JANUARY, 1975
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JANUARY, 1975 Vol, 5. No. 1.

main features

projects

reviews

news & information

COVER: Extract from original painting 'Dreamer and the Fool' by 26-year-old Sydney artist, Jane le Rossignol.

NEXT MONTH

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The feature articles listed above are included amongst those currently scheduled for our January issue.

However unforseeable circumstances, such as highly topical news or developments may affect the final issue content.

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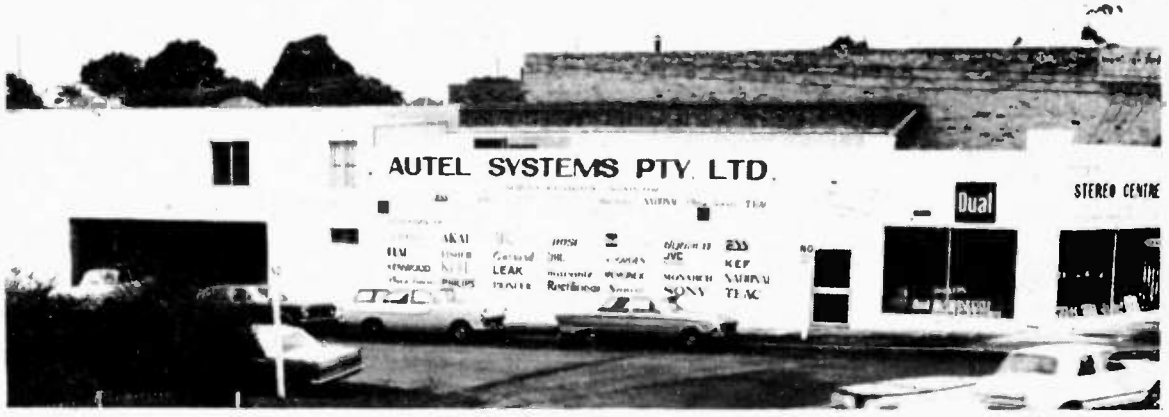

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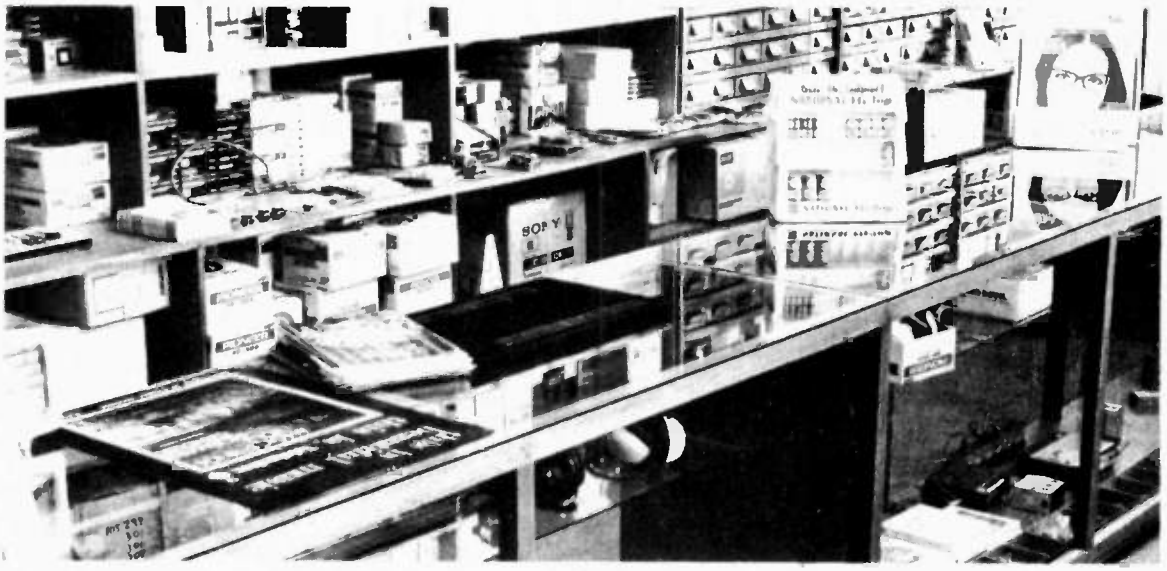

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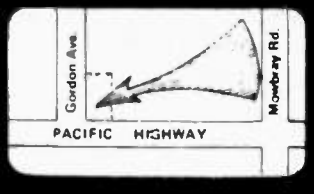

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1

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BSR HT70 Three Speed Single Play Turntable.

2

This is a high precision luxury player ideal for that select group of enthusiasts who insist on manual operation. It features a deep rim, die-cast turntable weighing 4½ lb, engineered to provide a perfect tracking angle, a rotating stub spindle which avoids centre hole wear on your records, and a fully synchronous dynamically balanced 4-pole motor to lock on to the frequency and compensate for fluctuations in the mains voltage. It features the BSR anti-skate force control and a low mass tone arm supported on ball race bearings, fitted with an ADC K7E cartridge. A pitch control is provided enabling the turntable speed to be adjusted by ± 3%. The unit is mounted in a specially selected quarter cut teak veneer plinth with smoke tinted dust cover. **$137.45***

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SOME CHANGES

3 **BSR 710 Automatic/Manual Transcription Turntable**
A slightly more economic version of BSR's fabulous 810. The specifications are similar except the 710 has a low mass aluminium arm suspended in a ball-bearing race, balanced by resiliently mounted decoupled counterweight, and fitted with an ADC K7E magnetic cartridge with elliptical diamond stylus. **$251.71***

BSR 660 Two Speed Magnetic Automatic/Manual Turntable
The finest model in BSR's Professional Series. Includes specially selected quarter cut teak veneer plinth with smoke tinted dustcover, ADC K7E elliptical diamond stylus cartridge. A die-cast 4 lb. platter coupled to a heavy-duty synchronous motor insures low wow, flutter, and rumble, and unvarying speed regardless of the number of records on the platter or variations in electric voltage. A pitch control is provided, enabling the turntable speed to be adjusted by ± 3%. The tone arm is a low-mass aluminium design, suspended on low-friction needle and ball bearings, and equipped with an adjustable counter-weight, dual-range, anti-skate control, slide-in cartridge head. An automatic locking device prevents accidental arm movement that could damage the stylus or records, and a viscous damped cue/pause control is fitted. **$136.46***

4

5 **BSR 560 Two Speed Magnetic Automatic/Manual Turntable.**
The best performing turntable in its price class. The 560 is well suited to any quality audio system. A synchronous motor insures low wow, flutter, and rumble, and unvarying speed regardless of the number of records on the platter or variations in electric voltage. The turntable weighs 3½ lbs. The tone arm system is the same used in the 660, complete with a viscous damped cue/pause control. It is mounted in a specially selected quarter cut teak veneer plinth with smoke tinted dust cover, and ADC K8E cartridge and elliptical diamond stylus. **$123.82***

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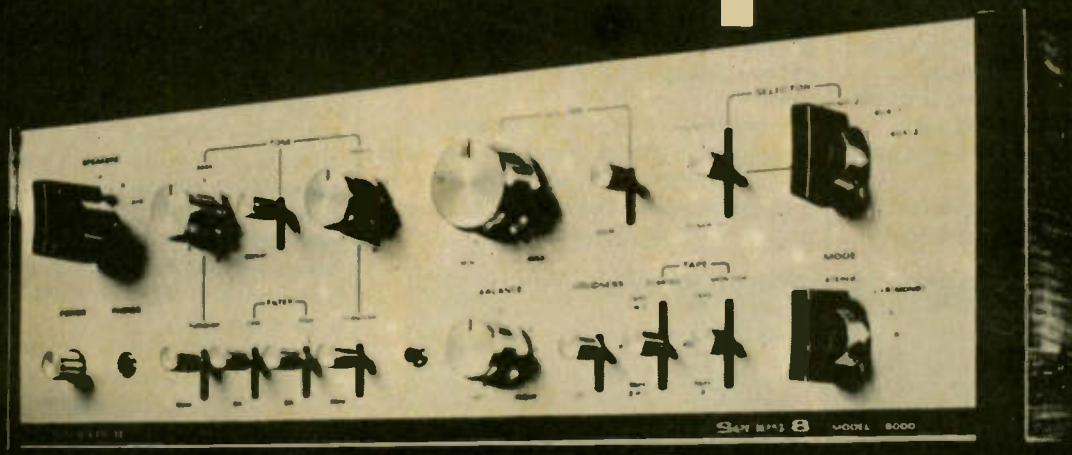
The compliment we like best about the new Monarch Series 8:

"It's no surprise!"



When people already think of one name as the best value for money, they naturally expect every new model to maintain the same high standards — or improve on them. So, Monarch's brilliant new Series 8 amplifiers will come as no great surprise.

No surprise — even though we've created a superb new amplifier, top-of-the-range Monarch 8000 to bring you continuous RMS power of 55 watts per channel at 8 ohms, with distortion of less than 0.1%; even though we've included tape dubbing and turnover controls; even though we've produced a frequency response of 10 Hz to 60,000 Hz; even though we're presenting three other new Monarch amplifiers — the 80, 88 and 800, which feature dramatic improvements in power and efficiency. It's no great surprise — because you *expect* Monarch to be the best . . . And it is, so all Monarch amplifiers remain "kings" on a power-to-performance-to-cost rating.

Try any of them. The prices are as undistorted as the sounds. All with the same beauty of design you expect of top performers. And all have the Monarch two-year guarantee on parts and labour. You know you're getting Monarch quality. Without paying more.

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news digest

NEW ELECTRON MICROSCOPE TO BE INSTALLED IN SYDNEY

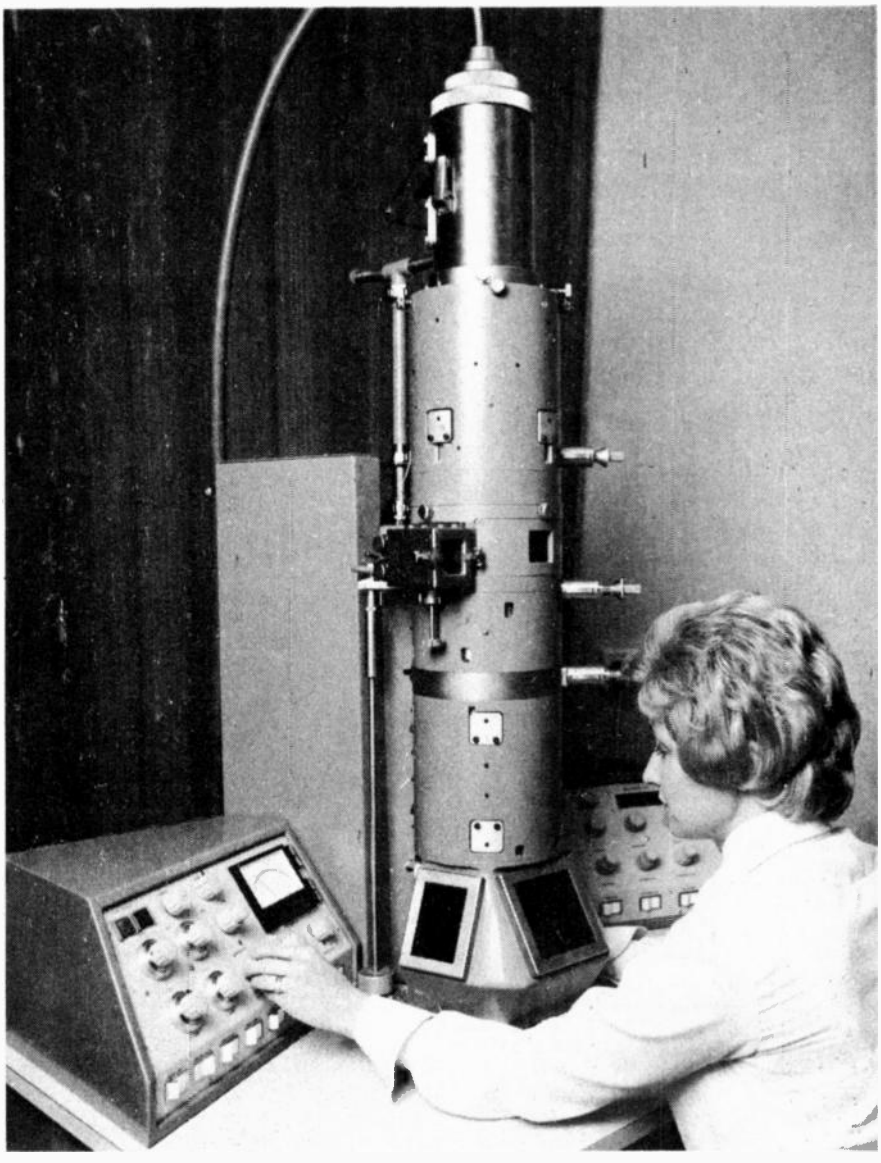
The MR 60C, a new low cost electron microscope recently introduced by the UK's Miles group of companies, will be shown at the World Electron Microscope Conference in Canberra before being installed in Sydney. Development of the microscope has taken four years and work on the first production batch has just started.

There are two models in the range, the MR 60 and the MR 60C (shown here). Both are designed to bring electron microscopy within financial reach of the smaller user although larger research groups would also benefit by using one of the units for preliminary, or back-up work.

Both instruments feature six specimen loading, with airlock and decontaminator, an objective lens, fully alignable intermediate and projector lenses and three large viewing windows with binocular for image focusing. The solid state electronics are in interchangeable modular units for ease of servicing. The magnification range of the larger model is X400 to X100, 000.

The basic model can be uprated to a higher performance, at a later date, by fitting double condenser lenses, a shorter focal length electron gun and additional illumination controls.

Further details may be obtained from the Miles Group of Companies, Riverbank Works, Old Shoreham Rd., Shoreham by Sea, Sussex, BN4 5FL, England.



WALKIE-TALKIE MESSAGE SENT 80 000 KM

With an antenna fashioned from an umbrella, an engineer beamed a walkie-talkie message more than 80 000 km to demonstrate the dramatic potential of space satellites for search-and-rescue missions. The long-distance transmission, originating from a walkie-talkie with a typical range of only eight km, showed that simple radio gear and a collapsible antenna could enable persons in distress to summon help from any point on earth, using a space satellite.

The demonstration was given by an American engineer using a five-watt radio identical to the walkie-talkies carried by law enforcement officials, fireman and foresters. For the demonstration, however, its transmitter and receiver had been tuned to the satellite's broadcasting frequencies. Two other items were needed: a special antenna, constructed on the frame of a golfer's umbrella, and the services of a geostationary space satellite orbiting at an altitude of 30 000 km over the Amazon River in Brazil.

In the demonstration, by means of the 'press-to-send' key on the walkie-talkie, a message in Morse code was transmitted from NASA headquarters in Washington DC to the ATS-3 geostationary satellite, which then relayed the signals to GE(USA)'s Radio-Optical Observatory near Schenectady, New York – a total distance greater than 80 000 km.

After receiving the message, Observatory personnel transmitted voice signals back through the satellite to the engineer's radio. This showed that downed pilots, the survivors of shipwrecks, and others in need of help could readily receive a voice reply from a search-and-rescue station, acknowledging the SOS and providing rescue information.

A global search-and-rescue system would require only six geostationary satellites to cover all but the polar regions. The satellites could be monitored by three ground stations using range measurements to locate

persons in trouble, and then despatch assistance. The six satellites could routinely be used for other important activities – since the search-and-rescue function would require only about a thousandth of any satellite's transmission power. The global satellite system could relay communications between ships, aircraft, and other vehicles and their home offices, while fixing the vehicles' positions with great accuracy. Then the search-and-rescue capability would be an added feature.

RECORDERS FOR MARINER-JUPITER/SATURN MISSION

Lockheed Electronics Co. are to supply tape recorders for NASA's Mariner-Jupiter/Saturn deep space fly by mission of 1977. Two flight recorders will be provided, one for each Mariner spacecraft, under the $US395,000 cost-plus-fixed-fee contract.

Similar to the recorders designed for the Viking Orbiter, the Mariner-Jupiter/Saturn tape recorder subsystem will be capable of storing 536 million bits of television (photographic) and other scientific information and will play back the data to earth stations at four different rates.

