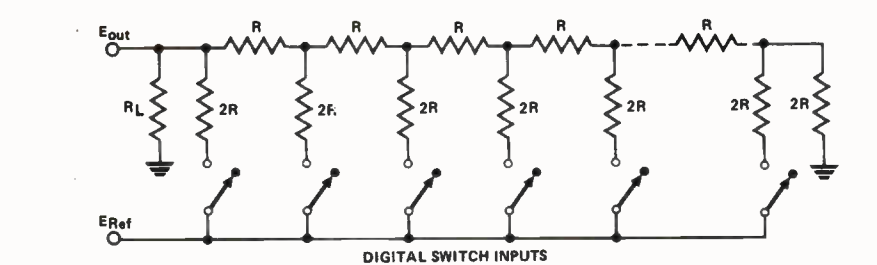


Fig. 6. The R-2R ladder network requires only two values of resistance and presents constant impedance to the output.

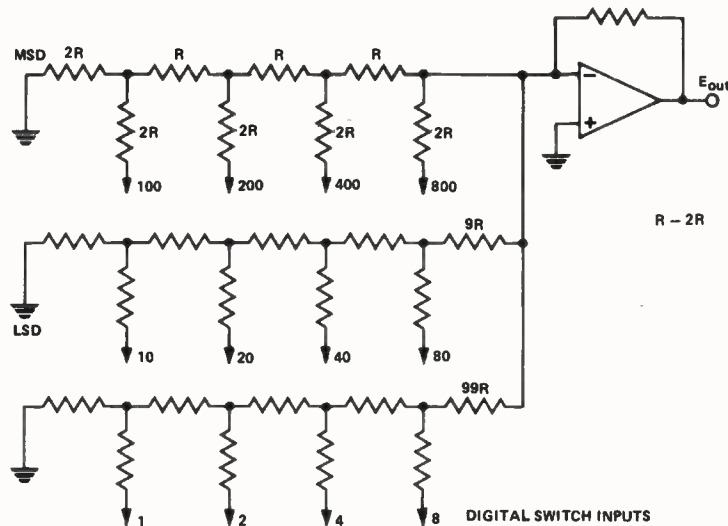


Fig. 7. Resistance layout for simple BCD-weighted DAC.

are shown in Fig.10. If the output is only to be observed after the system has settled, these matter little. In dynamic use of DAC's however, they may well excite unwanted behaviour in the system they are driving.

Deglitching in DAC's is not feasible with a low-pass filter on the output, for glitches vary widely in nature. The best solution is to use adequately fast and matched switching coupled with special deglitching, (sample-and-hold) circuits, that hold the output fixed during unwanted switching — transient conditions. Glitching states are, however, known states and are quite unlike random noise which defies prediction.

**Integrated circuit current sources** — As the DAC principle finds a variety of uses, manufacturers offer an integrated circuit which provides an output current, the magnitude of which is controlled by a four bit, binary-code input. The IC, as shown in Fig. 11, has

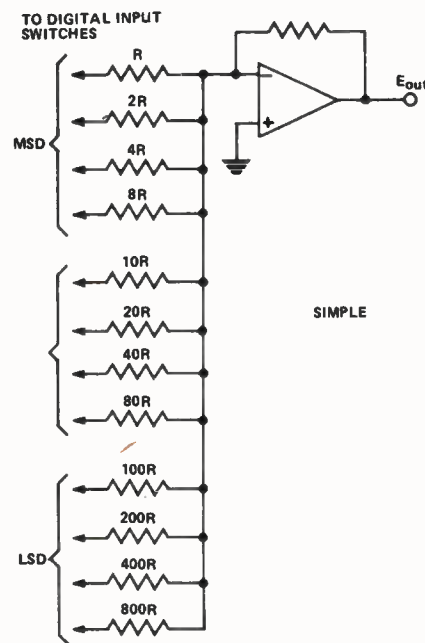


Fig. 7a. Resistance layout of R2R, BCD ladder D.A.C.

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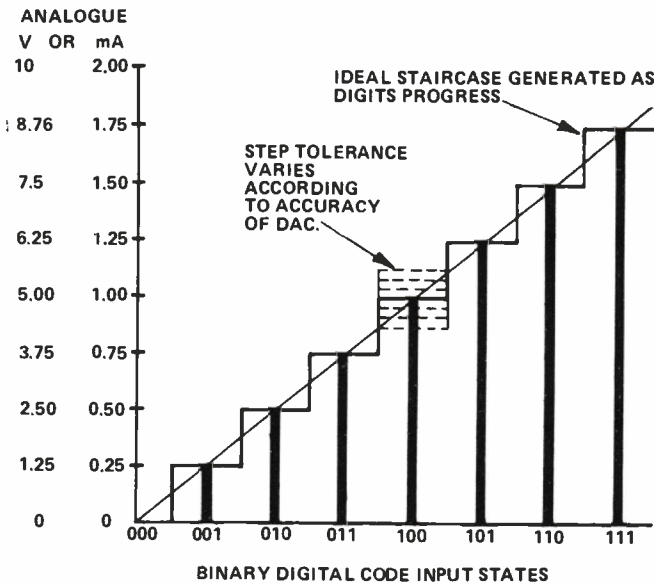


Fig. 8. Output/input characteristics of typical 3-bit DAC having full-scale current of 2 mA or 10 V output.

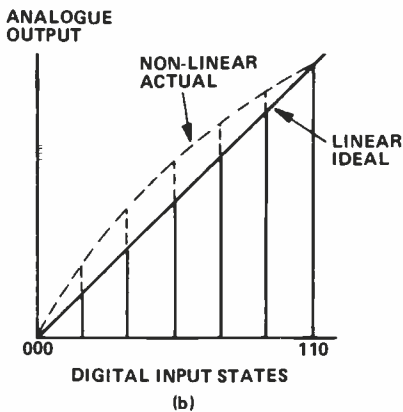
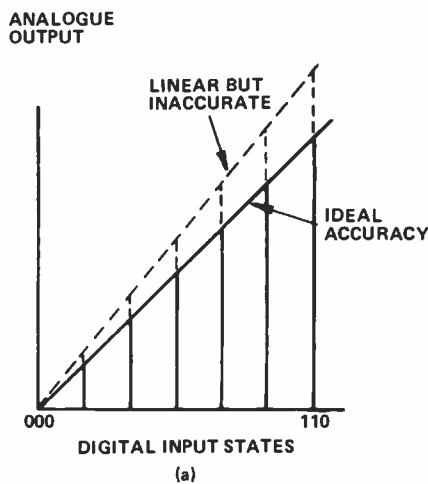


Fig. 9. Output/input definitions for DAC's (a) deviation of accuracy. (b) deviation of linearity.

enough precision to be used in 12-bit D/A and A/D conversion. Figure 12 illustrates how two of these ICs are combined to produce an 8-bit DAC.

**Digitally controlled sources** — The DAC's described above are usually concerned with signal processing as

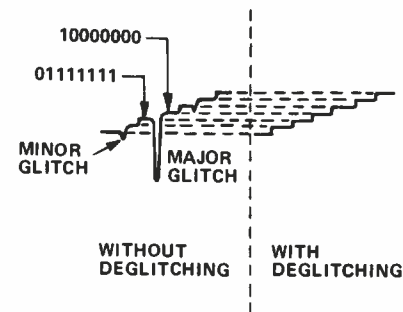


Fig. 10. Glitches occur in basic DAC's due to certain transient dynamic error conditions. They are eliminated by deglitching circuitry.

opposed to analogue power control. If larger output powers are needed digitally-controlled power supplies can be used — also referred to as digitally programmed supplies. They are available with digital control of current or voltage outputs. Instruments in the Hewlett-Packard range, for example, can provide up to 125 watt maximum demand whilst the output is controlled by binary or BCD inputs with a programming time of around 350 $\mu$ s.

## ARITHMETIC OPERATIONS WITH DAC'S

**Multiplication** — The resistor network of a DAC has two inputs — the reference supply (which is fixed in normal D/A conversion) and the switch inputs representing digital numbers. If the reference is allowed to vary as an input variable, see Fig. 13, the output of the DAC is the multiplicand of the two signal inputs. The reference may also be an ac signal and division and attenuation are also possible. The advantages of this

method are the high precision and speed available.

**Addition** — If the difference or sum of two digital signals is needed as an analogue output, two DAC's may be combined, as sum or difference, into the output op-amp, as shown in Fig. 14.

## ANALOGUE TO DIGITAL CONVERSION

Conversion from analogue to digital code can be obtained by many alternative techniques, each alternative having many variations. Basically, methods group into open-loop and feedback-loop systems. In each group some four to eight ways are in common usage. Here we look at a few of the most popular techniques, beginning with open-loop methods.

**Analogue-to-frequency** — The analogue voltage is converted, on a continuous basis, into a signal of proportional frequency by the use of an appropriately accurate V-to-F converter. (Voltage controlled oscillators are used — they must be adequately linear). This signal, see Fig. 15, is gated into a digital counter using fixed times of gate aperture. The counter accumulates a digital number equal to the average analogue level over the gate period. The counter output is released upon demand when gate periods expire. This method suffices for low accuracy analogue inputs but becomes expensive when precision, wide dynamic range is required.

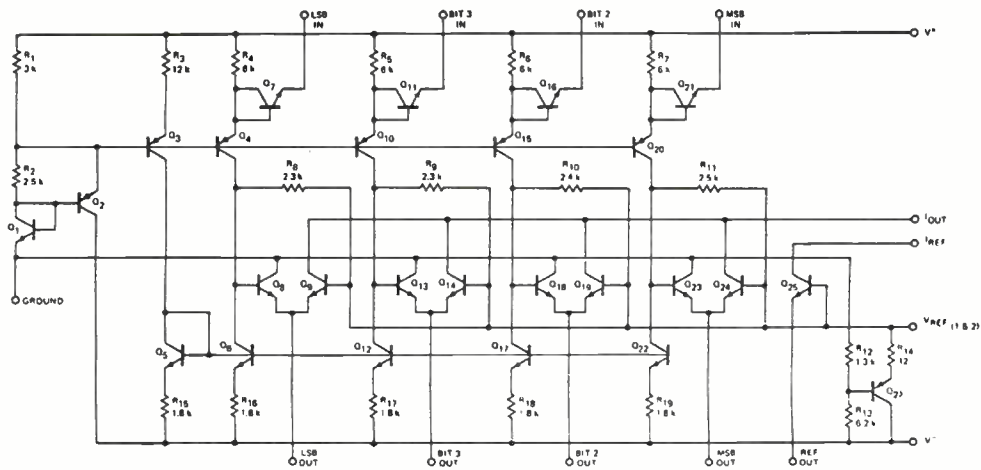
A variation of this is to reverse the philosophy and vary the pulse width of accurately generated pulses of constant frequency. The variable pulse width is then converted to a digital count proportional to the pulse width.

**Simultaneous, parallel or flash conversion** — The input analogue signal is presented to a stack of comparators (Schmitt trigger action) each set to trigger at increasing binary-weighted signal levels. The set of comparator outputs are then decoded to provide the required binary output form. Decoding is needed because at any instant all comparators set to below the signal level are in the one state, all above in the other. The method is given in Fig. 16. Although extremely fast — quantization time is the speed of a single comparator — the method has the serious disadvantage that large bit ranges require many comparators and numerous decoding gates.

**Closed-loop methods** — are more popular and there are about six main alternatives. The methods known as integrating, successive approximation and servo-DAC are most generally applied.

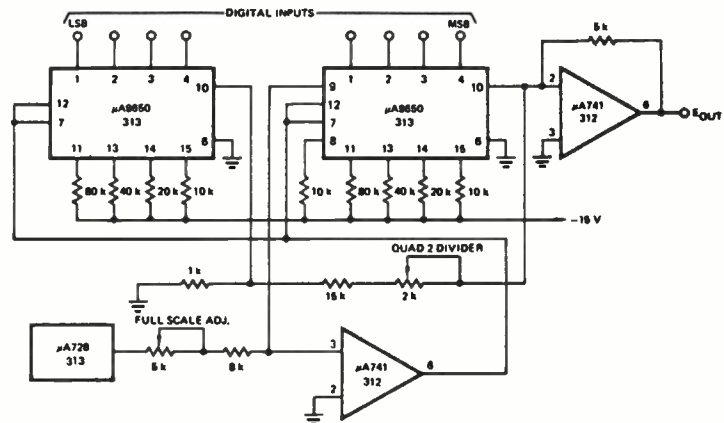
**Dual-ramp integration** — The

**Fig. 11. Schematic of dual-in-line 4-bit current source (Fairchild  $\mu$ A9650).**

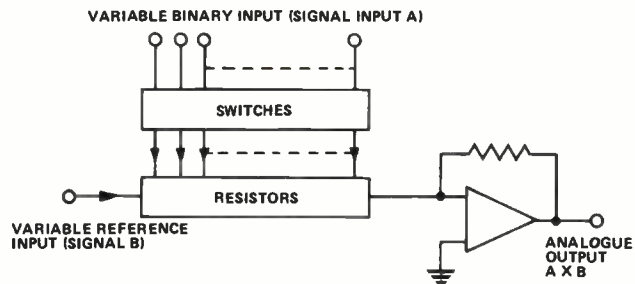


analogue voltage is first converted to a time period which in turn is converted into a binary number by a timer/counting system. Referring to Fig. 17a, conversion begins when the switch connects the analogue-signal input to the integrator which commences to ramp up. At the same time the counter begins, from zero, to count the clock pulses. When a predetermined number of pulses (1000 is convenient) appear in the counter the integrator is electronically switched over to the reference. At this point the capacitor has then charged linearly from the input, rising as a ramp to a voltage level decided by the average input-signal value as shown in Fig. 17b.