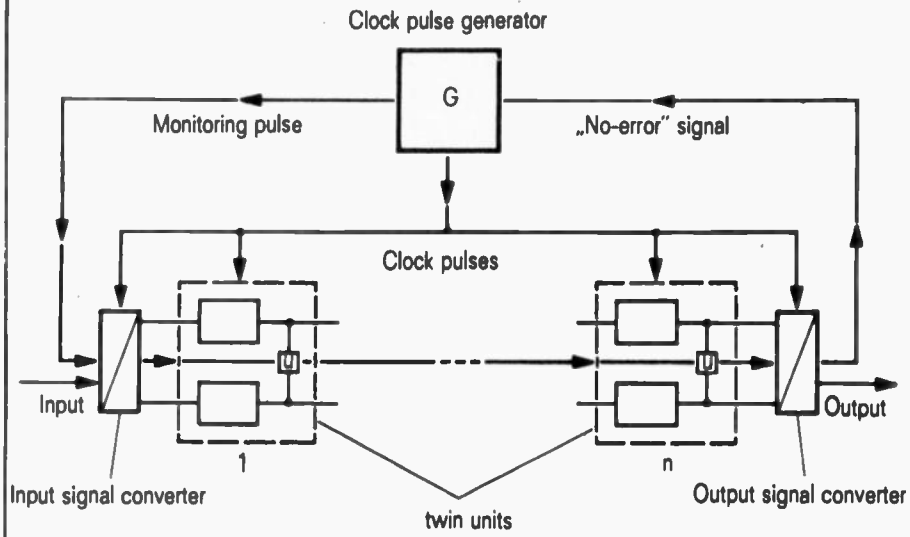
Each nine-track, reel-to-reel recorder is about 380 mm long, 180 mm high, and 155 mm deep, and weighs only 8 kg. A specially designed seamless peripheral belt is used to move the 380 m of recording tape back and forth from reel to reel while maintaining the tape tension and tape tracking integrity required to withstand the shock and attitude manoeuvres encountered during launch and throughout the long flight profile.

Two 730 kg Mariner Spacecrafts, launched 30 days apart in August and September 1977, will embark on a four-year journey swinging by Jupiter, the largest planet in our solar system, in early 1979. Using the pull-by technique first demonstrated by Mariner 10 on its voyage to Mercury, Mariner '77 will be propelled toward the ringed giant Saturn, arriving in mid-1981.

With its television cameras, multi-colored filters, spectrometers and photometric instruments for atmosphere analysis, and other sensors, Mariner '77 will study the cloud bands and Red Spot of Jupiter, the myriad of particles of Saturn's rings, and the atmospheres and compositions of the two planets.

On its journey past Jupiter and Saturn, the spacecraft will study some of the 22 moons of these giant planets. The spacecraft will continue to move away from the sun and eventually leave our solar system.

INTEGRATED SWITCHING SYSTEM WITH AUTOMATIC FAULT DIAGNOSIS



A new type of switching system, which in contrast with conventional integrated semiconductor circuits is of extremely high reliability, is being introduced by Siemens under the name URTL (supervisable resistor transistor logic). This system was developed by railway signalling engineers, whose preoccupation with safety is proverbial.

URTL is particularly suitable for use in electronic control units, in which faulty operation can be a danger to life and property – for example in reactors, air travel, industrial processes and railway signalling. Faulted signals are detected and all outputs of the switching unit are blocked before these signals can cause any trouble. The system also incorporates automatic fault diagnosis facilities, which optically indicate defective pc boards and thus greatly simplify maintenance and reduce down times to a minimum.

A switching unit using the URTL system consists of a series of so-called twin modules, which each contain two similar functional units. The two output signals of each twin module are compared by a monitoring circuit and the result is passed on to a clock pulse generator. This generator is so designed that it only transmits the clock pulses required for the actual data processing in the switching unit when all the comparison operations produce positive results. If just one comparison is negative, the clock pulse generator stops supplying pulses and thus inhibits further processing in the switching unit.

The output signal converters required at the switching unit periphery to drive relays and heavy current facilities are so designed that they supply no further energy when the clock pulses fail to arrive, in other words, all the outputs are without current when the switching unit has an internal defect. If output signals which impede operation are allocated to this current-less state, a fault occurring in the switching unit causes it to fail to safety.

To ensure that faults are detected by the switching system before the arrival of data from the process to be controlled, all URTL modules are tested at regular intervals in both switching states independently of the data flow. In this way, every defect becomes apparent immediately after its occurrence, and the switching unit in question stops in the processing step in which a fault has been detected. A luminescent diode glows on the front panel of the faulted pc board. As faults are diagnosed automatically, they can be eliminated in a very short time by replacing the defective pc board.

PHILIPS/TEKTRONIX MERGER?

The giant Philips organisation, may take over the US Tektronix company to facilitate Philips' planned entry into the US instrumentation market.

Although no specific offers have been made, a Philips spokesman (in Eindhoven) confirmed that there had been discussions between the two companies but stresses that they were 'just feeling one another out'.

SINGLE CHIP 16-BIT MICRO-PROCESSOR

A 16-bit single-chip microprocessor (called PACE) will soon be introduced by National Semiconductor. Technology is p-channel silicon gate MOS.

Unlike n-channel devices, the new National Semiconductor device requires only one five volt and one 12 volt supply.

First ALTEC established entirely new criteria for studio quality monitors.*

NOW THE DOMESTIC ALTEC IS HERE

For years now on the international scene the most discriminating sound engineers have specified ALTEC quality monitors. Look around the leading television, radio and recording studios – anywhere in the world – *and you'll find ALTEC monitors.*
Sales in the U.S. have reached new peaks – and in the highly competitive and selective European market demand for ALTEC systems has never been greater.
In Australia ALTEC enjoys an ever increasing proportion of the professional market.

The Corona is an attractive two-way bookshelf system that delivers excellent sound throughout a wide frequency range. It has a continuous power rating up to 45 watts but may be used with amplifiers rated as low as 10 watts per channel. A high compliance 10-inch speaker is mounted in an infinite baffle to provide optimum bass response. High frequencies are reproduced crisp and clear by an Altec 3-inch direct radiating speaker. Distortion is extremely low. The Corona's dividing network is tailored to the overall system, using a crossover frequency of 2500 Hz. It includes high frequency attenuation in 3 dB steps above 200 Hz. The enclosure finish is a rich, hand-rubbed walnut and features a contemporary styled snap-on grille.
And most important of all? It's ALTEC sound. *And ALTEC sound is quite unmistakeable.*

Ask any of the sound engineers who specify and enthuse over ALTEC quality monitors. Once you've heard and enjoyed ALTEC sound, *you'll never be satisfied with anything else.*
ALTEC's 893B Corona is the one speaker that can fit into your system beautifully, be it high powered or low powered.

SPECIFICATIONS

Frequency Response: 50 – 18,000 Hz • Power Rating: 45 watts • Impedance: 8 ohms
Crossover Frequency: 2500 Hz • Dimensions: 22" H x 12¼" W x 9½" D

Speaker Systems are priced from $250 pr.

*ALTEC LANSING equipment is used by:

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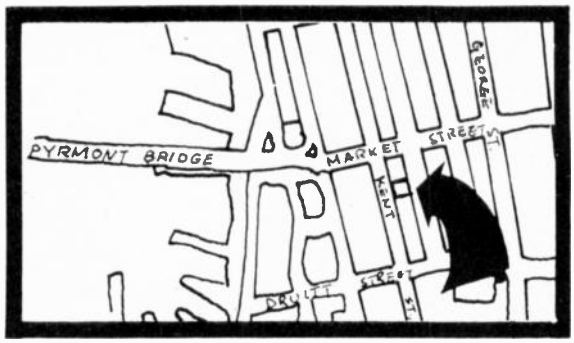


news digest

UPDATED LEAD ACID BATTERIES

Chloride Batteries Australia Limited has modernised and upgraded its Plante range of industrial batteries. Plante is regarded as the "Rolls Royce" of stationery batteries.

The new era of Plante batteries is a continuation of development in production that spans some 112 years.

Ever since a Frenchman, Gaston Plante, developed the battery, the components have been contained in ½" thick huge glass jars or lead lined wooden boxes.

In keeping with modern day technology, a plastic (styrene acrylonitrile) is now being used to manufacture the container and lid. The big advantages are the dramatic reduction in weight, making floor loading easier, and lower unit cost of production.

Plante's design is basically the same, but the tremendous saving in weight resulting from the use of plastic is shown by the fact that there is a difference of nearly half a ton between glass and styrene in a 110 volt, 1000 ampere battery.

The thermo plastic resin used in production is highly resistant to heat deformation and does not suffer from age or environmental cracking. Optical clear material allows the internal cell components to be checked easily, while electrolyte level lines on the jar give easy recognition of watering requirements.

Both the container and lid are of heavy sections built to stand up to climatic conditions anywhere in Australia. High quality acid-resistant rubber brushes are used in the lids to provide a leakproof seal between the cell posts and the lids.

NEW DIGITAL DISPLAYS

Liquid-crystal displays with dc driven time-shared multiplex drive have been developed by Shinshu Seiki Co. Intended for digital meters, the devices could prove stiff competition for leds and Nixie tubes as power requirements are some ten times lower.

The development is particularly significant at the present time because the electronic watch industry had virtually standardized on led displays rather than liquid crystal. Even companies currently producing liquid crystal display watches are now planning to either change over to leds or at least make an led watch as well.

SIMULATOR FOR SYDNEY

The Australian Government has just awarded a contract to the Digital Systems Division of Ferranti Limited for a $1 million Air Traffic Control simulator to be installed at the ATC Centre at Sydney. The simulator includes displays and computer input devices of the type used in the Australian operational ATC systems, and its design will allow simulation of the second stage in ATC automation when introduced in the Commonwealth in the last half of the 1970's.

Much of the work on the refinement of the simulator specification has been carried out in close co-operation between the Department of Transport and Ferranti over a period of more than two years. The simulator is due to go into operation in Sydney in 1976.

The simulator can provide a complete air traffic control environment for a volume of air space 2000 km square and 30,000 m high. This can be precisely similar to a real volume of air-space, with aircraft, radar, airways, airports, navaids and weather, or it can be varied to meet specific training requirements and to allow trials of new procedures and routings.

NIGHT RESCUE HELICOPTER IN DEVELOPMENT

A rescue system for helicopters to permit the prompt recovery of downed airmen in hostile territory at night and in adverse weather will be designed and tested under the direction of the U.S. Air Force Systems Command. A $3 million prototype program will be carried out in-house by the Command's Aeronautical Systems Div., using an HH-53 helicopter. It will use off-the-shelf avionics systems for low-level navigation, search, homing and retrieval, including terrain avoidance radar, infrared sensors, inertial measuring, doppler, projected map display, and a central avionics computer.

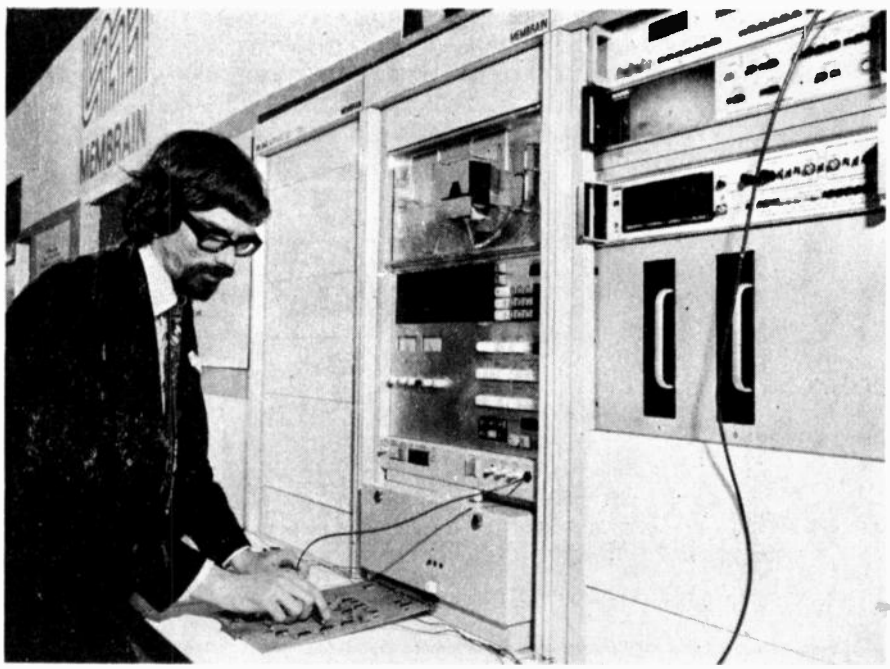
NEW DIAGNOSTIC TEST SYSTEM

A comprehensive new diagnostic test system for electronic sub-assemblies, the computer-operated MB2460, was introduced by Membrain Limited at the Automatic Testing Exhibition, held recently at Brighton England. The system combines digital and analogue capability.

The unit incorporates a matrix allowing any pin to be connected to a number of analogue instruments such as dc current/voltage force and sense unit, ac waveform generator, resistance measurement unit, or counter timer. The design of the test head and matrix allows high fidelity signals to be applied to a device under test. A standard feature is the MB 7400 computer station controlling the instrumentation and the digital diagnostic software system.

The Automatic Testing 74 conference and exhibition was the second international event devoted to automatic testing and test data acquisition equipment, the world market for which is growing at an annual rate of nearly 40%.

Further details of the Membrain unit may be obtained from Membrain Limited, Ferndown Industrial Estate, Wimborne Road West, Wimborne, Dorset BH21 7PG, England.



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news digest

US STAFF RETRENCHED

Although the current economic downturn has not hit many US manufacturers as badly as some had feared, a number of major semiconductor manufacturers have been forced to lay-off substantial numbers of staff.

Motorola's Phoenix division has now layed off 4500 of its previous 30 000 workforce, Texas have now dropped nearly 8000 of its 73 800 previous staff whilst Signetics have layed off about 4000 of its previous 11 000.

In TV production, Rockwell have retrenched about 35% of its staff and RCA about 7%.

LOW-PRICE DIGITAL WATCH

A low-price digital quartz crystal watch with liquid-crystal display has just been launched by Japan's Orient Watch Co.

The electronics, produced by the Sharp Corp. uses a single chip for all functions. These include a 32 kHz oscillator, divider, and driver for the liquid crystal 3½ digit display. Both the chip and the wiring substrate are formed as a simple hybrid package.

Production is initially scheduled at 10 000 units a month increasing to 50 000 a month by December 1975. Price is believed to be about $140. The watch will be marketed world-wide.

NEW CAR VOLTAGE REGULATOR

A new thick-film automobile voltage regulator, soon to be marketed by Siemens AG, protects other devices operating from the vehicle's electrical system from surge voltages exceeding 45 V.

The regulator is made on a ceramic substrate 0.8 mm thick and is pre-adjusted during manufacture by a laser trimming process.

ZENER IC'S

An integrated circuit voltage reference has been developed by National Semiconductor.

The chips have long term stability quoted as 0.01%, temperature drift of 0.1 ppm, drain of 200 μA, and dynamic impedance of 1 ohm.

Production is planned for April.

BATTERY POWERED BUSES

A battery-powered bus fleet has started operation in Monshengladbach — town in the northern part of Germany.

Motive power is derived from electronically controlled 90 kW motors. Maximum power output for short periods is 180 kW at which power efficiency is 92%.

Efficiency of the electronic control system is claimed by its manufacturers (Robert Bosch) to be 99%. Regenerative braking is used to extend the operating range.

KOSS TO MAKE SPEAKERS

Koss, better known for their headphone range, are introducing a new range of electrostatic loudspeakers.

The first unit — top in the new range, radiates from both front and rear surfaces and has a recommended input of 60 to 75 watts. It is currently being demonstrated to dealers. Selling price is approx $US600.

HORN SPEAKER JOURNAL

Collectors of vintage radios and gramophones may be interested in a monthly magazine specifically devoted to their interests.

It's called 'The Horn Loudspeaker' it costs a mere $3.00 a year and it's published by a gentleman called Jim Cranshaw of 9820 Silver Meadow Drive, Dallas, Texas USA.

Jim's current world circulation is only 1000 but it deserves to be more — so for what it's worth . . .

COCA — COLANISATION

The Right Hon. the Lord Mayor of Sydney, Alderman Nicholas Shehadie, O.B.E. recently opened a tri-vision 'community' display situated at Sydney's Kings Cross.

Design and construction of the project was the work of Claude Neon Limited, on behalf of the Sydney Bottler of Coca-Cola. The structure is electronically the most complex to be erected in Australia. The display was completely custom-made, and over a period of seven months maintained forty full-time tradesmen of varying skills, including sign-writers, electricians and sheet metal workers. Construction cost is estimated at $140,000.

The sign comprises three sections:

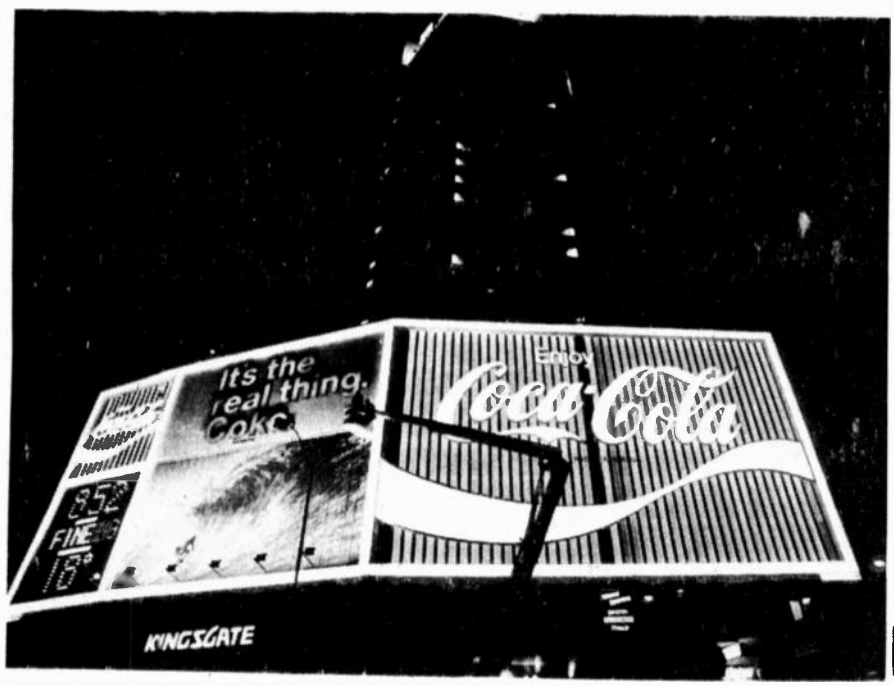
(a) Digital time clock, temperature and weather guide.

(b) Tri-vision panel incorporating a community message from the Sydney City Council. The panel is 15m long and revolves every 12 seconds to display one of three designs including

(c) Product advertisement with animated background and border.

The total dimensions of the sign are 15m by 40m and its completion provides Sydney with another landmark of world standard — says Coca Cola.

We thought you might like to know.



news digest

HI-FI EXPLAINED

A new publication called Hi-Fi Explained has just been published by Modern Magazines, the publishers of Electronics Today and Hi-Fi Review.

The book is intended for non-technical and semi-technical hi-fi enthusiasts. It has been written – by ETI Editorial Director, Collyn Rivers – in totally non-technical language throughout and seeks to answer the innumerable questions faced by novices buying hi-fi for the first time.

Included in the book is the most comprehensive reference listing of equipment brands and their associated agents ever published in Australia.

Main contents include:– The Aim of Hi-Fi; What is Stereo; Records or Tapes; Record Players; Tape Recorders; Amplifiers; Frequency Modulation; Loudspeakers; How to Buy Hi-Fi; Setting up the Gear; Room Acoustics; Upgrading; Fault Finding; Record Care; Glossary of Terms; Who Sells What.

Hi-Fi explained is on sale now at all main newsagents.

ETI READER SURVEY

Our very sincere thanks to the many thousands of our readers who responded to the reader survey form published in ETI last year.

Frankly the response totally overwhelmed us – for whilst professional survey organisations are doing well if they obtain a two to three per cent response, ours exceeded that nearly ten times!

In fact so overwhelming was the response, that Technical Editor Brian Chapman actually had to sit down and build an elementary computer before we could analyse the over half-million bits of data involved.

As a result of the survey we have made a number of minor changes to the magazine's format – and there are still one or two yet to come. We hope you like what we have done – we thank you very much indeed for the most encouraging results – and an especial thank you to those many people who congratulated us on our efforts so far.

We hope to run a further survey in the not too distant future to enable us to assess whether the changes we have made meet with general approval – remember it's *your* magazine!

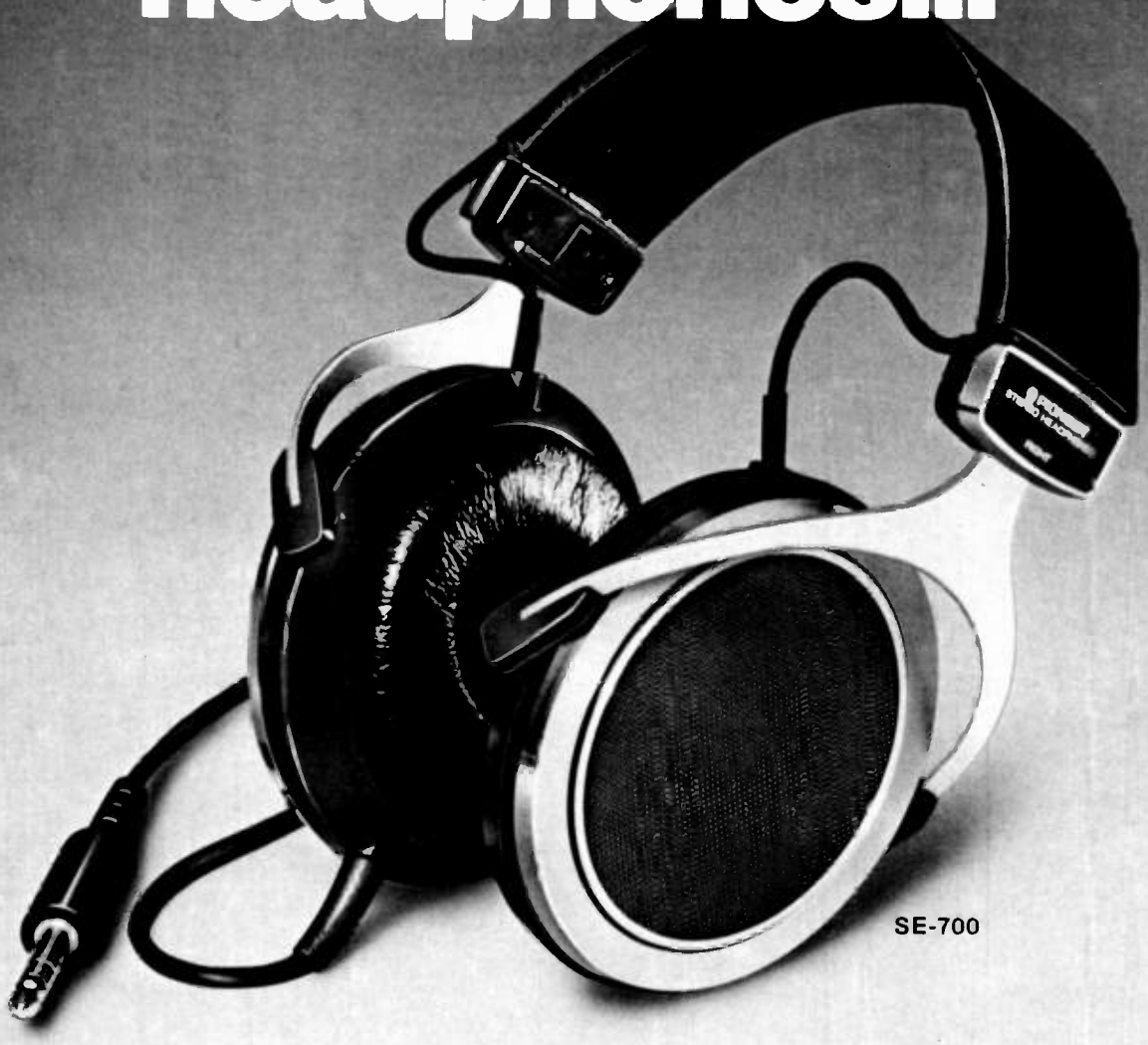
As promised when we published our reader survey form, twenty five of our respondents (chosen totally at random) have been given a year's free subscription.

Winners were:–

S.K. Carter, Coolum Beach, Queensland.
G.B. Wolfe, Bombala, New South Wales
E. Collins, Bundaberg, Queensland
Nigel Isaacs, Auckland, New Zealand
W.C. Sargent, Camperdown, Victoria.
G. Lepp, Doncaster, Victoria.
Brian Hobby, South Oakleigh, Victoria.
Peter Raengel, Mount Pleasant, Western Australia
Peter Stevenson, Moss Vale. New South Wales
M.A. Stinson, Christies Beach, South Australia.
Ivan Faes, Queanbeyan, New South Wales
G.S. Fraser, Mosman, Queensland
Kevin Symons, Clare, South Australia.
B. Maclarn, Ormond, Victoria.
R.N. McCoughtry, Ivanhoe, Victoria.
J.P. Phillips, Port Augusta, South Australia.
D.A. Speed, West Hobart, Tasmania.
Robert Dyball, Woodberry, New South Wales.
Andrew G. Herold, Elwood, Victoria.
G. Briansky, Balgowlah, New South Wales.
R.J. Judd, Uralla, New South Wales.
Peter Bugg, HMAS Derwent
T.L. Dung, Torrensville, South Australia.
J.A. Blair, Deakin, A.C.T.

If any of these readers have not yet received their first free subscription copies would they please contact the Editor.

Introducing new High-polymer headphones...



Pioneer is first again. High performance stereo headphones that can handle big power inputs, yet offer truly clear, transparent sound. Through our vast resources as one of the world's leading audio specialists, Pioneer makes use of an ultra-thin aluminium coated high-polymer film. When an audio signal reaches the headphones the driver elements create an ideal "breathing" motion with outstanding transient characteristics over a wide frequency range. The result is high efficiency, excellent linearity plus total listening comfort (only 295g/10oz).

Stop in for a demonstration and hear the exciting difference. Pioneer's new SE-700 high-polymer stereo headphones, music listening enjoyment that you can take the easy way.

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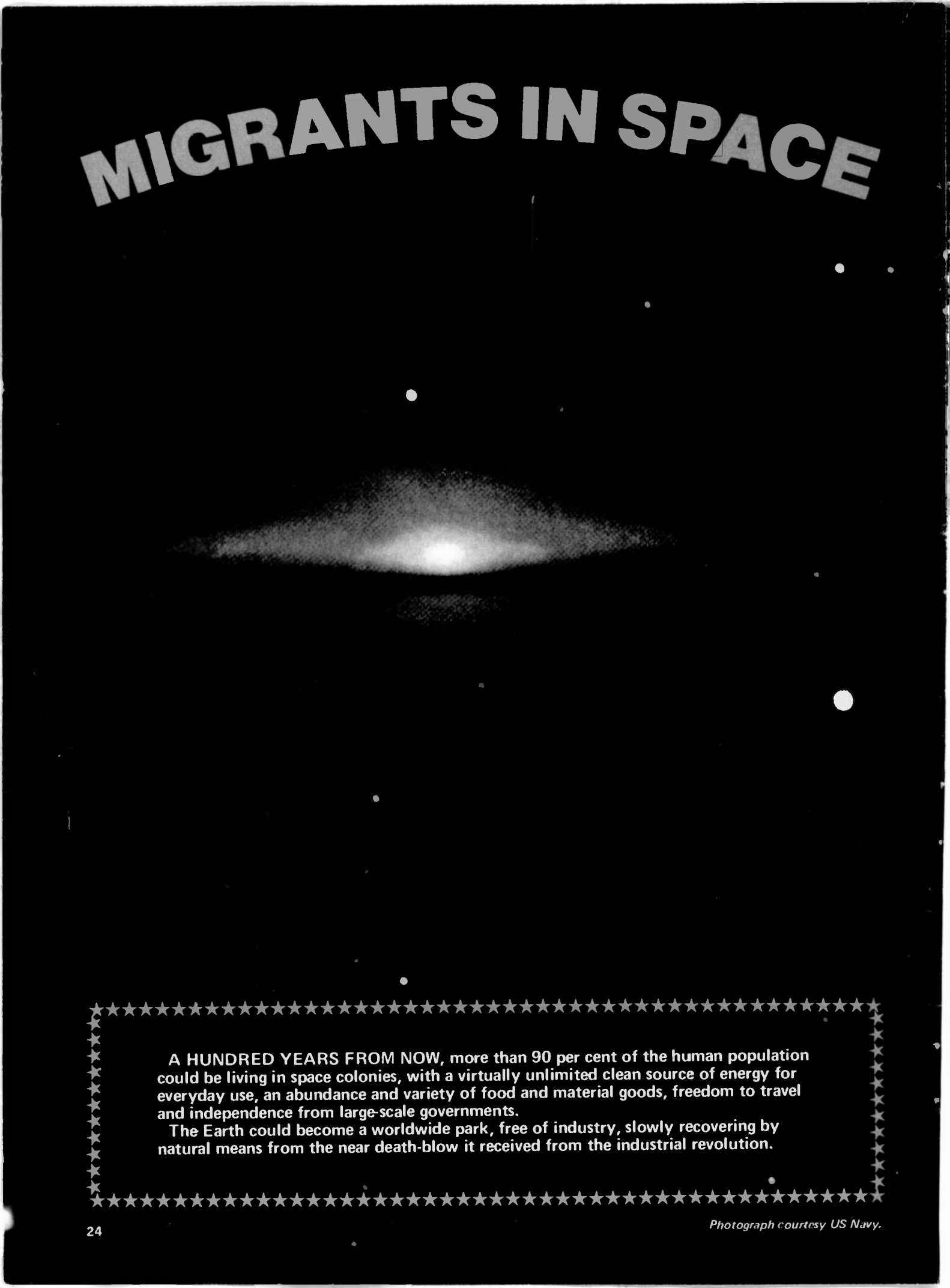
MIGRANTS IN SPACE



A HUNDRED YEARS FROM NOW, more than 90 per cent of the human population could be living in space colonies, with a virtually unlimited clean source of energy for everyday use, an abundance and variety of food and material goods, freedom to travel and independence from large-scale governments.

The Earth could become a worldwide park, free of industry, slowly recovering by natural means from the near death-blow it received from the industrial revolution.

Photograph courtesy US Navy.

Our world's population may colonise space — thirty years from now!

TOP WORLD SCIENTISTS are currently investigating a very serious proposition — momentous in its implications — that our population emigrate to huge man-made structures in the sky.

Located at the so-called Lagrangian point of the Earth-Moon system (area of zero gravity), the structures would hold millions of people living in environments indistinguishable from that of an idealised version of Earth.

The concept started a few years ago during an advanced technology seminar at Princeton University.

Gerard O'Neill, then Professor of Physics at Princeton, asked a few of this brightest engineering students to discuss topics that would 'involve large-scale engineering combined with potential benefits for mankind'.

Among the topics discussed was whether the surface of a planet was in fact the best habitat for high technology civilizations. This led to a brief study of other possible 'space habitats'.

To the surprise of the group, initial investigations showed that space habitations were not necessarily limited to small-scale laboratory units — such as our recent 'Skylab' project. Massive habitations not only appeared to be feasible (from an engineering viewpoint) but could actually be achieved using technology available today.

Since then, quantitative studies have shown quite conclusively that the concept is practicable — no matter how 'science-fictionish' it may sound and, despite many scientists' reservations, the concept is rapidly gaining scientific respectibility.

ACADEMIC ACCEPTANCE

A two-day symposium was held recently at Princeton to discuss the implications of space colonisation; the authoritative US journal Physics Today has recently accepted a manuscript outlining the proposal — even the arch-conservative UK journal, Nature, has published a descriptive note!

The proposed space structures vary in size from a small pilot model a 'mere' one kilometre in length by two hundred metres diameter, to the largest proposed so far which is 32 km long by 5.4 km diameter.

The proposed structures are cylindrical in cross section and have three massive windows along their length. The population live in valleys spaced between the windows — so that each valley is opposite an associated window.

Each cylinder is orientated so that its longitudinal axis is pointed toward the Sun: sunlight is reflected through the windows by huge mirrors located around the outer circumference of the cylinder.

An artificial gravity would be induced by causing the cylinders to revolve slowly around their longitudinal axis. To overcome gyroscopic precession, cylinders would probably be arranged as pairs — contra-rotating as shown in Fig.2.

Travel from one cylinder, of each pair, to the other would be uniquely simple and elegant. All that is required is that a 'space-taxi' leaves one cylinder at exactly the right moment, whereupon it will then travel totally without need for power, arriving at the surface of the other cylinder with precisely zero velocity!