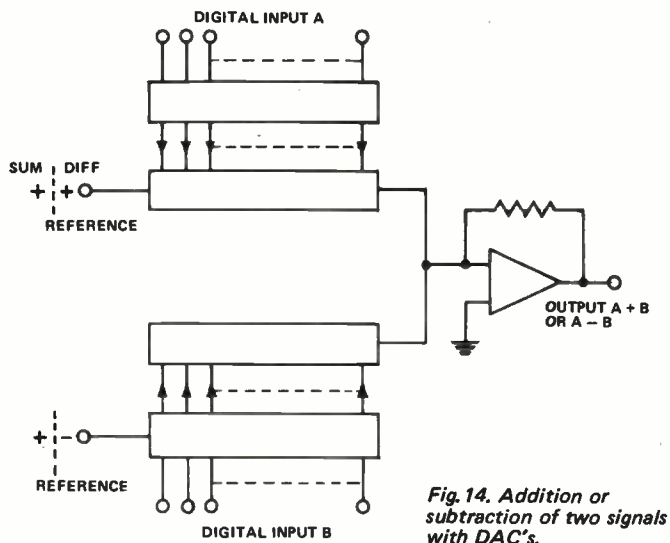
As the switch changes to the reference position the counter is reset to zero and begins counting again. The reference, chosen to be of opposite polarity to the input signal, now causes the charged capacitor of the integrator to ramp back downward at a constant slope. When the integrator output reaches the zero threshold the counter is stopped and its contents displayed. The count displayed is the ratio of downward ramp counts to



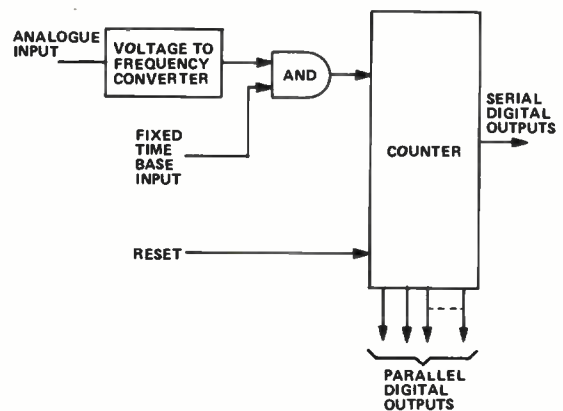
**Fig. 12. Applying 4-bit current source IC's to form an 8-bit DAC.**



**Fig. 13. Using a DAC to multiply an analogue signal by a digital signal.**



**Fig. 14. Addition or subtraction of two signals with DAC's.**



**Fig. 15. Voltage-to-frequency method of A/D conversion.**

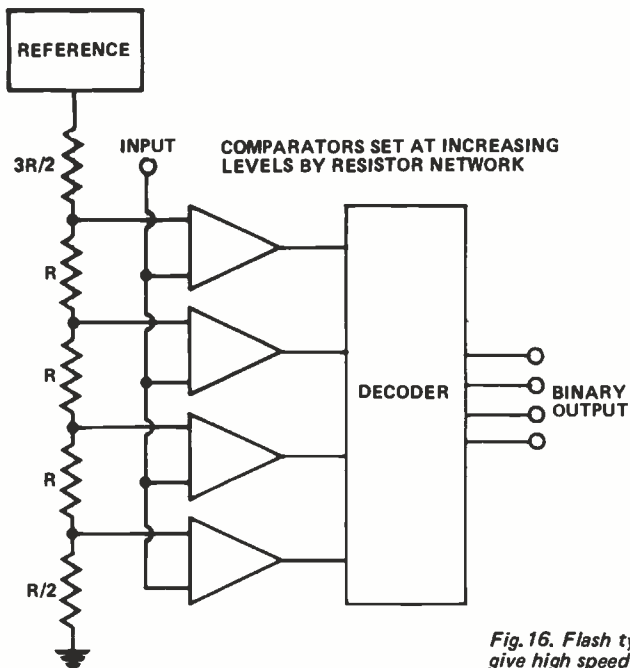


Fig. 16. Flash type converters give high speed A/D conversion.

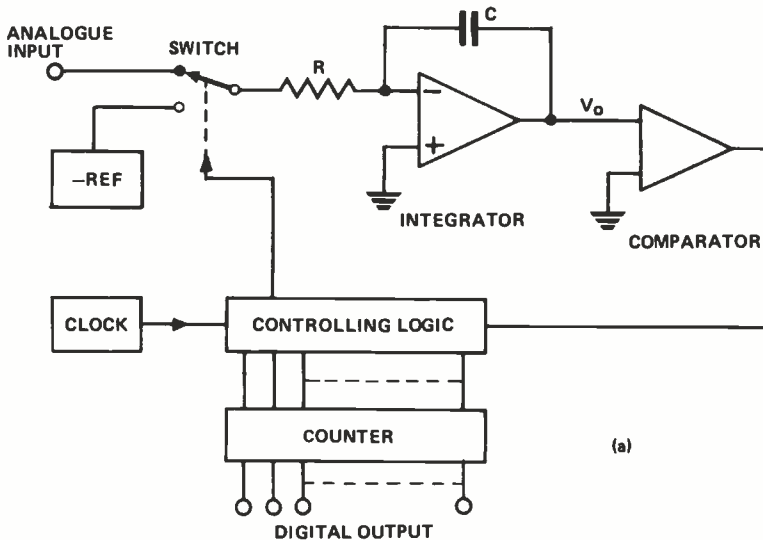
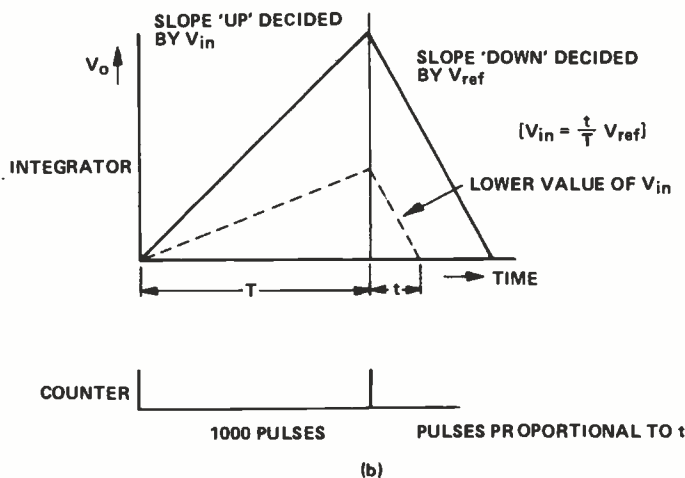


Fig. 17. A/D conversion using dual-ramp integration. (a) schematic (b) timing diagram.



upward ramp counts which, when a 1000 upward limit is used, gives a direct reading of input voltage if the reference voltage is appropriately chosen.

A simpler form, using only one ramp, is also used but it lacks the features of the dual-ramp method in which the absolute value of the capacitor and the clock frequency are of no significance provided they are stable for the duration of the conversion period. The dual ramp method does, however, require a relatively long conversion period but this is an advantage in one respect — the value measured is more accurate. This is due to the fact that when noise is integrated over an extended time period it tends to zero.

A more sophisticated triple-ramp method provides increased speed and accuracy for a moderate increase in cost and complexity. In essence two reference signals are provided, one acting as a 'coarse', the other as a 'fine' ramping control. The 'coarse' ramp rapidly converts the bulk of the input signal level leaving the 'fine' ramp to add the extra resolution. Figure 18 shows the schematic and timing diagram of a triple-ramp A/D converter.