Apart from the main habitation cylinders, other possibly smaller scale cylinders could be located close to the main space habitats. These latter cylinders could be used for housing polluting type industries.

Feasibility studies show that it is perfectly possible to construct and locate a 1 km long pilot model by 1988. Once in space and populated by a probable 10 000 people, work would commence on building the larger series of units.

ASSEMBLED IN SPACE

This first unit would be assembled in space by people transported by modified versions of NASA's already planned space shuttles. Approximately 10 000 tonnes of materials would be required from Earth and a further 500 000 tonnes would be surface mined by a small team working on the surface of the Moon — where all the elements required for the project (primarily oxygen, aluminium, titanium and silicon) are now known to be readily available.

The esential water and oxygen would be made available by transporting some 5000 tonnes of liquid hydrogen from Earth, and combining this with the oxygen known to exist in lunar rock.

Several characteristically ingenious means have been proposed for transporting lunar material to the space site. These include a rotary launcher (a sort of super-sling) and a linear motor powering a rapidly accelerating bucket. In essence the material would be 'flung' into space in the exact direction of the space site — there to be collected by the site crew.

Power generation would be no problem either for building of eventual habitations and/or industries. Ample pollution-free energy would always be available from the Sun.

Once the initial pilot unit is established, and scientists agree that this is feasible using nothing but existing technology by 1988, then work could commence on building medium-sized habitats in situ.

Then, some twenty or thirty years later, work would commence on the largest units using materials probably gathered from the asteroid belts by gigantic ore-carrying space-ships.

THE COST

The cost of establishing the first pilot module is estimated at twenty thousand million dollars. That is, about the same as the cost of the Apollo programme.

Although there could well be

MIGRANTS IN SPACE

psychological reactions, it is unlikely that people living within the enclosures would have any physiological feeling of restricted space.

It is difficult to visualize the vast scale of the cylinders – but they are so enormous that the 'sky' itself would appear as blue as it does on Earth.

In virtually every way the environment would be indistinguishable from Earth's. There would be normal atmosphere, sunshine, agriculture, trees, flowers, rivers, lakes, all normal animal life. The weather would of course be controllable at will – daytime and night-time could be simulated as also could be seasons of the year.

Each cylinder would be larger in area than quite large islands – such as Malta, or the Isle of Wight – mountains the size of Australia's Mt. Kosiosco would fit, with ample space to spare, inside the cylinder radius!

The space habitat concept is capturing the imaginations of people around the world. Every study undertaken so far has shown that the basic concept is both practicable and feasible.

Whether or not manking *should* make such a move is a separate argument. Would it perhaps be better to concentrate the cost and engineering talent required to making our Earth a happier and better place to live – accepting as we must the severe constraints on population, and freedom that this entails? Or should we try and change our whole concepts of what is not a 'natural' way of life. No wonder perhaps that O'Neill's most enthusiastic supporters are young Maoists! ●

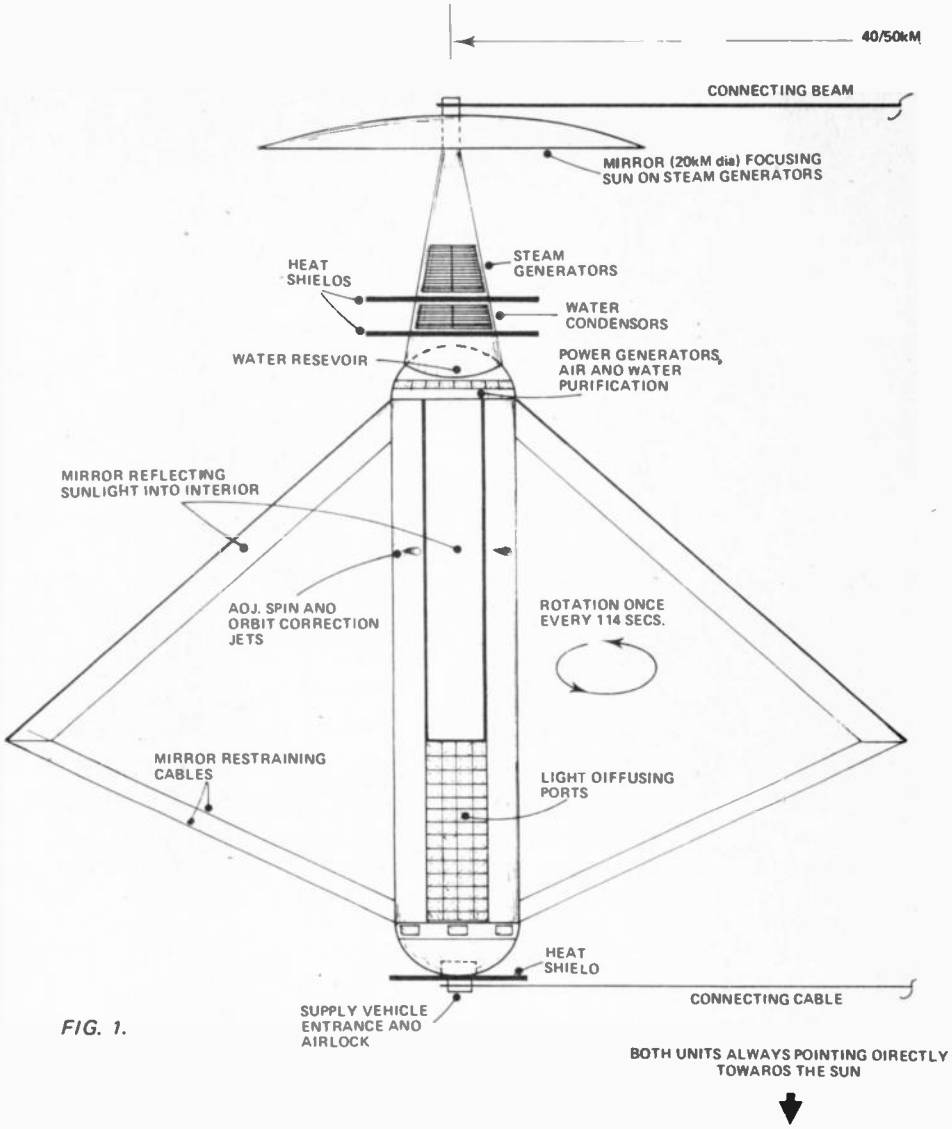


FIG. 1.

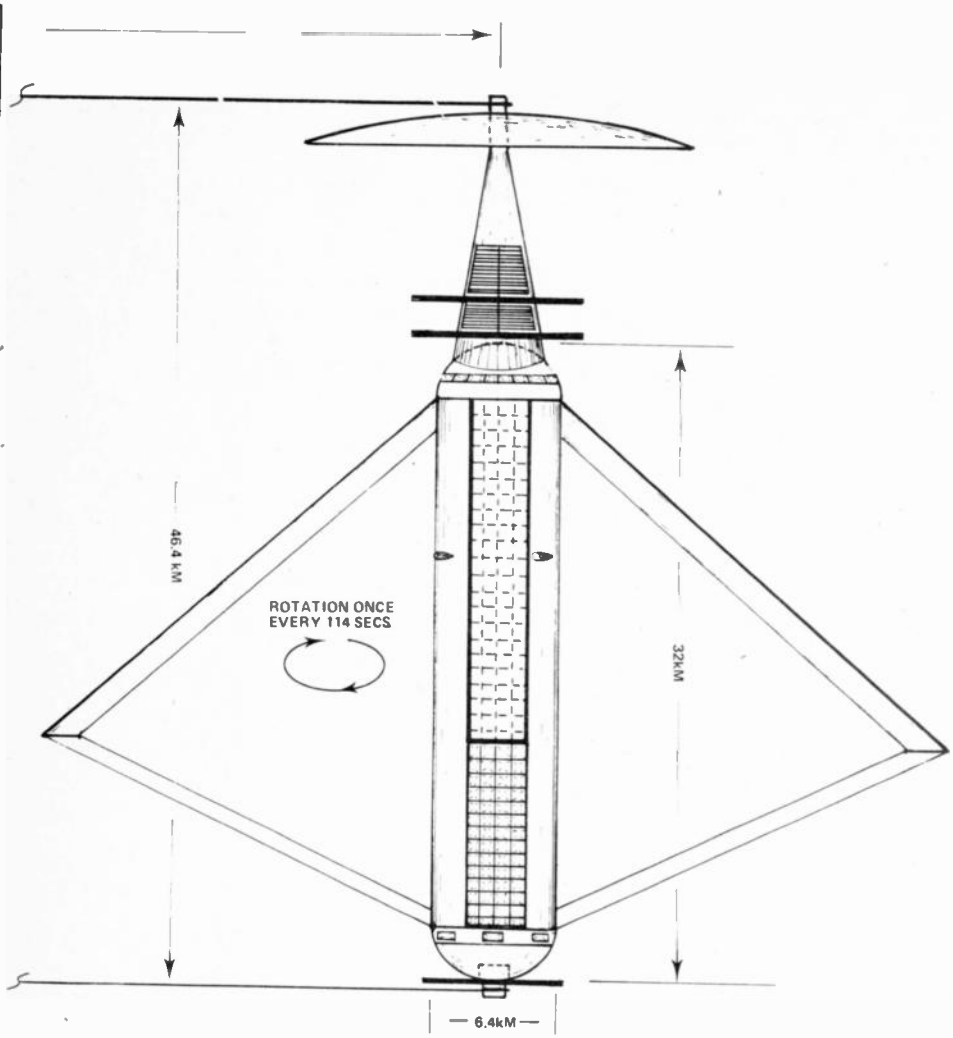
▲ *This drawing by ETI staff artist Ron Farley is based on original material. It shows all main concepts and is approximately to scale. The cylinders will be assembled as linked contra-rotating pairs to concel out gyroscopic precession.*

End view of space habitat dramatically illustrates the enormous size of the cylinder (6400 metres ▶ across). Here Australia's Mt Kosciusko (2228 metres) is drawn to scale. The circular mirror shown at the rear of the cylinder is approx. 20km across.

PROPOSED HABITATS

Unit	Length	Diameter	Population	Date
1	1000 m	200 m	10 000	1988
2	3200 m	640 m	150 000	1996
3	10 000 m	2000 m	10^6	2002
4	32 000 m	6400 m	10^7	2008

Dates quoted are earliest possible assuming work started almost immediately. Population is for double units as shown in our main drawing.



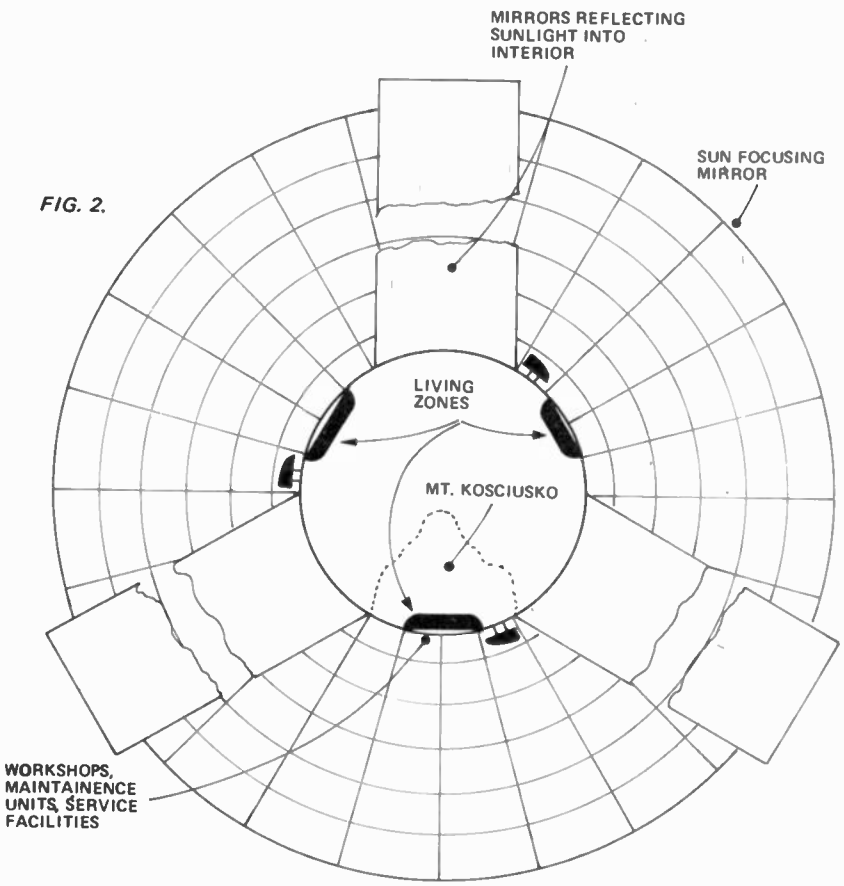


FIG. 2.

HI-FI EXPLAINED

- an expert book written with non-experts in mind

- THE AIM OF HI-FI
- WHAT IS STEREO
- RECORDS OR TAPES
- RECORD PLAYERS
- TAPE RECORDERS
- AMPLIFIERS
- FREQUENCY MODULATION
- LOUDSPEAKERS
- HOW TO BUY HI-FI
- SETTING UP THE GEAR
- ROOM ACOUSTICS
- UPGRADING
- FAULT FINDING
- RECORD CARE
- GLOSSARY OF TERMS
- WHO SELLS WHAT

$2·50

HI-FI EXPLAINED – written by Collyn Rivers, Editorial Director of Hi-Fi Review and Electronics Today International, Published by Modern Magazines (Holdings) Limited, 15 Boundary St., Rushcutters Bay, NSW, 2011.

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* Recommended retail price

Partners in Perfection

SHURE V15 Type III Super-Track Plus Phono Cartridge

Overwhelming choice of critics the world over.

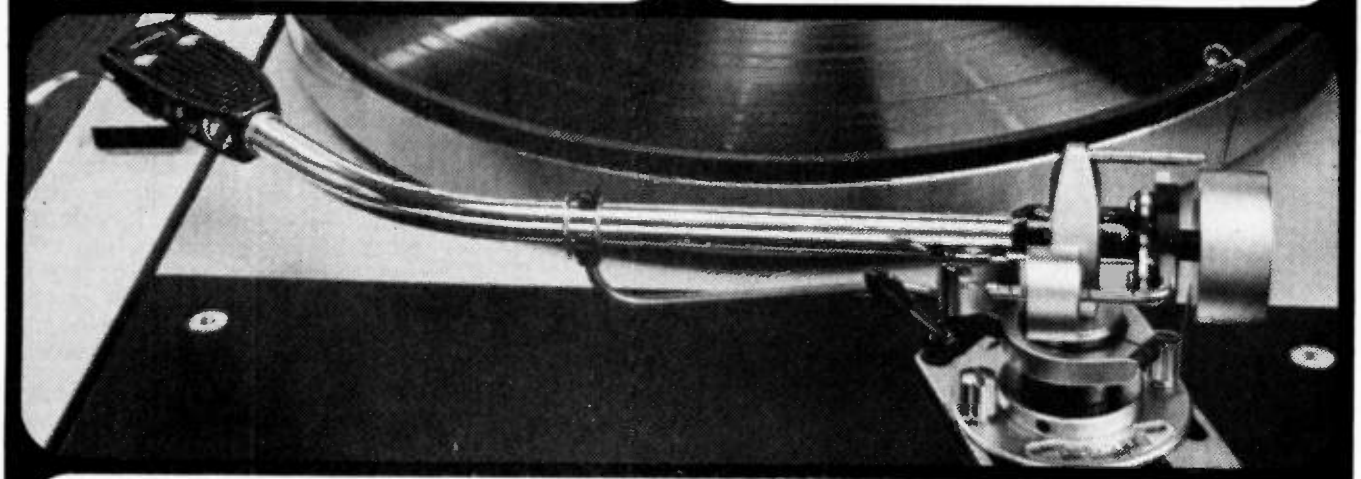
The sound of the V-15 Type III, paradoxically, is due in no small part to an absence of a sound of its own. In no way does it interpose itself upon the music. Thus, the resultant sound of the Type III is not "sweet," "mellow," or "brilliant"...it is the sound of the recording itself! Its truly flat, unaccented frequency response and extended dynamic range mean a hearable difference in all your recordings, old and new.

In extended listening, the uncolored neutral timbre and tonality of the Type III results in a remarkable listening experience in which complex melodic lines from every conceivable kind of music are delineated with startling and hitherto unheard clarity.