**Successive approximation** — Due to its high resolution and fast conversion speed successive approximation is the most widely used method. A schematic diagram is given in Fig. 19. Conversion progresses step-wise with the precisely generated DAC output being compared against the unknown analogue input. The first comparison is made with the most significant digit of the DAC, which gives 1/2 full scale, being compared against the unknown. If it is smaller, the bit is retained as a '0', if larger it is set to '1', thus the MSD value of the programmer is found. The next digit, working towards the least significant end one digit at a time, is then tested for the same criteria being set accordingly. The process is repeated until all programmer digits are set to '0' or '1'. The value in the programmer is then transferred to the register for outputting in parallel or serial form. Conversion time is not decided by the value of input as in ramp methods, duration of conversion being the number of bits times a fixed digit test interval, which can be as fast as 100ns. By comparison, from one maker's options, successive approximation instruments offer conversion times which range from 1-60µs compared with 2.5-6.0ms for integrating converters. Accuracy clearly depends upon that of the DAC which forms part of the comparison system.

**Servo-DAC method** — Fig 20 shows this system. When conversion begins, a counter is gated and commences to

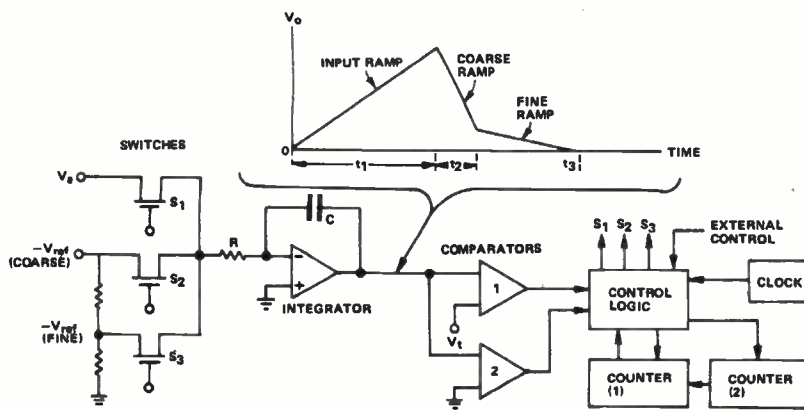


Fig. 18. Triple-ramp A/D converters offer faster speed for slightly more complexity of integrating method.

count upward. Its digital output is converted back to analogue form by a DAC. The output of the DAC is compared against the unknown input voltage. When the two analogue voltages are equal, the comparator inhibits the counter. At that time the value in the counter is a digital representation of the input – with 1:1 correspondence; or other ratios depending upon the summing resistances used. It is a simple low-cost method providing reasonable accuracy but operates at a slower speed than offered by successive approximation designs.

**Non-linear conversion** – Each bit of the above methods represents an equal quantum error. Thus one quantum error in full-scale is considerably less inaccuracy than in say a tenth or hundredth of full-scale. The smaller the reading, the greater the relative error of quantisation. When range-changing is not practicable a non-linear digital method can be used to compress the large scale in order to reduce the percentage of reading error. The method is explained in Motorola Application Note AN-471.

### SAMPLE-AND-HOLD UNITS

A digital signal provided by an A/D converter represents some measure of the analogue level seen in a certain gating period – the so-called aperture time. Aperture time, bit resolution and maximum signal frequency are strictly interrelated. Figure 21 is a chart enabling this characteristic to be found. For example, we may need to digitize a 10 kHz sinusoid (as the highest frequency to be preserved in a complex waveform) to a resolution of 12 bits. The chart shows we must have an aperture time of no greater than 42 ns. Thus we see extremely fast converters are needed for direct conversion of moderately high-frequency signals at high resolution.

A sample-and-hold circuit circumvents this difficulty by taking a rapid narrow-aperture sample of a

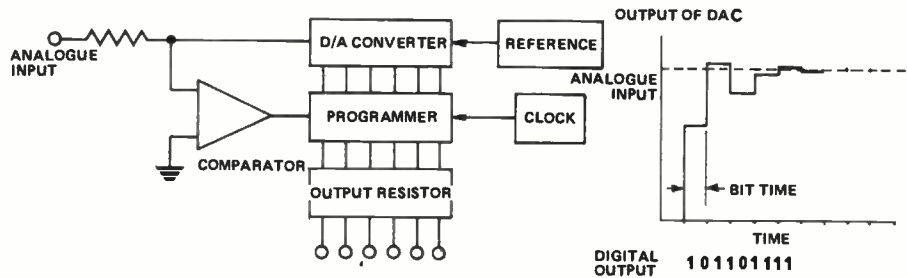


Fig. 19. In the successive approximation A/D converters a DAC is used to convert the incremented digital output back to analogue form for comparison with the input.

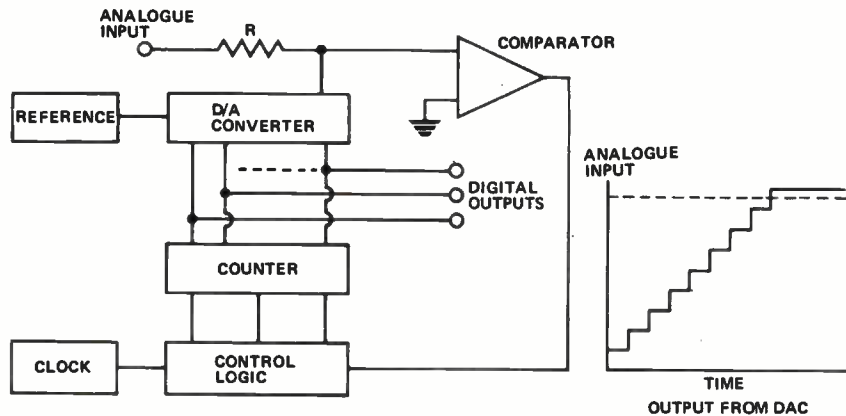


Fig. 20. Schematic of servo A/D converter system.

signal and holding it in a simple analogue store long enough for the converter to act with a much wider aperture time. Figure 2 shows such a system. To preserve the highest signal frequency of a complex signal we only need to sample at twice (or higher) the signal frequency (Shannon's sampling theorem). This is a considerably slower rate than needed for direct A/D conversion. If sampled too slowly, not only will higher frequency information be lost but an effect, called aliasing, will occur by which a lower frequency is generated that may not exist in the original signal.

As mentioned above sample-and-hold circuits are also used in DAC's to remove glitches.

Basically a sample-and-hold comprises a capacitor with which to store an analogue voltage level, and a switch to charge the capacitor to that

value in a way that can be rapidly and effectively isolated from the source. In practice low leakage FET switches are used in conjunction with IC op-amp integrators. It is also important to buffer the output of the sample-and-hold to reduce the loading which would otherwise decay the stored level.

Many circuit variations exist, the one shown in Fig.22 – a closed loop configuration – gives good linearity and accuracy. When extremely long storage times, or negligible decay with time is needed, the voltage on the capacitor can be transferred via an A/D converter into a digital storage register and back again into analogue form via a DAC as shown schematically in Fig.23. This naturally increases the cost considerably. More detailed information is available in "Analog-digital conversion handbook" TH6, by Analog Devices.

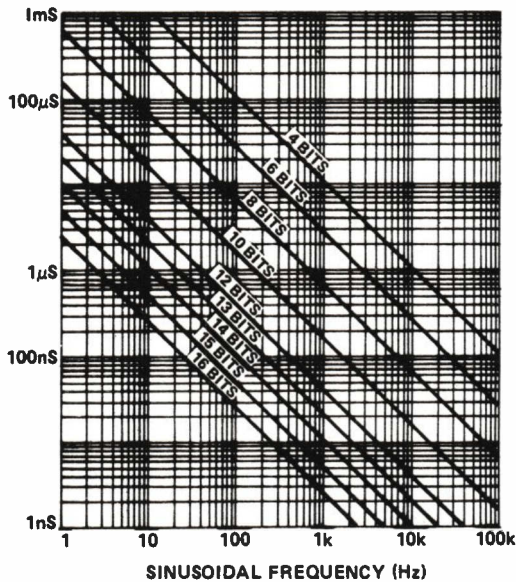
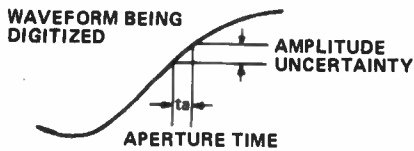


Fig.21. Graph showing relationship between aperture time required, resolution of signal conversion and frequency of sinusoidal signal undergoing conversion.

## MULTIPLEXERS

The task of the multiplexer, shown in Fig.2, is to sequentially connect a multiplicity of compatible inputs to a single output line. In the case given in Fig.2 it feeds a sample-and-hold, which stores the signal for A/D conversion.

A multiplexer consists, therefore, of as many switches as there are input channels to be combined. In practice these must possess adequate speed and very low on-to-off switch resistance ratio. Solid-state multiplexers mostly use MOSFET switching devices feeding a buffer stage (a voltage follower configuration which has extremely high,  $10^9$  ohms, input impedance). Fig.24 shows such an arrangement. Fig.25 is the internal schematic of an 8 channel unit which has an ON resistance of 300 ohms and OFF resistance of 100 megohms with 0.03nA leakage. The settling time to 0.01% of value is  $1\mu$  sec and it can be sequenced to 500 kHz. Channel selection is made via the appropriate digital-code input.

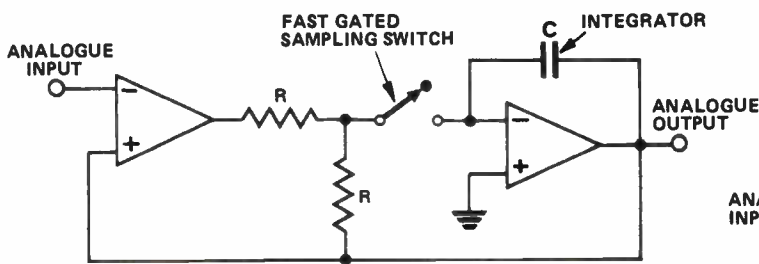


Fig.22. One form of stable and accurate sample-and-hold circuit.

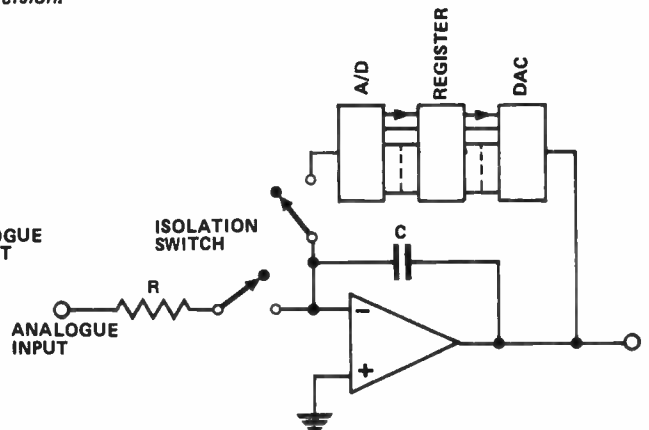


Fig.23. Infinite hold is obtained by transferring the integrated value into a digital store using A/D and D/A conversion.

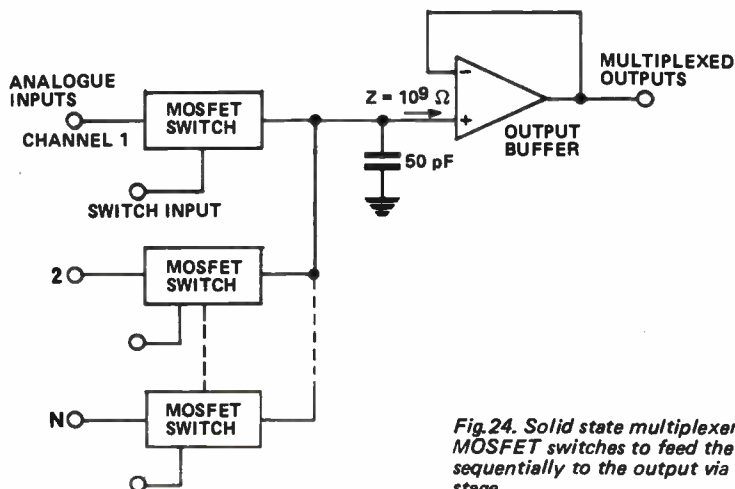


Fig.24. Solid state multiplexers use MOSFET switches to feed the inputs sequentially to the output via a buffer stage.

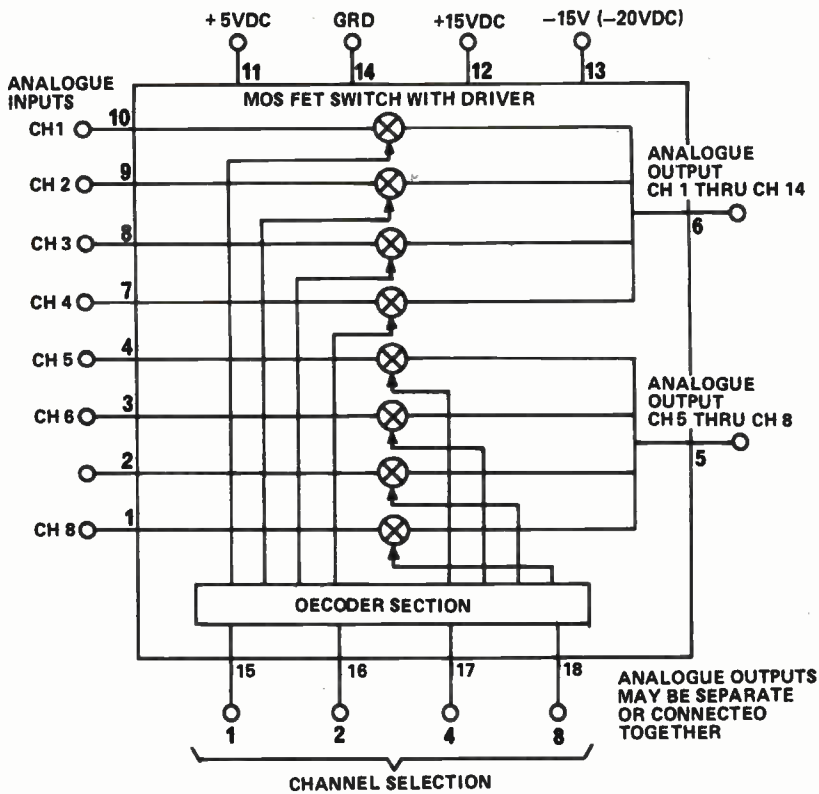


Fig.25. Internal schematic of Datel 8 channel, MM-8 multiplexer.