SHURE SME Series II Pick-up Arm

No wonder it has been called "the best pickup arm in the world." The Shure SME Series II Improved combines flawless craftsmanship and unmatched precision with design improvements that reduce tone arm/cartridge system mass and friction to significantly lower levels. Ultra-low friction pivot points, with high-precision protected ball and knife edge bearings; arm deflects either vertically or horizontally with less than. 020 gram force applied at stylus tip. Precisely accurate adjustments for every factor related to perfect tracking, including height, overhang, length, tracking force and bias (anti-skating).

Recommended for use with all Shure high trackability cartridges and when teamed with a super-trackability Shure V15 Type III the result is quite simply unsurpassed for precision record playback.



Choose a Turntable that will make up the perfect team

The "perfect partners" should naturally be teamed with top quality turntables. Arrow Electronics offer two models for your consideration. One for the **"belt drive"** enthusiast and the other for those who prefer **"direct drive"**. These turntables are the **Thorens TD125 Mk.II** and the new **Technics Model SL120.** All items can be supplied separately or completely assembled.

Write now for details and your "Arrow Quote"

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AE090/FP

– both must be matched for optimum results – but what determines the match, and why are some manufacturers reticent about recommendations?

MOST HI-FI COMPONENTS may be interchanged with relative impunity, for manufacturers ensure that their products are compatible, one with another.

Pick-up cartridges and tone arms are an exception though. They're interchangeable physically – but that's not the problem.

Dimensions are relatively standardized, but other factors are not. Will changer A trip properly with cartridge B? How will cartridge C track a warped record in tone arm D? Do the adjustments on turntable E have sufficient range to allow use of pickup F?

Accompanying this article you will find lists of cartridge manufacturers showing their recommendations for the turntables that will perform correctly with their pickups. Why have such a list? Does it tell all you need to know? Read on.

The tone arm has only one job – holding the cartridge at the correct geometrical relationship to the record groove and at the correct tracking force. That sounds simple, but no arm does its job perfectly. Every arm has frictional resistance. In all but a few highly specialised turntables the record groove is doing the actual work. Via the stylus assembly, it is dragging the arm across the record, revolution by revolution. No arm goes that route without *some* resistance.

A changer or automatic single-play turntable may compound the problems. For present purposes the most important factor is tripping force. The changer may track satisfactorily at 1 gram while the record is playing but require more than 1 gram to trip the changer cycle at the end of the record. When this is true, the stylus may simply be pulled out of the leadout groove following the music, and the changer will refuse to "change". And in the process the stylus assembly can even be damaged – a hard failing to diagnose, though the kind of lateral stylus displacement it causes can seriously affect separation.

In other words it is not enough to compare recommended tracking force (of the pickup) with available tracking-force settings (on the arm) to determine compatibility. Nor is it necessarily safe to accept verbatim, in this respect, manufacturers' specs for tripping force. Even if your turntable meets specs when it is new (and many companies specify on the basis of *average* predictable performance), it may not when dirt and wear begin to attack its innards. Some margin between specified tripping force and actual tracking force settings certainly is desirable.

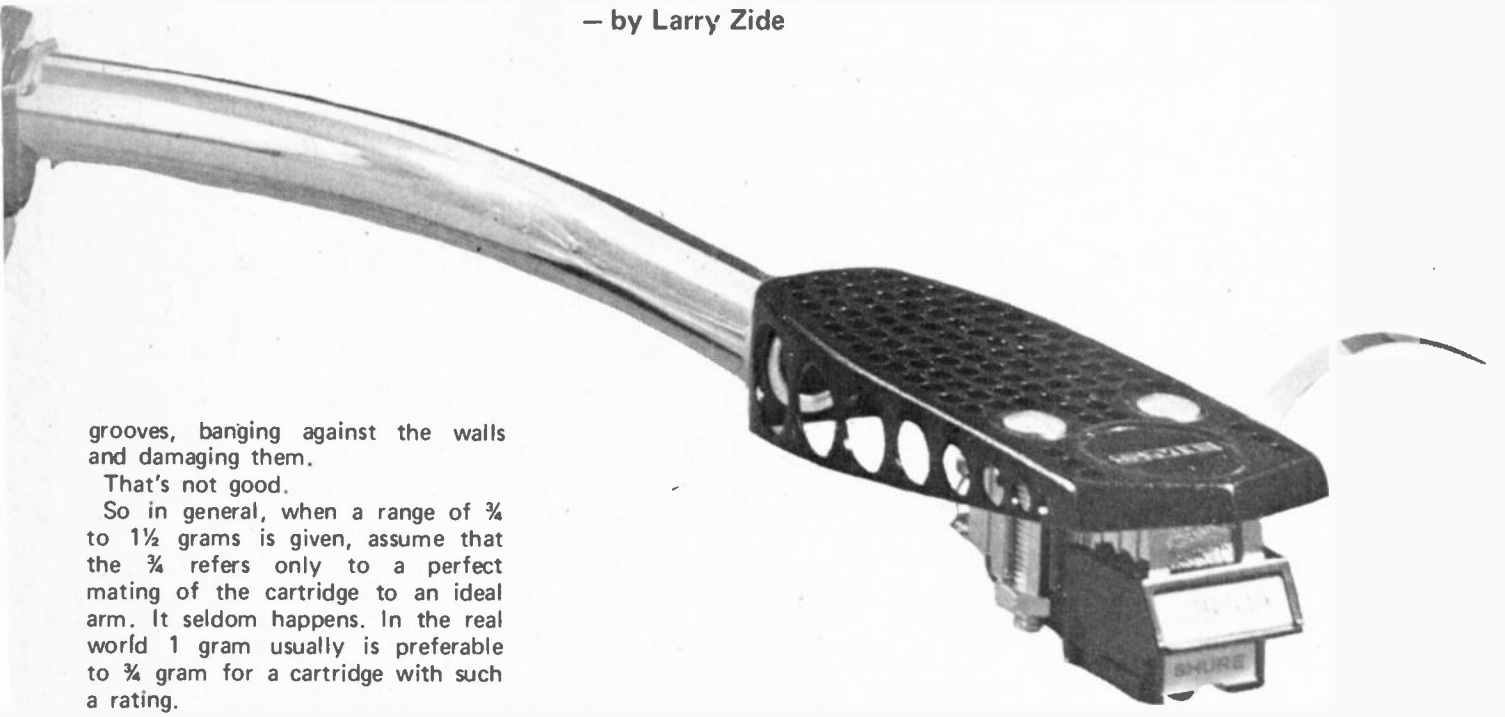
Vertical Tracking Force

In the jargon of high fidelity a "light-tracking" pickup has been equated with a "high-performance" pickup, though the two are not the same. While it's true that most of the best pickups generally can be tracked at very low weight (say, about 1 gram), misapplication of the fact has led to the irrational importance that has been placed on low tracking forces.

You must begin by understanding that lighter is good but lightest may not be. A stylus tracking at twice its optimum weight is wearing itself and the groove a little faster than it might. Maybe you'll get only 800 plays out of the diamond instead of 1000. But a stylus loaded with insufficient weight will bounce around in heavily modulated

CARTRIDGES AND ARMS

— by Larry Zide



grooves, banging against the walls and damaging them.

That's not good.

So in general, when a range of ¾ to 1½ grams is given, assume that the ¾ refers only to a perfect mating of the cartridge to an ideal arm. It seldom happens. In the real world 1 gram usually is preferable to ¾ gram for a cartridge with such a rating.

The undue emphasis on super-low tracking forces poses less obvious pitfalls for the user in search of high performance. Not only may he choose a pickup whose recommended tracking range is on the low side for his turntable assembly, but he may actually be encouraged to do so in some cases by the manufacturer or dealer who sells the turntable!

Let's say that a popular high-performance cartridge is rated for ¾ to 1½ grams; changer manufacturer's top model will perform at 1½ grams. The company doesn't want to rule out this popular cartridge (after all, some potential customers already *have* the cartridge) and is, in fact, justified in specifying it as appropriate for the top changer — under ideal conditions. Less than ideal conditions (perhaps excessive speaker feedback or inordinately warped records or dust in the tone-arm bearings) *may*, however, prevent satisfactory performance. Where does one draw the line?

Or the purchaser may end up with a mismatch via another route. The dealer offers a series of turntables (including the top changer) on a cut-price deal with a series of cartridges — but not including the ¾ — 1½ gram model. Then for an extra $10 or $20, he may offer the "step-up" cartridges like that model. This looks like a very good deal, though the match *may* be questionable.

So in matching pickup weight recommendations to arm performance, just as in matching them to tripping-force specs, it is advisable to allow a little leeway.

Warped Records

Two aspects of cartridge-arm compatibility are dramatized by warped records. The first has to do with moving mass. A low-mass arm — meaning a light arm and one whose weight is concentrated as much as possible near the pivot — can be defeated by installing a heavy cartridge. If you are undecided between two cartridges and like their performance equally well, choose the lighter one; if the weight difference is significant, it probably will play warped records better.

The reason for this can be explained by remembering that: *A moving mass continues to "want" to move.* A heavy arm, rising to track a warp, wants to continue to rise for an instant at the top of the warp; and it wants to push down against the record (drastically increasing the momentary stylus force) at the trough. The low-mass arm wants to do the same things, of course, but with proportionately less force to its "desires". So the stylus is less likely to lose contact with the groove at the peak of the upswing or to "bottom" during the downswing.

The other factor involved in proper tracking of warped discs (and no record is perfectly flat) is stylus compliance. Any cartridge-arm combination resonates at a particular frequency, the frequency and the severity of the resonance being dependent on both the arm's mass and the compliance of the stylus. For most combinations this resonance will occur at frequencies well below 20 Hz. Obviously, you will say, the resonance *should* be below audibility (that is: below 20 Hz) to prevent exaggeration of any rumble components derived from the turntable or from the record. True, but warp itself represents a kind of "rumble" to the extent that it is an extremely low-frequency "modulation" of the record's surface. And in fact a cartridge-arm resonance that is excessive in

amplitude can exaggerate the problems of tracking warped discs, particularly when the resonance is *too* low in frequency.

It has been found that a resonance of 7 to 15 Hz is optimum since warp "frequencies" tend to be lower. The resonant frequency of the combination can be reduced either by increasing the mass of the arm (including the cartridge) or by increasing the dynamic compliance if not of the stylus assembly. Dynamic compliance is not the same thing as static compliance (the "compliance spec" normally shown), so even given the formula for the resonant frequency plus a "full" set of specs for both the cartridge and the arm it is not possible to calculate the resonance. But the mass of most current arms is low enough to allow use of very compliant styli without undue worry about warps. The possibility of mismatch remains, however.

It is exaggerated by the excessive emphasis that has been put on stylus compliance. Like tracking-force range, compliance has been assumed as a criterion of merit by the buying public: "The higher the compliance, the better the cartridge." The proposition simply won't hold water, but it has cajoled turntable owners into choosing

Which Cartridges Go with Which Tone Arms?

17 Manufacturers State Their Recommendations

PHONO CARTRIDGES	TURNTABLES and TONE ARMS*
AUDIO DYNAMICS	
	Declines to provide information due to affiliation with BSR. Believes data could be misconstrued as knocking a competitor and would only add to customer's confusion.
AUDIO-TECHNICA	
	Audio-Technica Company has been gathering data on available turntables and tone arms, but no firm recommendations were available by press time.
B & O	
MMC-6000	**Audio-Technica:** AT-1003, AT-1005. **B & O:** Beogram 4002. **Connoisseur:** BD-2/C. **SME:** 3009, 3009/S2. **Sony:** PS-2251. **Stax:** UA-7. **Technics:** SP-1200, SP-1100A, SP-10. **Thorens:** TD-125AB.
MMC-4000	**Audio-Technica:** AT-1003, AT-1005. **B & O:** Beogram 3000. **BSR:** 810. **Connoisseur:** BD-2/C. **Dual:** 1229, 1218, 1216, 1214, 701. **Lenco:** L-85, L-78, L-75. **Miracord:** 770H, 760, 660H, 50H Mk. II, 50H. **JVC:** VL-8. **Philips:** GA-212, SL-8E, ST-4. **Sansui:** SR-2050C. **SME:** 3009/2, 3009. **Sony:** PS-2251. **Stax:** UA-7. **Technics:** SP-1200, SP-1100A. **Thorens:** TD-160C, TD-125AB. **Yamaha:** YP-700.
SP-14	**Acoustic Research:** AR-XB. **Audio-Technica:** AT-1003, AT-1005. **B&O:** Beogram 3000. **BSR:** 810. **Connoisseur:** BD-2/C. **Dual:** 1229, 1218, 1216, 1214, 701. **Empire:** 598-2. **Garrard:** Zero 100C. **Glenburn:** 2110. **JVC:** VL-8. **Lenco:** L-85, L-78, L-75, B-52. **Miracord:** 770H. **P-E:** PE-3015, PE-3012. **Philips:** GA-308, GA-212. **Pioneer:** All models. **Rabco:** ST-4. **Realistic:** Lab 36-A. **Rek-O-Kut:** CVS-12. **Sansui:** SR-2050C, SR-1050C. **Sanyo:** TP-805A. **SME:** 3009/2, 3009. **Sony:** PS-2251. **Stax:** UA-7. **Technics:** SP-1200, SP-1100A, SP-10. **Thorens:** TD-160C, TD-125AB. **Toshiba:** SR-40E. **Yamaha:** YP-700.
SP-12	**Audio-Technica:** AT-1005, AT-1003. **B & O:** Beogram 3000. **Connoisseur:** BD-2/C. **Dual:** 1229, 1218, 1216, 1214, 701. **Empire:** 598. **Garrard:** Zero 100C, Zero 92, SL-95B. **JVC:** VL-8. **Lenco:** L-85, L-78, L-75, B-52. **Miracord:** 770H, 760, 660H, 50H Mk. II, 50H. **Philips:** GA-212. **Pioneer:** All models. **Rabco:** SL-8E, ST-4. **Realistic:** Lab-36A. **Rek-O-Kut:** CVS-12. **Sansui:** SR-2050C. **Sanyo:** TP-805A. **SME:** 3009/S2, 3009. **Sony:** PS-2251. **Stax:** UA-7. **Technics:** SP-1200, SP-1100A, SP-10. **Thorens:** TD-160C, TD-125AB. **Yamaha:** YP-700.
DECCA	
London	**B & O:** All models. **BSR:** All models. **Connoisseur:** All models. **Decca:** International tone arm. **Dual:** All models. **Empire:** All models. **Garrard:** Zero 100, 401.
Export Mk.-5	**JVC:** All models. **Lenco:** All models. **Linnsonder:** LP-12. **P-E:** All models. **Philips:** All models. **Rabco:** SL-8E. **Rek-O-Kut:** All models. **Sansui:** All models. **SME:** 3009/S2. **SME:** 3009/S2. **Sony:** All models. **SSI:** All models. **Technics:** All models. **Thorens:** 125 Mk. II.
London Mk.-5	Same as Export Model.
ELAC	
STS-444-E	**B & O:** Beogram 3000. **BSR:** 810. **Dual:** 1229, 701. **Empire:** 208. **Garrad:** Zero 100C. **Lenco:** L-85, L-78, L-75. **Miracord:** 770H, 760, 50H Mk. II. **P-E:** PE-3060. **Philips:** GA-212. **Pioneer:** PL-51, PL-35. **Sansui:** SR-2050C, SR-1050C, TP-80. **Sony:** PS-5520. **Technics:** SL-1200, SL-1100. **Thorens:** TD-160C, TD-125 Mk. II. **Yamaha:** YP-700.
STS-344-E	**Acoustic Research:** AR-XB. **B & O:** Beogram 3000. **BSR:** 810, 710. **Dual:** 1229, 1218, 1216, 701. **Empire:** 208. **Garrard:** Zero 100C. **Lenco:** L-85, L-78, L-75. **Miracord:** 770H, 760, 50H Mk. II. **P-E:** PE-3060, PE-3015. **Philips:** GA-212. **Pioneer:** PL-51, PL-35. **Sansui:** SR-2050C, SR-1050C, TP-80. **Sony:** PS-5520. **Technics:** SL-1200, SL-1100. **Thorens:** TD-160C, TD-125 Mk. II. **Yamaha:** YP-700.
STS-344-17	**Acoustic Research:** AR-XB. **B & O:** Beogram 3000. **BSR:** 810, 710. **Dual:** 1229, 1218, 1216, 1214, 701. **Empire:** 208. **Garrard:** Zero 100C, SL-92. **Lenco:** L-85, L-78, L-75.