### FURTHER READING

A comprehensive discussion of the topics, and a long bibliography, of this part is to be found in "Analog-digital conversion handbook", D.H. Sheingold, Analog Devices, U.S.A. 1972. Less extensive but nevertheless very useful articles are - "Engineering product handbook", Datel Systems, CAT-T99405, 1974, U.S.A.

"Analog-to-digital conversion techniques", E. Renschler, Motorola Semiconductor Products Inc., AN-471, 1969, U.S.A. "Product Guide", Analog Devices, 1975, U.S.A. ●

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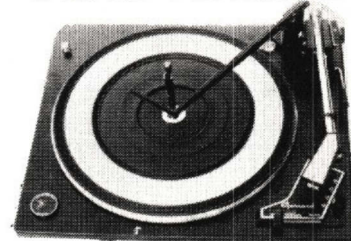
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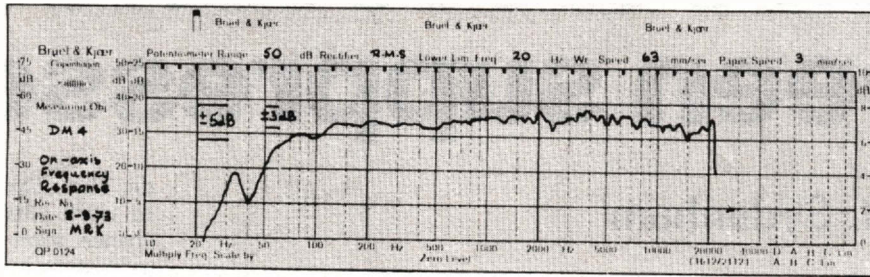
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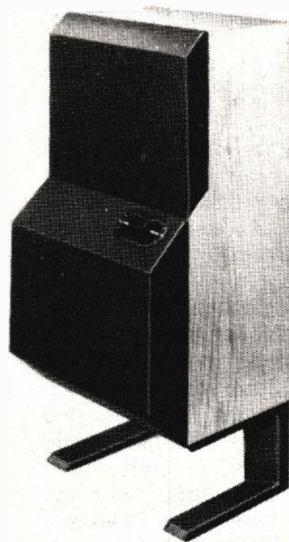
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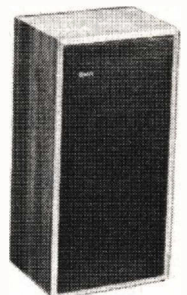
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# Have Tesla's discoveries been suppressed?

by Dr. P.H. Sydenham

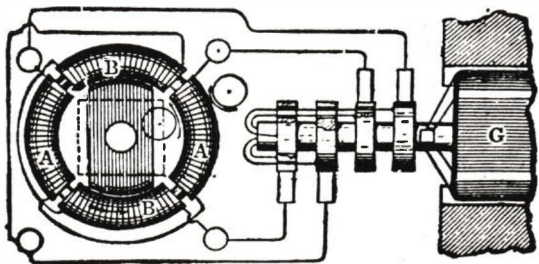


Fig. 1. Diagram used by Tesla in "The Electrician" to explain how a rotating field may be produced by a poly-phase system.

SEVERAL readers have pointed out that our two-part review "Radio – the true pioneers" (ETI, March and April 1975) omitted mention of the work of Tesla. Mr. F. Krogher of Kean Park, Victoria, for instance, refers to Tesla's prodigious patents in diverse areas of early wireless, and recommends a biography of Tesla by J. J. O'Neill – "Prodigal Genius, The Life of Nikola Tesla", London, Neville Spearman, 1968.

Dr. Sydenham, who compiled the history, stands severely knuckle-wrapped for the omission, but appeals (with F.K.'s support) that

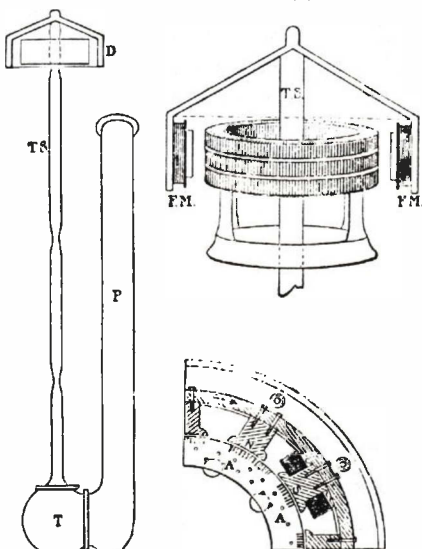


Fig. 2. Sketch of turbine and dynamo installed at Niagara Falls – 5000 horsepower at 2000 V. Ten units were installed. They consumed 260 000 lbs of water per second. Turbine (TS) shaft was 140 feet long of 38 in diameter. Penstock (P) delivers water to the turbine (T).

Tesla rarely gets a mention in connection with radio simply because that was not his main interest. Of the extensive collection of books used to compile the articles only two have entries at all on Tesla.

Tesla was born in 1856 in Smijan, Yugoslavia. It is recorded that he had an unusual flair for mental visualisation of complex ideas, a virtue also endowed on Faraday, one of the acknowledged greats in electricity at that time.

By the beginning of the 1880 decade, dc electrical machines were well on the way into routine commercial and domestic use as motors and generators. There were arc-lamps in homes and streets, electric house lifts, electrically lit jewels for the ladies, photo-flood lights, slide projectors. But ac transmission systems were scarcely exploited. In 1882 Tesla put his talents to this aspect of electricity utility.

Just prior to 1884, Tesla exhibited a working model of an ac machine in Paris. (Figure 1 is one of Tesla's own pictures.) He then began a campaign hopefully to persuade the emerging electrical giants, such as the Continental Edison Company, that ac transmission was more efficient than

dc. This episode resulted in a job offer to work with Edison in America. A chance soon came, the repair of dc generators in the ocean-going steamer 'Oregon', for Nikola to show his skills. He became Edison's chief assistant.

A few years later Tesla set up his own laboratory from which he finally reported (in 1888) the electromagnetic rotary field which enabled three-phase power transmission to be implemented. Shortly after this, George Westinghouse, of Westinghouse Electric Co., bought into Tesla's interests and built a hydro-electric system (see Fig. 2) of, enormous proportion at Niagara Falls. Tesla was a man of great generosity. It is said he tore up a contract binding Westinghouse to pay him \$12 million – saying that it was more important for the Niagara plant to keep the home-lights burning than for Westinghouse to become bankrupt because of a debt to him.

Notwithstanding his already significant work in power electrical engineering Tesla turned to thoughts of higher frequency (RF) currents – higher by far than the typical 100 Hz limit of power generators of that time. He became immersed in the relationship between magnetic fields, currents and the earth.

In our articles on the pioneers of radio it was shown how a spark discharge, produced with an inductor and capacitor, (Leyden jars to begin

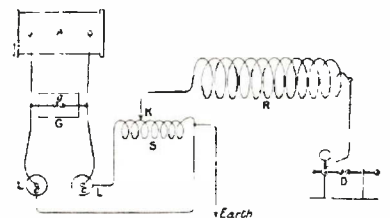
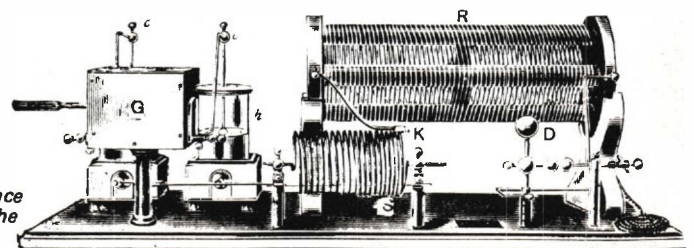


Fig. 3. Modern (at least in 1910) Tesla coil apparatus. The inductance coil A is not shown in the lower diagram.



with) was finally proven to be an oscillatory process lying typically in the radio frequency band. Rigs that produced such discharges continued to be developed. The addition of a vibrating bell-like contact or spark-gap discharge arrangements produced a continuous train of discharges. When step-up transformer action was also incorporated, the Tesla coil was formed. (Another name is the Ruhmkorff coil). Figure 3 is a 1910 Tesla apparatus – the inductance coil is not shown.

It was the spectacular things Tesla did with his radio frequency extremely high voltage generators that gained him so much fame. At a lecture to the American Institution of Electrical Engineers, given around 1891, he made a memorable impression being reported at the time as –

*"his work places Tesla among the greatest of our present-day scientists and inventors, such as Edison, Graham Bell and Thomson."*

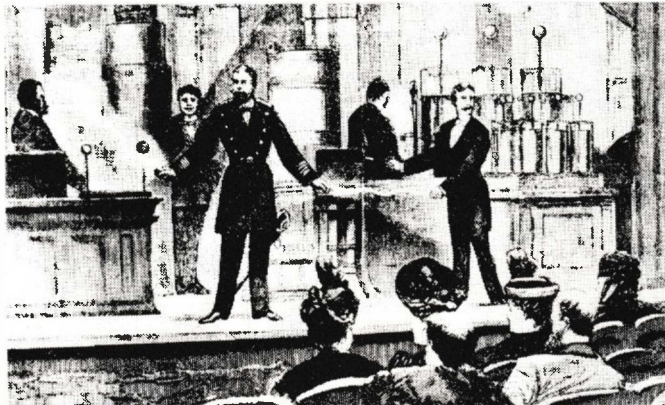
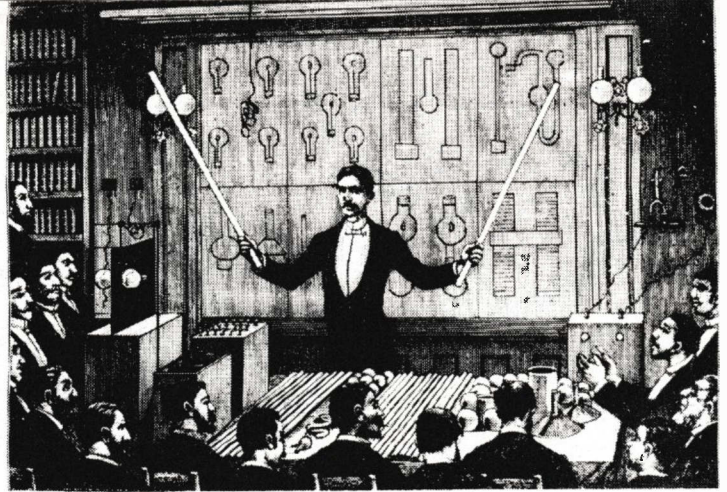
Invitations poured in for his spectacular displays with man-made lightning and RF discharges. His equipment used two kinds of generator. The first was a 384 pole ac dynamo running at 50 revolutions per minute to give 19.2 kHz. The other was a Ruhmkorff-type induction coil used with a condenser (capacitor) and a spark gap. This produced the then amazing half a million volts at "scores of thousands of cycles per second". It was the latter that impressed his audiences, for Tesla "brandished flaming swords like an archangel" – see Fig. 4. (or should it be arc-angel! – Ed).

Fortunately for everybody these RF discharges were not lethal but Tesla said when about to try them out for the first time (experimenters were naive to say the least), "it was as if I were poised to jump from Brooklyn Bridge".

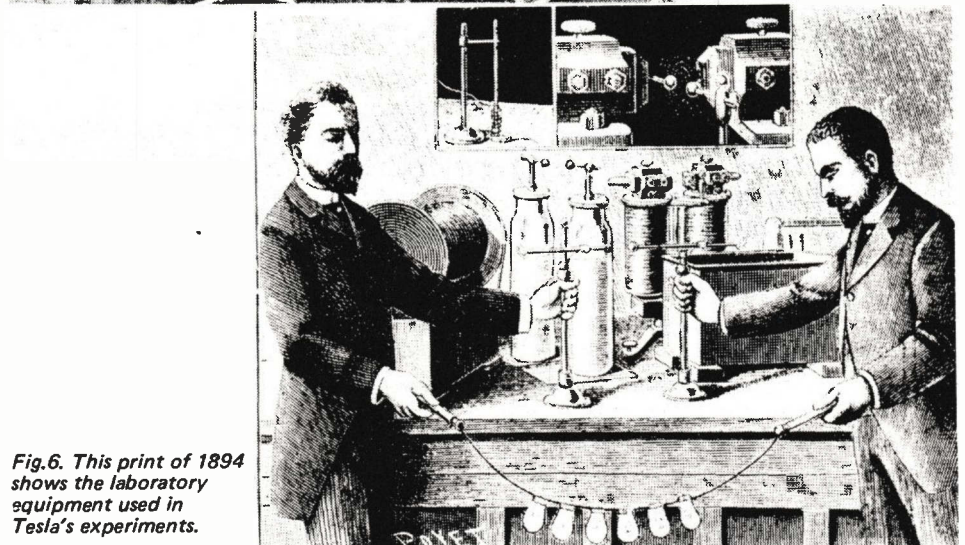
Demonstrations included drawing arcs between a string of people, as recorded, Fig. 5, in a contemporary magazine. Another was to make Geissler tubes (glass tubes filled with rarified air but having no electrical contact with external circuits) glow whilst suspended between, but well free of, the poles of his high-voltage transformer. Figure 6 is of an 1894 woodcut.

He also found (as did many others at the time) that the coils could be tuned to provide a desired frequency thus enabling wireless communication with selectivity to be produced. Tesla, however, had other interests in wireless transmission of energy – his vision was power transmission by RF currents rather than information transfer.

*Fig.4. Tesla amazed the scientific world in 1893 by holding glowing tubes aloft without any electrical connections being made to the tubes.*



*Fig.5. A contemporary print of Tesla's experiments conducted in Berlin in 1894.*



*Fig.6. This print of 1894 shows the laboratory equipment used in Tesla's experiments.*

In 1899 he built a huge experimental barn at Colorado Springs in Colorado – 30 metres long and 7½ metres wide on top of which was an 25 metre tower supporting a 60 metre mast. At the top was a 1 metre diameter copper ball.

He subsequently proved the earth is electrically charged at a high potential. A Los Angeles Free Press report talks of visionary ideas not yet exploited – use of the earth's resonance energy and the launching of waves of electrical energy to transmit power to places remote from generators. There is talk of charging the earth to produce tremendous voltages and of terminals to extract it. Tesla is said to have 'lit 200 incandescent lamps at a distance of 26 miles'. It is said his ideas failed

to be exploited by commerce because the transmitted electricity could not be charged for.