*Note: Model numbers represent integrated turntable-arm ensembles except for Ortofon, Rek-O-Kut, and SME, which offer separate tone arms. Compatibility information supplied by the cartridge manufacturers.

super-compliant cartridges — and therefore, on occasion, into greater tracking problems with warped discs than need be.

Evaluating the Specs

Some manufacturers are unwilling to say which of their pickups will track with another manufacturer's tone arm. They argue that they can control the quality and specifications of their own cartridges but not those of another company's product.

Not only may they find that a changer that "will track at 1 gram" actually needs 2 grams to trip, but there's no guarantee that a year from now the same model may not have been revised to trip at 1 gram, or 3 grams. Even if a cartridge manufacturer goes to the time (and expense) of testing a given turntable for compatibility, his findings can be invalidated in short order. And with so many models on the market the prospect of testing his pickup in each — and of doing so on a continuing basis — is not encouraging.

But without such complete testing some incompatibility "sleepers" are bound to remain. For example, the Decca pickups listed in the table have an unusually strong magnetic field. The Philips turntables shown as "compatible" for the pickups

PHONO CARTRIDGES	TURNTABLE and TONE ARMS*
	B-52. **Miracord:** 770H, 760, 625, 50H Mk. II. **P-E:** PE-3060, PE-3015, PE-3012. **Philips:** GA-308, GA-212. **Pioneer:** PL-51, PL-35, PL-12D. **Sansui:** SR-2050C, SR-1050C, TP-80. **Sony:** PS-5520. **Technics:** SL-1200, SL-1100. **Thorens:** TD-160C, TD-125 Mk. II. **Yamaha:** YP-700.
STS-244-E	**Acoustic Research:** AR-XB. **B & O:** Beogram 3000. **BSR:** 810, 710. **Dual:** 1218, 1216, 1214. **Garrard:** SL-92. **Lenco:** L-75, B-52. **Miracord:** 625. **P-E:** PE-3015, PE-3012. **Philips:** GA-308. **Pioneer:** PL-12D.
STS-244-17	Same as Model STS-244-E.
EMPIRE	
4000D/III	**Dual:** 1229. **Empire:** 598, 498, 398. **Garrard:** Zero 100C. **Miracord:** 770H, 50H. **Pioneer:** PL-61. **SME:** 3009. **Sony:** PS-2251. **Technics:** SL-1200. **Thorens:** TD-125 Mk. II.
4000D/II	**BIC:** 980. **BSR:** 810. **Dual:** 1229, 1218. **Empire:** 598, 498, 398. **Garrard:** Zero 100C, Zero 92. **Miracord:** 770H, 50H. **P-E:** PE-3060. **Pioneer:** PL-61. **SME:** 3009. **Sony:** PS-2251. **Technics:** SL-1200. **Thorens:** TD-125 Mk. II.
4000D/I	**BIC:** 980, 960. **BSR:** 810, 610AX, 510. **Dual:** 1218, 1216. **Empire:** 598, 498, 398. **Garrard:** Zero 100C, Zero 92. **Glenburn:** All models. **Lenco:** All models. **Miracord:** 770H, 50H. **P-E:** PE-3060. **Pioneer:** PL-61. **SME:** 3009. **Sony:** PS-2251. **Technics:** SL-1200. **Thorens:** TD-125 Mk. II.
2000E/III	**BIC:** 980, 960. **BSR:** 810. **Dual:** 1219, 1218, 1216. **Empire:** 598, 498, 398. **Garrard:** Zero 100C. **Lenco:** All models. **Miracord:** 770H, 50H. **Pioneer:** PL-61. **SME:** 3009. **Sony:** PS-2251. **Technics:** SL-1200. **Thorens:** TD-125 Mk. II.
2000E/II	**BIC:** 980, 960. **BSR:** 810, 610AX, 510. **Dual:** 1228, 1218, 1216. **Empire:** 598, 498, 398. **Garrard:** Zero 100C, Zero 92. **Glenburn:** All models. **Lenco:** All models. **Miracord:** 770H, 50H. **P-E:** PE-3060. **Pioneer:** PL-61. **Sony:** PS-2251. **Thorens:** TD-125 Mk. II.
2000E/I	**Acoustic Research:** AR-XB. **BIC:** 960. **BSR:** 810, 610AX, 510. **Dual:** 1218, 1216. **Garrard:** Zero 100C, Zero 92, 82. **Glenburn:** All models. **Lenco:** All models. **P-E:** PE-3060. **Pioneer:** PLA-35. **Sony:** PS-5520. **Thorens:** TD-160C.
2000E	**Acoustic Research:** AR-XB. **BIC:** 980. **BSR:** 610AX, 510. **Dual:** 1216. **Garrard:** 82. **Glenburn:** All models. **Pioneer:** PLA-35. **Sony:** PS-5520. **Thorens:** TD-160C.
2000	Same as Model 2000E, except not compatible with **BIC** 980.
1000ZE/X	**Dual:** 1229. **Empire:** 598, 498, 398. **Garrard:** Zero 100C. **Miracord:** 770H, 50H. **Pioneer:** PL-61. **SME:** 3009. **Sony:** PS-2251. **Technics:** SL-1200. **Thorens:** TD-125 Mk. II.
999VE/X	**BSR:** 810. **Dual:** 1229, 1218. **Empire:** 598, 498, 398. **Garrard:** Zero 100C, Zero 92. **Miracord:** 770H, 50H. **P-E:** PE-3060. **Pioneer:** PL-61. **SME:** 3009. **Sony:** PS-2251. **Technics:** SL-1200. **Thorens:** TD-125 Mk. II.
999TE/X	Same as Model 99VE/X, except also is compatible with **Dual** 1216 and all **Lenco** models.
999SE/X	**Acoustic Research:** AR-XB. **BSR:** 810, 610AX, 510. **Dual:** 1218, 1216. **Empire:** 598, 498, 398. **Garrard:** Zero 100C, Zero 92. **Glenburn:** All models. **Lenco:** All models. **Miracord:** 770H, 50H. **P-E:** PE-3060. **Pioneer:** PL-61, PLA-35. **SME:** 3009. **Sony:** PS-5520, PS-2251. **Technics:** SL-1200. **Thorens:** TD-160C, TD-125 Mk. II.
999E/X	**Acoustic Research:** AR-XB. **BSR:** 810, 610AX, 510. **Dual:** 1218, 1216. **Garrard:** Zero 100C, Zero 92, 82. **Glenburn:** All models. **Lenco:** All models. **Pioneer:** PLA-35. **Sony:** PS-5520. **Thorens:** TD-160C.
90EE/X	**Acoustic Research:** AR-XB. **BSR:** 610AX, 510. **Garrard:** 82. **Glenburn:** All models. **P-E:** PE-3060. **Pioneer:** PLA-35. **Sony:** PS-5520. **Thorens:** TD-160C.
909/X	Same as Model 90EE/X, except not compatible with **Garrard** or **Glenburn** models shown.
440D	Same as Model 999SE/X, except not compatible with **Acoustic Research** AR-XB; is compatible with **Garrard** 82.
66QE/X	Same as Model 440D, except is not compatible with **BSR** 810.
66PE/X	Same as Model 66QE/X.
66LE/X	**BSR:** 610AX, 510. **Dual:** 1216. **Garrard:** Zero 92, 82. **Glenburn:** All models. **Lenco:** All models. **P-E:** PE-3060. **Pioneer:** PLA-35. **Sony:** PS-5520.
66E/X	Same as Model 66LE/X.
66/X	Same as Model 66LE/X.
GRADO	
FTR +	Works in all changers and turntables tracking between 1.5 and 3.0 grams.
FTE +	Same as Model FTR +.
FCR +	Same as Model FTR +.
FCE +	Same as Model FTR +.
FTR + 1	Works in all changers and turntables tracking between 1.0 and 2.0 grams.
FCR + 1	Same as Model FTR + 1.

have ferrous platters. The result, some users report, is so much attraction between magnet and platter that the stylus assembly bottoms. Philips confirm this experience by stating that the combination is incompatible.

One of Decca's (US) agents, in denying the incompatibility, states that his company regularly uses the combination in demonstrating speakers and never has had a case of bottoming. The agent adds, however, that tracking force on the Philips normally is set to 2 grams — rather low for this particular cartridge, though the magnetic attraction between pickup and platter presumably adds to the actual weight.

Are the two incompatible? You can call it either way, depending on your point of view.

The question of compatibility does not admit of entirely unequivocal answers. But no manufacturer wants his product to be used in a combination that will reflect badly on it. And some cartridge makers (Stanton is among those on the chart that stand out) go to great lengths to help their customers choose wisely in spite of all that mitigates against their doing so.

In a way, the credibility crunch is hardest on those companies that offer both pickups and arms or turntable ensembles, because when specifying in one area they must

PHONO CARTRIDGES	TURNTABLE and TONE ARMS*
F3E +	Same as Model FTR + 1.
F-2 +	Same as Model FTR + 1.
F-1 +	Same as Model FTR + 1.
JVC	
4MD-20X	**JVC:** VL-8, VL-5.
MICRO-ACOUSTICS	
QDC-1 Series	**Acoustic Research:** All models. **Audio-Technica:** All models. **BSR:** All models except 310X. **Connoisseur:** All models. **Dual:** All models. **Empire:** All models. **Garrard:** All models except 40B. **JVC:** All models. **Lenco:** All models. **Miracord:** All models. **Panasonic:** All models. **P-E:** All models. **Philips:** All models. **Pioneer:** All models. **Rabco:** All models. **Rek-O-Kut:** All models. **Sansui:** All models. **Sanyo:** All models. **SME:** All models. **Sony:** All models. **SSI:** All models. **Technics:** All models. **Thorens:** All models. **Yamaha:** All models.
ORTOFON	
SL-15E	**BSR:** 810. **Dual:** 1229, 1218, 701. **Empire:** 598-2, 498A, 398A. **Garrard:** Zero 100C, Zero 92. **JVC:** VL-8. **Miracord:** 770H, 760, 50H Mk II. **Ortofon:** AS212TA. **P-E:** PE-3060. **Pioneer:** PL-61. **Rabco:** SL-8E. **Sansui:** SR-2050C, SR-212. **SME:** 3009 S2. **Sony:** PS-5520, PS-2251. **Technics:** SL-1200, SP-12. **Thorens:** TD-165, TD-160C, TD-125 Mk II.
M-15E	**BSR:** 810. **Dual:** 1229, 1218, 701. **Garrard:** Zero 100C, Zero 92. **JVC:** VL-8. **Miracord:** 770H, 760, 50H Mk II. **Ortofon:** AS-212TA. **P-E:** PE-3060. **Philips:** GA-212. **Pioneer:** PL-61. **Rabco:** SL-8E. **Sansui:** SR-2050C. **SME:** 3009 S2. **Sony:** PS-2251. **Technics:** SL-1200, SP-12. **Thorens:** TD-160C, TD-125 Mk II.
M-15	Same as Model M-15E.
F-15E	**Acoustic Research:** AR-XA. **BSR:** 810, 710, 610AX, 510, 310. **Dual:** 1229, 1218, 1216, 1214, 701. **Empire:** 598-2, 498, 398. **Garrard:** Zero 100C, Zero 92, 82, A-70, 62, 40B. **Glenburn:** All models. **JVC:** VL-8. **Lenco:** All models. **Miracord:** 770H, 760, 750 Mk II, 50H Mk II. **Ortofon:** AS-212TA. **P-E:** PE-3060, PE-3015, PE-3012. **Philips:** GA-407, GA-308, GA-212. **Pioneer:** PL-61, PL-12AC. **Rabco:** SL-8E, ST-4. **Sansui:** SR-2050C, SR-212. **SME:** 3009 S2. **Sony:** PS-5520, PS-2251. **Technics:** SL-1200, SP-12. **Thorens:** TD-165, TD-160C, TD-125 Mk II.
F-15	Same as Model F-15E.
PANASONIC	
EPC-460C	3.2-gram cartridge is compatible with tone arms able to track at less than 2.5 grams. Needs bias voltage normally supplied by preamp in specially designed CD-4 demodulator.
PICKERING	
XV-15DCF Series	
1200E	**Acoustic Research:** AR-XB. **BIC:** 980, 960. **Dual:** 1228, 701, 601. **Garrard:** Zero 100C, Zero 92, 82. **P-E:** PE-3048. **Philips:** GA-209S. **Pioneer:** PL-45, PLA-35, PL-12D, PL-10. **Sony:** PS-5550, PS-5520, PS-2251, PS-2250. **Technics:** SL-1200, SL-1100, SP-10. **Thorens:** TD-165, TD-125 Mk II.
750E	Same as Model 1200E.
400E	Same as Model 1200E, except also compatible with **Philips** GA-407.
350	Same as model 400E.
200E	**BSR:** 620, 520. **Dual:** 1226, 1225, 1216, 1215, 1214. **Philips:** GA-407.
150	Same as Model 200E.
140E	**BSR:** 260.
100	Same as Model 140E.
V-15 Micro IV Series	
AME	Same as Model 400E.
ATE	Same as Model 200E.
ACE	Same as Model 140E.
AM	Same as Model 400E.
AT	Same as Model 200E.
AC	Same as Model 140E.
RADIO SHACK	
Realistic/Shure Series	
R-700E	**Realistic:** Realistic/Miracord 45.
R-27E	**Realistic:** Realistic/Miracord 40C, Realistic Lab-36A.
R-47EB	**Realistic:** Lab-34B.
R-7C	**Realistic:** Lab-12B.

deal with competitors' products in the other. Let's say that you are a manufacturer and that you know your popular pickup to be only a marginal match for your competitors 'Macro-Miracle' turntable. If you say the two are compatible, you may cause problems both for yourself and for your competitor. If you say they're incompatible, you leave yourself open to charges of letting commercial considerations cloud your judgement: Aren't you trying to downgrade the competing 'Macro-Miracle'?

The charts that accompany this article were constructed entirely from information provided by the cartridge manufacturers. All of the problems discussed above can be read into those charts. This should not be taken as a condemnation of manufacturers' specifications. Rather, it is an index of a significant problem that exists and — so far — has resisted a successful across-the-board solution. Use the tables as a starting point by all means, keeping in mind the basic rule that the better pickups are designed to work well in the better arms, and vice versa. That is, the manufacturer's need to produce equipment that will work well with other components *of the same class* generally is reliable insurance against serious problems. ●

PHONO CARTRIDGES	TURNTABLE and TONE ARMS*
REK-O-KUT	
F-3	**REK-O-KUT:** S-320.
SHURE	
V-15 Type III	Compatible with precision quality tone arms and automatic turntables capable of tracking at 1.25 grams or less.
M91ED	Compatible with high-quality tone arms and automatic turntables capable of tracking at 1.5 grams or less.
M75ED Type 2	Same as Model M91ED.
M75EJ Type 2	Compatible with standard tone arms and automatic turntables tracking at from 1.5 to 3 grams.
M75ECS	Recommended for older manual tone arms and changers requiring 2 to 4 grams of tracking force.
M75CS	Recommended for upgrading older, heavier-tracking cartridges or for virtually any tone arm or changer tracking at from 3 to 5 grams.
STANTON	
780/4DQ	Compatible with turntables properly wired for 100-pF capacitance load.
681EEE	**ACOUSTIC RESEARCH:** AR-XA, AR-XB. **BSR:** 810, 710. **DUAL:** 1229, 1219, 1218, 1019, 1015, 701, 601. **GARRARD:** Zero 100C, Zero 92, SL-95, SL-95B, 82. **LENCO:** L-85, L-78, L-75. **MIRACORD:** 770H, 760, 750, 660, 650, 50H Mk. II. **P-E:** PE-3060, PE-3048, PE-2040, PE-2038, PE-2035. **PHILIPS:** GA-212, 209S. **PIONEER:** PL-61, PL-51, PL-45, PL-41D, PLA-35, PL-12D. **RABCO:** SL-8E. **SANSUI:** SR-2050C, SR-1050C. **SONY:** PS-5550, PS-5520, S-2251, PS-2250, PS-1800, PS-1800A. **SME:** 3012, 3009. **TECHNICS:** SL-1200, SL-1100, SP-10. **THORENS:** TD-165C, TD-160C, TD-125AB Mk. II.
681EE	Same as Model 681EEE, except not compatible with **PIONEER** models shown.
681A	**ACOUSTIC RESEARCH:** AR-XA, AR-XB. **BSR:** 810, 710, 620, 610, 520, 510. **CONNOISSEUR:** BD-1, BD-2. **DUAL:** 1229, 1226, 1225, 1219, 1218, 1216, 1215, 1214, 1019, 1015, 1010. **GARRARD:** Zero 100, Zero 92, SL-95, SL-95B, SL-75, SL-72B, SL-55, Lab 80 Mk. II, Lab 80, A-70, 82, 70, 62. **GLENBURN:** 2155, 2130, 2110. **LENCO:** L-85, L-78, L-75, B-52. **MIRACORD:** 770H, 760, 750, 660, 650, 625, 50H Mk. II, 18H, M-10, M-10F, M-10H. **P-E:** PE-3060, PE-3048, PE-3015, PE-3012, PE-2040, PE-2038, PE-2035, PE-2010, PE-2005. **PHILIPS:** GA-407, GA-308, GA-212, 209S. **PIONEER:** PL-61, PL-51, PL-45, PL-41D, PLA-35, PL-12D. **RABCO:** SL-8E, ST-4. **SANSUI:** SR-2050C, SR-1050C. **SONY:** PS-5550, PS-5520, PS-2251, PS-2250, PS-1800, PS-1800A. **SME:** 3012, 3009, **TECHNICS:** SL-1200, SL-1100, SP-10. **THORENS:** TD-165C, TD-160C, TD-125AB Mk. II.
600EE	Same as Model 681EEE, except also compatible with **GLENBURN** 2155.
600E	**BSR:** 620, 610, 520, 510, 310, 260. **CONNOISSEUR:** BD-1, BD-2. **DUAL:** 1226, 1225, 1216, 1215, 1214, 1010. **GARRARD:** SL-75, SL-72B, SL-55, SL-40B, Lab 80 Mk. II, Lab 80, A-70, 70, 62, 50 Mk. II, 50, 40. **GLENBURN:** 2130, 2110. **LENCO:** B-52. **MIRACORD:** 625, 18H, M-10, M-10F, M-10H. **P-E:** PE-3015, PE-3012, PE-2010, PE-2005. **PHILIPS:** GA-407, GA-308. **RABCO:** ST-4.
600AA	**P-E:** PE-3060, PE-3048, PE-2040, PE-2038, PE-2035. **RABCO:** SL-8E.
600A	**ACOUSTIC RESEARCH:** AR-XA, AR-XB. **BSR:** 810, 710, 620, 610, 520, 510, 310, 260. **CONNOISSEUR:** BD-1, BD-2. **DUAL:** 1229, 1226, 1225, 1219, 1218, 1216, 1215, 1214, 1019, 1015, 1010, 701, 601. **GARRARD:** Zero 100, Zero 92, SL-95, SL-95B, SL-75, SL-72B, SL-55, SL-40B, Lab 80 Mk. II, Lab 80, A-70, 82, 70, 62, 50 Mk. II, 50, 40. **GLENBURN:** 2155, 2130, 2110. **LENCO:** L-85, L-78, L-75, B-52. **MIRACORD:** 770H, 760, 750, 660, 650, 625, 18H, M-10, M-10F, M-10H. **P-E:** PE-3015, PE-3012, PE-2010, PE-2005. **PHILIPS:** GA-407, GA-308, GA-212, 209S. **PIONEER:** PL-61, PL-51, PL-45, PL-41D, PLA-35, PL-12D. **RABCO:** ST-4. **SANSUI:** SR-2050C, SR-1050C. **SONY:** PS-5550, PS-5520, PS-2251, PS-2250, PS-1800, PS-1800A. **SME:** 3012, 3009. **TECHNICS:** SL-1200, SL-1100, SP-10. **THORENS:** TD-165C, TD-160C, TD-125AB Mk. II.
500EE	Same as Model 600EE.
500E	Same as Model 600E.
500AA	Same as Model 600EE.
500AL	**BSR:** 310, 260. **GARRARD:** SL-40B, 50 Mk. II, 50, 40.
500A	**BSR:** 620, 610, 520, 510, 310, 260. **DUAL:** 1226, 1225, 1216, 1215, 1214, 1010. **GARRARD:** SL-75, SL-72B, SL-55, SL-40B, Lab 80 Mk. II, Lab 80, A-70, 70, 62, 50 Mk. II, 50, 40. **GLENBURN:** 2130, 2110. **LENCO:** B-52. **MIRACORD:** 625, 18H, M-10, M-10F, M-10H. **P-E:** PE-3015, PE-3012, PE-2010, PE-2005. **PHILIPS:** GA-407, GA-308. **RABCO:** ST-4.
TOSHIBA	
C401S/SZ200	**ACOUSTIC RESEARCH:** AR-XB. **AUDIO-TECHNICA:** AT-1005, AT-1003. **BSR:** 810, 710. **DUAL:** 1229, 1218, 1216, 701. **EMPIRE:** 598-2. **GARRARD:** Zero 100C, SL-95B. **JVC:** VL-8. **LENCO:** L-85, L-78. **MIRACORD:** 760, 50H Mk. II. **PHILIPS:** GA-212. **PIONEER:** PL-61, PL-51, PLA-35, PL-22D. **SME:** 3012, 3009. **TECHNICS:** SL-1200, SP-1100A. **THORENS:** 125B Mk. II. **TOSHIBA:** SR-80, SR-50, SR-40E.

award winner*

Unlike conventional turntables, the Technics SL1200 has no mechanical speed reduction system such as fluttering idler wheels or vibrating belts which help cause annoying wow and flutter.

Instead the Technics SL1200 turntable has a heart: a Direct Drive, 35 pole D.C. brushless motor rotating at exactly 33⅓ and 45 R.P.M., which guarantees a wow and flutter less than 0.03% WRMS and a rumble better than −50 dB (DIN a) −70 dB (DIN B).

The Technics SL1200 is a true professional high fidelity turntable using a 33cm dynamically balanced 3.9lb aluminium diecast platter set directly onto the motor (the heart) assuring glide smooth rotation.

An S-shaped statically balanced, precision built tonearm with anti-skating control is employed, plus a stylus pressure adjustment from 0-4 grams guarantees perfect tracking.

Variable pitch controls, built in stroboscope speed indicator, oil dampened cueing device, 'feather-touch' cueing control, 4 channel ready, deluxe dust cover, adjustable audio insulated legs supporting a cast aluminium base are just some of the advanced features.

Without doubt this is the finest turntable available today.

* Technics SL1200 won the 'Blue Ribbon' prize in the 'Daily Mail Ideal Home Exhibition' in the United Kingdom. The 'Blue Ribbon' prize is given to products which are distinguished in function, design, practicability and value for money.

GUARANTEED AND SERVICED BY HACO

National Technics

WT GD62T

DICK SMITH ELECTRONICS CENTRE

Look Here!

Thorn DCR1 Dolby Cassette Deck $236

The best deck value anywhere featuring limiter to prevent overload on recording, Dolby Noise Reduction circuit, Bias switch, Blend microphone control, Separate L&R controls for line and mic. Large Peak level meters. Output level control. Multiplex filter for FM recording. Memory rewind. We could go on and on. Wow & Flutter under 0.16%. Response from 40 to 15000 Hz + 2½ dB, S/N Cr02 Dolby 56 dB etc. Terrific value for the enthusiast at $190.00 (P & P Freight on).

Speaker Specials

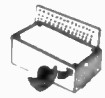
These two cabinets feature real timber veneers (not plastic) and foam black grills for good sound dispersion.

2 Speaker 2 way has an 8" woofer and 2" tweeter giving response from 40 Hz to 20 kHz. Only $89.00 a pair (P & P Freight on).

3 Speaker 3 way system features a 12" really heavy duty woofer plus 6" mid range and dome tweeter. Tremendous bass from this one, 30 to 25 kHz and full 35W rms handling. Only $140 (P & P Freight on).

CALL IN AND HEAR THEM.

ZIPPY BOXES



Here's the boxes for project builders who want a real professional look to their projects. These boxes are moulded in ABS, so they are tough yet easy to drill. The finish is a posh black with ingenious posts in each corner to take self tapping screws and hold a printed circuit board. They are supplied with a flush fitting aluminium panel which fits all ways round (such is the precision of these boxes). Special panels are also available made of bakelite at 80c and matrix board at 80c (large size only).

Size UB1 15 x 9 x 5 cm $1.65
Size UB3 12½ x 6 x 4 cm $2.00

AM/FM MULTIPLEX TUNER There is a shortage of tuners so get your's early. On Separate AM and FM front ends. 10 transistors, 14 diodes. FM 88 to 108MHz, AFC, 60 dB S/N, 35 dB sep, 600 mV output AM 535 to 1605kHz. ferrite rod. Multiplex adaptor built-in with indicator. 240V operated in Walnut case. Guaranteed 12 months. Only $85 (P & P Free). Hurry, demand is going to be heavy.

TC2 Tube Tester $45.00

If you can't get in to test your valves FREE use the TC2 to test for shorts, filaments continuity and emission. 4 popular valve bases. 15 page manual lists about 1500 valves you can check and is fitted in drawer so you can't loose it. Sturdy metal construction with large meter movement. Only $45.00 (P & P $2.00).

M.W. & I.F. SIGNAL GENERATOR

The Mitsui has been specially designed for broadcast receiver alignment. One band covers 400 – 550 kHz for aligning IFs. Other covers 550 to 1600 kHz for MW tuning. 6 month guarantee and batteries included for only $9.95 (P & P 75c)

MITSUI SIGNAL INJECTOR

Handy penshaped injector for locating faults in radios, amps, tape recorders, tv etc. Saves time and effort and is great value for only $5.75 (P & P 75c).

Coming soon

Sinclair Project 80

SPEAKERS A DOLLAR

Super special little 2¼" 8 ohm speakers. Ideal replacement for radios giving good sound at half normal price. Only $1.00 each (P & P 75c).

VALUPACKS

RESISTOR PACKS

Compiled from Philips computer listing of usage. Definitely not the usual useless pack with 2 or 3 of every value like 33 ohm, 18k etc. In our's you get 20 x 1k and only 2 x 56 ohm. However there's at least 2 of every value from 22 ohm to 470 k. Over 50 different values and 260 ¼W, 5% carbon film resistors. Normal value over $8.00. You get over 260 resistors for only $6.50.

CAPACITOR PACKS

Here is our first computer listed pack of single ended electros. 42 top quality caps based on usage (not the useless values). Check what you get

10V 2 x 33 uF
16V 4 x 100 uF 4 x 220 uF, 2 x 470 uF
25V 4 x 2.2, 4 x 4.7, 4 x 25 2 x 33, 4 x 47, 4 x 100, 4 x 220, 2 x 330, 2 x 470

You see it's not a random pack but based on computer usage listing. CAP1 pack has 42 electros for only $7.90. Normal value is around $12.50

DIGIPACKS

These have been produced for counter enthusiasts. A detailed instruction sheet covers the operation of the ICs and how they are interconnected. Clocking, reset and latching are described. Both packs can be cascaded.

TTL 'A' pack has a Datalit 707 display with 7490 BCD counter and 7447 decoder driver and forms the basis of a single decade counter for only $6.90.

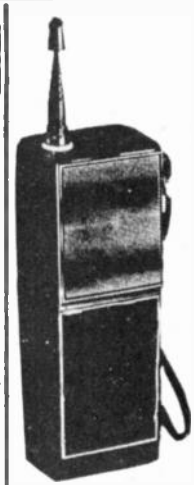
TTL 'B' pack has the same components as the A pack but also has 7445 latch IC which holds the display while counting. Only $7.90.

BOTH CALLBOOKS FOR ONLY $16.00

US RADIO AMATEUR CALLBOOK lists 283,000 K and W calls in over 600 pages. Covers all States and US citizens overseas $9.95 (P & P 75c).

FOREIGN RADIO AMATEUR CALLBOOK is the companion volume listing over 211,000 amateurs outside USA. Also has a useful selection of info. Over 400 pages give full address information. $9.95 (P & P 75c).

630 Battery Saver is a fully approved, double insulated job for extra safety. Will supply up to 300mA and is suitable for 6V, 7.5V or 9V appliances. Save a fortune on batteries with this neat little unit. Ready to plug in for just $10.90 (P & P 75c).



TREMENDOUS LOW PRICE WALKIE TALKIE OFFER CONTACT CT10

Remember the famous Midland 13700 units in our last year's catalogue? We sold thousands of these units (and no wonder when you read the spec). The Midland is no longer available but we have located an absolutely IDENTICAL Unit, ONLY THE NAME HAS CHANGED. Check these features:

Provision for 2 channels (27.240MHz or 27.880 MHz). Tuned RF stage. One microvolt sensitivity. Mute control, Calling tone. Heavy duty aerial. Maximum power allowable. PMG APPROVED (licence required). Transmitter effectively converts its 1W output power into a high ratio output power by high level push-pull class B modulation. Rugged case. Supplied with one set of crystals (specify frequency). Other frequency available at $7.00 pair.

Range:	up to 10 miles depending on terrain up to 50 miles over water
Frequency:	27.240 or 27.880 MHz
Freq. Stab:	0.005%
Tx:	Crystal controlled 1W
Rx:	Crystal locked superhet
Antenna:	13 section telescopic
Power:	8 x 1.5V UM3 cells
Size:	8¼ x 3¼ x 1¾"
Weight:	25 oz

$39.95

We have the Contact CT10 at the same, YES SAME price as our old catalogue. It must be the cheapest, 1 Watt, fully approved unit in Australia at ONLY $39.95. Buy 5 or more and save $2.00 on each unit at only $37.95 (P & P $2.00 per unit).

KITS

ETI Push button dimmer (NOV 74)

The very latest in dimmers. Push one button to increase brightness the other to decrease it. Handles up to 500 VA or put a huge heatsink on for 1000VA (incandescent or fluoros). Takes 3 seconds to go from off to full brightness and will hold for up to 24 hours. All electronic parts (no hardware switch etc.) for $16.50.

METER BEATER (ETI NOV 74)

Based on 555 timer provides a signal after ½ hour, 1 hour or 2 hours so you have time to dash back before picking up a ticket. Soon pays for itself. Electronic parts only $17.50.

NEW PRICE SAVE $5.00

No. 47 Musicolour MKII Colour Organ E.A. December, 1972

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 240 V 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!

MUSICOLOUR $54.00

PCBs

ETI 527 light dimmer $1.20
ETI 428 colour organ $3.60
ETI 313 car alarm $1.20
E.A. Computer complete set in fibreglass only $32.50

CAR ALARM (ETI NOV 74)

Here's a simple little circuit using the 556 timer which blows your horn for 1 second intervals when the car is interfered with. Easily installed in 12V pos or neg vehicles (relay extra). Surely your car is worth $14

STROBE KIT (ETI AUG 71) $26.50

Ideal for parties or discotheque etc. Flash rate variable from 1 to 20 flashes per second. Mains powered. Complete $26.50; Reflector only $5.00 (P & P $1.00). 6.5 uF, 250V caps $2.95.

No. 71 ETI 422 Stereo Amp Complete

SPECIAL NOTE
Beware of cheaper prices. Our kit includes rear panel genuine METAL TO3 Pack 115W output transistors exactly to spec. No cheaper lower, power plastic types (special kit with cheaper plastic types for $115 not recommended)

SPECIFICATIONS
Power output 50Wrms
Frequency Response 8dB from 20Hz to 20kHz
Channel separation 45dB
Hum & Noise 78dB aux/6.1dB (disc) input sens: Aux 210mV Disc 2.1mV Main amp 500mV Distortion (10W) 0.16% Tone controls ±13dB Damping factor >70 PCBs in fibreglass throughout Handsome teak cabinet Full instructions

This stereo amplifier kit is complete in all details and conforms with the E.T. design of May 1974. A guaranteed 50W RMS per channel into 8 ohm loads, from 20HZ to 20KHZ at 0.5 dB. Distortion less than 1%, typically 0.15%, many facilities including tape, tuner mike inputs, preamp output, main amp input at 3 basic sensitivities of 2.1mV, 210mV and 500mV. Kit comes complete in every way. Definitely the best build-it-yourself amplifier available and equal to many commercial units costing three times as much. Purchase the complete kit at $133.00 (P & P $3.00).

Dick Smith Wholesale P/L

St. Leonards Head Office & Mail Orders:
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Tel. 439 5311

Bankstown
361 Hume Highway, Bankstown (Nr. Chapel Rd)
Tel. 709 6600

Dick breaks the TIME~PRICE barrier!