Tesla died in 1943, his last work being on the use of cosmic rays as energy sources. The Free Press report says the FBI seized his papers and confiscated all of his reports. Did Tesla have a unique and powerful secret? He certainly was a visionary, perhaps he did discover something great that is being withheld.

Today he is truly acknowledged. His name is used as the now adopted unit of magnetic field intensity and most laboratories possess Tesla-coils for ionising gas in evacuated tubes.

We would welcome a well-written and illustrated article on the later life of Tesla – can any reader assist? ●

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**CONVOY CONTUTOR  
LL Teaching Machine  
Cassette Recorder**

**\$99.50**

# Cassette Recorder

HI-FI Review recently arranged with Convoy International to supply our readers with the well-known Contutor LL cassette recorders at the very low price of \$99.50.

We now have a further (but definitely final) 200 machines available — and we are once again offering these to our readers for the original offer price of \$99.50.

The Contutor LL (language laboratory) Teaching Machines are cassette recorders specifically intended for educational applications and made to Convoy's specification by Sanyo. They are basically a high quality stereo cassette machine with additional features, outlined below:—

The machines operate from either mains or batteries. A power cord is supplied to enable the machine to be connected to the 240 volt ac mains. Provision is also made for operation from six dry cells which fit into a holder within the unit (batteries are not included). The unit may also be powered via a vehicle's 12 volt supply if the user obtains a 12 volt to 9 volt converter. A simple unit of this type was described in *Electronics Today International* February 1972.

Unlike most conventional recorders, the LL machines have an inbuilt condenser microphone. Two separate microphone inputs are also featured thus enabling true stereo recordings to be made.

A two-watt amplifier and 120 mm loudspeaker are inbuilt. These facilities enable recorded cassettes to be listened to immediately. It also enables the machine to be used

independently of other equipment, or even a mains supply, virtually anywhere. The reproduction quality is of a surprisingly high standard.

The main difference between the LL recorders and conventional machines is that *additional* facilities have been provided for teaching purposes.

In essence, extra controls and circuitry have been included to perform a number of functions.

One of the most useful and important facilities is the LL key. When this is depressed the erase head is not operative on the machine's first channel. This enables the teacher to record a series of words or musical phrases on one track — leaving gaps between each sequence of sounds. The pupil can then record his own attempts at reproducing these sounds on the second channel whilst listening to the teacher. Once this has been completed the pupil can then compare his attempts with the original simply by replaying the cassette. He can then wipe off his own track *without erasing the teacher's recording*. Removing the cassette tab makes accidental erasure of teacher-track impossible.

This LL facility is of enormous value — not only in language teaching but also in musical applications where a direct audible comparison is required between an original and a subsequent recording. It also allows 'self duets'!

A pause control is included. This enables recording to be started or stopped instantaneously. It also enables record levels to be set without setting the cassette in motion.

Two VU meters are provided. The left-hand one doubles as a battery condition indicator.

As with conventional recorders, the LL machine may be connected directly to a stereo amplifier and speaker system. A DIN to DIN connecting cable is provided for this purpose. Reproduction of mono or stereo cassettes is first class — as may be seen from the accompanying specification table. Thus recorded music can be replayed with excellent fidelity — a most valuable feature if the machine is to be used for musical demonstrations. Stereo recordings of high quality can also be made via the DIN cord from the amplifier.

The LL facility is also of value where a slide projector is to be synchronized with voice or musical accompaniment. The user can build a simple device that will cause pulses to be recorded on the right-hand channel. These pulses will then trigger a slide changing mechanism in the projector in synchronism with the accompaniment which will then be recorded on the left hand channel. Details of how to do this were published in the April 1972 issue of Electronics Today. Photostat copies of this project are available from our back issue dept for \$1.00.

Another most valuable feature is a variable speed control. This enables the playback speed to be varied by +5% and -15%. Thus when the machine is to be used for music teaching the pitch of recorded music can be varied to match exactly the pitch of the accompanying instrument/s. The speed facility is also valuable for syllable analysis and for fast revision.

Unusual extra facilities are also provided for fast winding. In one mode the wind and rewind facilities are as conventional machines. However if the 'play' key is depressed at the same time as the wind/rewind keys then the recorded part of the tape will be heard (at high speed) whilst fast winding is in progress. These facilities are very useful for rapidly selecting any required part of the tape. On the LL machines the rewind key is labelled 'review', the fast forward key is labelled 'cue'.

## NOTES

This offer is exclusively limited to readers of Electronics Today International and Hi-Fi Review.

The machines will be supplied to the purchasers by Convoy International — who will also be responsible for subsequent servicing and warranty rectification and/or repairs. Please remember that we run magazines, not the Post Office — so do please allow four weeks for delivery.

Delivery will be made by road freight or certified post. The cost of this is included within the offer price. We regret that we cannot offer any discount to readers who collect their machines directly from Convoy International.

Organisations wishing to claim sales tax exemption — please refer to note elsewhere in this offer.

Readers who would prefer to see a unit before committing themselves to purchasing may see a demonstration model at Convoy Technocentre. Their address is 1 Maclean St, Woolloomooloo, Tel. 358 2088. (The large white building facing the end of Plunket St.). They are open late on Thursday evenings and also on Saturday mornings. Ample car parking is available opposite the Technocentre.

All Contutor LL cassette recorders sold under this offer are warranted for a period of 90 days from delivery against defective workmanship and materials.

The warranty includes the cost of parts and labour, but not the cost of freight to and from Convoy International Pty. Ltd., 1 Maclean St, Woolloomooloo, NSW.

The special offer price of \$99.50 includes sales tax. Schools, Universities, religious bodies and certain other organisations can claim sales tax exemption.

For these organisations the special offer price is \$88. A valid official tax exemption certificate *must* be supplied.

## WHAT IS OFFERED

The price of \$99.50 (\$88 if a sales tax number or exemption certificate is supplied) includes the following:

- 1/ One Contutor LL cassette recorder
- 2/ One pair of stereo headphones
- 3/ One DIN to DIN connector
- 4/ Instruction manual

## MANUFACTURER'S SPECIFICATION

### CONTUTOR TEACHING MACHINE MODEL CT 5500LL

Manufacturer	Sanyo
Tape Speed	1 7/8" per second
Speed Adjustment	+5%, -15%
Fast Forward Time	120 secs (C 60 cassette)
Fast Rewind	120 secs (C-60 cassette)
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However because of the specialised nature of the Contutor LL recorder, sales were not generally sought at retail level. Convoy's price list dated 6th May 1975 quotes a recommended retail price of \$129.50.

The cost of packing and freight is included within the offer price. Units can *only* be obtained via the order form on this page. Readers wishing to collect the units directly from Convoy International may do so but cheques must still be made out to Electronics Today International using our official order form. ●

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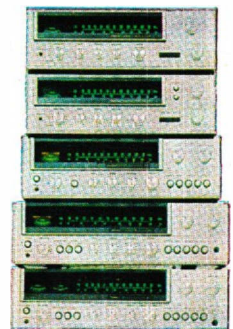
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