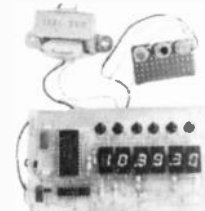
DIGITAL CLOCK KIT $29.95

SEE THIS ISSUE

No, not the usual $59.00 but a complete kit for only $29.95 using top quality National semiconductors. Even the basic beginner can build one in under an hour following our simple instructions. Full money back guarantee so why not buy one, inspect it at home for 7 days and if not satisfied return the kit and we will refund your money.

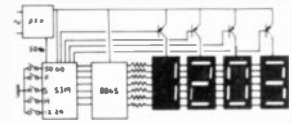
Check these terrific features:

- *Operates on 240V mains 50 or 60 cycle*
- *12 or 24 hour display*
- *Large 0.3" Red LED solid state display*
- *Full circuit board supplied*
- *Easy to understand instructions*
- *'Seconds' readout can be easily added*
- *Power supply included – no extras*
- *Uses brand new National ICs and semiconductors. Spares are available.*



As featured in E.T.I. with Seconds option

Here is the actual circuit. One of our staff members built his in only 40 minutes. Remember most of the wiring is already done on the circuit board!!



Kit includes the following

2 ICs, 4 readouts, 4 driver transistors, PC board, transformer, pushbuttons, resistors, diodes, capacitors, etc. NOTHING MISSING except a case which you can easily make yourself or use one of our zippy boxes.

Special Seconds Readout requires only two transistors, two readouts to make a full 6 digit clock. No extra wiring since circuit board has provision for expansion. Special price for seconds kit is only $6.00.

Short form kit for the budget conscious contains all semis and instructions you simply add common components and use veroboard or etch your own PCB. We've cut this one to the bone at $19.95.
Still can't believe it's this cheap? Well send a stamped self addressed envelope and we'll send you the instructions.

In response to the needs of the recording and broadcasting industries. Stanton creates the new calibration standard

...the 681 TRIPLE-E

A definite need arose.

The recording industry has been cutting discs with higher accuracy to achieve greater definition and sound quality.

Naturally, the engineers turned to Stanton for a cartridge of excellence to serve as a primary calibration standard in recording system check-outs.

The result is a *new* calibration standard, the Stanton 681 TRIPLE-E. Perhaps, with this cartridge, the outer limits of excellence in stereo sound reproduction has been reached.

The Stanton 681 TRIPLE-E offers improved tracking at *all* frequencies. It achieves perfectly flat frequency response to beyond 20 Kc. It features a dramatically reduced tip mass. Actually, its new nude diamond is an ultra miniaturized stone with only 2/3 the mass of its predecessor. And the stylus assembly possesses even greater durability than had been previously thought possible to achieve.

The Stanton 681 TRIPLE-E features a new design of both cartridge and body and stylus; it has been created for those for whom the best is none too good.

Each 681 TRIPLE-E is guaranteed to meet its specifications within exacting limits, and each one boasts the most meaningful warranty possible: an individual calibration test result is packed with each unit.

STANTON

Sole Australian Distributors

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QLD.: Brisbane Agencies, 72 Wickham St., Fortitude Valley. 4006.

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LER063

A Peaceful of Goodies for the Hobbyist & the Electronics 'buff' from M.S.C

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EVERYTHING IN ELECTRONICS

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P.O. Box 156 REDFERN 69-5922

PAC 'A' TOROIDAL CORES TMC type 107527 SB. External diameter 1 3/8" x 3/8" deep. Internal diameter ¾" approx. 6 for $2.00 P & P 50c.

PAC 'B' TOROIDAL CORES TMC type 107763 JB. External diameter 2 7/8" x 7/8" deep. Internal diameter 1 3/8" approx. 2 for $1.00 P & P 75c.

PAC 'C' PHILIPS BEEHIVE TRIMMERS. One of the most ingenious trimmers ever produced. Concentric air-spaced type. 3-30pF & 10-90pF. 3 of each type. Only $2.00 for the 6. P & P 30c.

PAC 'D' MONSTER TAG STRIP PAC. 50 assorted tag strips. From 2 to 9 tags. With and without mounting l.er $7.50 value for only $1.50 P & P 50c.

PAC 'E' MONSTER CAPACITOR PAC. 50 branded capacitors. Each pac contains 25 different Electrolytics & 25 different polyester, ceramic and mica capacitors. We guarantee 50 different types with no repeats. ALL NEW, UNUSED & PERFECT. $15.00 value at only $5.00 P & P 65c.

PAC 'F' 200 assorted 10% & 20% resistors. From ¼ to 2watt. All branded makes. Superb value at only $2.00 P & P 65c.

PAC 'H' Containing 10 unmarked but guaranteed NPN transistors in T05 package. Believed to tbe TT800 series transistors. Last few now remaining at 95c P & P 30c.

PAC 'G' Containing 10 Unmarked but guaranteed BC177 or BC178. We cannot say how many of either type would be in a PAC, but this is tremendous value at only 95c P & P 30c.

PAC 'I' 20 ARROW toggle switches. S.P.D.T. type. Very sturdily constructed and with moulded Dolly. In original packs of 20. Unbeatable value at $3.00 for 20. P & P 85c.

PAC 'J' 20 3.5mm Jack sockets. Open type $1.50 P & P 15c.

PAC 'K' 10 3.5mm Jack sockets. Housed type. $1.25 P & P 15c.

PAC 'L' 10 3.5mm Jack sockets. Housed switch type. $1.75 P & P 15c.

PAC 'M' 10 assorted miniature type TRIMPOTS. 10 different values. Carbon track. Imported brand. Only $1.00 P & P 20c.

PAC 'N' IBM Computer board. 10 boards containing at least 40 transistors, resistors, diodes & caps. Only $3.00 P & P 65c.

DISCATRONS Portable record playing deck mechanism for 7" records. Complete in metal case, with carrying handle, 12v Motor, Stylus, control mechanism, push buttons. Definately the last FEW at a give-a-way price . . . FOR PERSONAL CALLERS ONLY. $1.25 each to clear.

SIGNAL DIODES . . . Type IN914 (IN4148) Used in numerous projects in both E.A. & E.T.I. 10 for $1.00

SIGNAL DIODES . . . Type 0A95. Again a very popular and much used diode in numerous projects. Unbeatable value 10 for $1.25.

SIGNAL DIODES . . . Type AA119. 10 for 85c.

POLYESTER CAPACITORS. By Philips, Wima, Ducon & Nichicon. A tremendous PAC for the hobbyist. All useful values. A great saving. All new and unused. 25 for $2.50.

ELECTROYTIC CAPACITORS By Philips, Wima, Ducon & Nichicon. A tremendous PAC for the hobbyist. All useful values. A great saving. All new & unused. 25 for $2.50.

ELECTROLYTIC CAPACITORS As above but 50 assorted types. ONLY $4.50.

MOTORIZED 12volt CAR AERIALS. Manufactured by HARMAN. Beautifully packed, and complete with all necessary connecting cable, raise and lowering switch and retaining clamp. A FANTASTIC XMAS OFFER at only $14.95 each. P & P $1.00.

LOCK-DOWN CAR ANTENNA. Completely vandal proof. 3' 4" extended. Nil feet when locked down. 2 keys supplied, and includes 4' cable with connector. Side key lock: $3.40 each; Top key lock: $3.25 each, P&P 75c.

AMEREX STEREO HEADPHONES. A very high grade pair of Stereo Headphones at a very moderate price. An ideal gift for Xmas. Frequency Range: 20-20kHz. Impedeance: 4-8Ω. Power rating: 0.2W. Each earpiece contains a volume control. Comes complete with Curly Cord and Stereo Jack plug. M.S.C. Price. ONLY $9.50 each plus 75c P & P. AMEREX HEADPHONES. As above with straight cord and less volume controls $6.75 each. P & P 75c.

McMURDO SLIMLINE CONNECTORS. Slimline Connectors are a most handy innovation for making up Male and Female wiring connections for Printed circuit and VERO Board. The removeable pins are soldered direct into the application Board, and the mating wiring direct on to the Female Strip connector, which also has a fixed polarising pin to avoid accidental reversing of Connector. 20 Connectors from 4 to 12 way in .1" & .15" & .2" pitch. $2.50 per 20. P & P 30c.

VU STEREO METERS. Dual precision Meters enclosed in clear plastic case. As recommended in the 'EA' Stereo Cassette Project using the 'VORTEX' Deck. Adaptable for any other compatible project. Limited quantities available. ONLY $6.75 each plus 50c P & P.

SPECTROL (U.S.A. Manufacture) WIRE WOUND PRECISION POTENTIOMETER. Extremely robust construction & waterproof sealed. 100Ω plus or minus 1%. Model type 132-9564. Dia: ¼". Total length 1½". Spindle ¼" x 3/8". ONLY $2.95 each plus 30c P & P.

POTENTIOMETERS. 20 assorted types. Carbon and wire-wounds, in LOG, LINEAR, Dual & Single, also switched types. A really fantastic offer, compared with todays prices and availability. All guaranteed NEW & UNUSED. ONLY $3.00 P & P $1.00 LIMITED QUANTITIES ONLY.

LOOK AT THIS SCOOP PURCHASE ONLY FROM M.S.C.

Complete 7 transistor 2 diode Radio made by Bendix. These Radio's come with a ready made up chassis with large tuning dial, 3½ – 8Ω – 6 watt speaker, 6 way battery box (Penlight cells not inc.) and volume control switch with knob.

These units can come to you at the mad price of only $3.85 P and P 85c.

BEYSCHLAG 1 & 2% RESISTORS. One of the best in the world. A very special offer of 1/8, ¼, ½, 2 & 3 Watt types. 50 assorted values at $2.25. Remember these are usually priced between 18c and 40c each. A PAC OF 50 for $2.25. Limited supplies only.

30 ASSORTED TELEVISION & RADIO KNOBS. In gold, silver, black and grey finish. From H.M.V., Healing, PYE & A.W.A. Very useful for the Radio & TV Service man. Only $2.50 a Pac. Worth more than treble. All guaranteed and unused. P & P 45c.

McMURDO CHASSIS MOUNTING FUSEHOLDERS. For 1¼" x ¼" (3AG) glass enclosed cartridge fuses) Current rating 10amps at 240 VAC. 10 for $1.50 plus P & P 15c.

ACOS DUST JOCKEY RECORD CLEANER

The most attractive and best presented Record Cleaner available. Well engineered and contains a free bottle of antistatic fluid. ONLY $3.50 P & P 50c.

EXTENDING AERIALS

Transistor or Television type. Sturdily made and finished in heavy chrome. Extends from 6" to 36". Totally directional due to the integral swivel base. Only from M.S.C. can these be bought at the fantastic price of $1.75 each or 2 for $3.00 P & P 50c.

FIRST TIME HERE . . . Exclusive to us HEADPHONE RADIO Looks like a normal headset, but has in-built miniature transistor radio, that simply drags the stations in. Fully adjustable headband, and finished in Ivory Bakelite. A special connector adaptor is also supplied that converts the Unit into an ordinary High class stereo headphone. Definitely NOT A GIMMICK and is fully warranted. Must be heard to be believed. ONLY $26.00 each plus P & P.

RODAN DIGITAL INDICATOR TUBE

Type GR-211. Electronic gas-filled Cold Cathode display device. In-line 9-0 Side viewing. Anode supply voltage 200v Diameter of glass tube 30mm. Height of digits 35mm. Colour of display digits Neon Red. $2.50 each to clear data sheet supplied.

PAC M13 HEAT SINKS

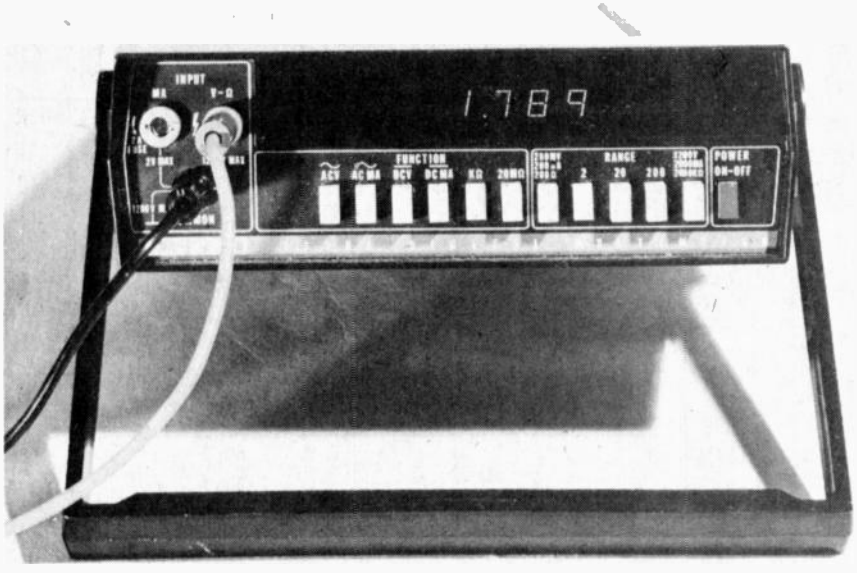
Finned type. Size 2" x 6". Ready drilled to accept either 1 power transistor in TO3 case (2N3055 or similar) or 2 Power Transistors in T066 case (2N3054 or similar). Originally made for car radio's. 60c each or 2 for $1.00 Post 30c

THE GREAT NAME FOR ELECTRONIC COMPONENTS IN AUSTRALIA

FLUKE MODEL 8000A MULTIMETER

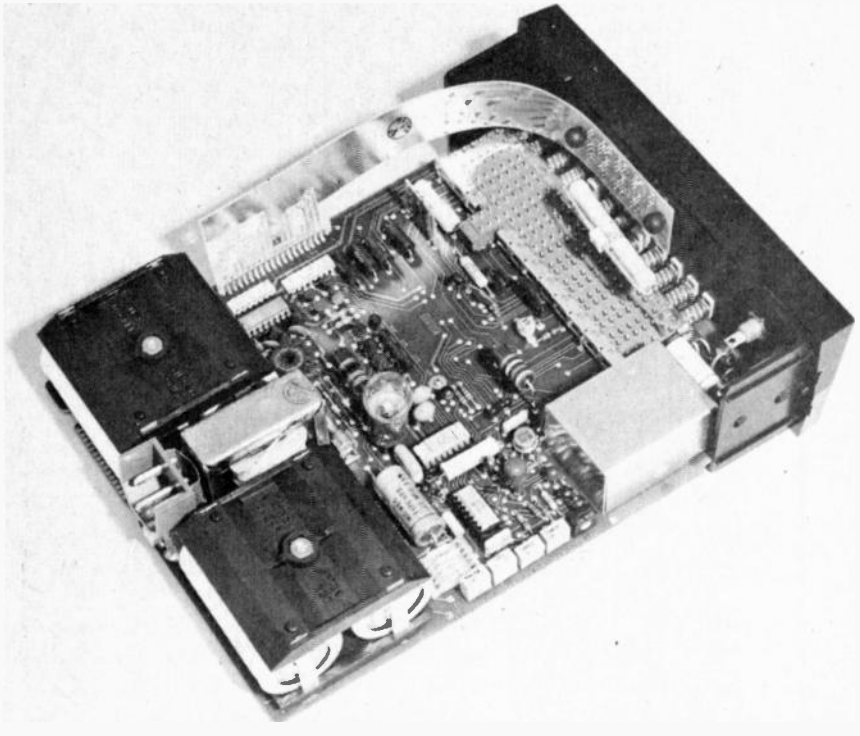
Recommended retail prices:

Low ohms	$ 50
High AMP	$ 20
BCD	$ 70
Basic unit	$260



"a delight to use".

SEVERAL years ago digital meters were invariably expensive and relatively large. They were only suitable for measuring dc voltage, and were fitted with manual polarity switches. But times have changed and today's digital multimeters have three to six different functions, covered by 26 or more ranges (dc volts, ac volts, resistance, dc current, ac current, and frequency). They may have auto ranging and auto polarity, and be much smaller and cost for less than their predecessors. These advances have been obtained, (without sacrificing accuracy) primarily by advances in integrated circuit technology.



The John Fluke Manufacturing Company has been well respected for many years as a manufacturer of high precision instruments for use as standards, or sub-standards, in electronic laboratories. In recent years a number of digital voltmeters and multimeters have been added to their range. These have accuracies down to 0.002% or better.

The instrument reviewed here is the Fluke 8000A digital multimeter. It is at the low price end of the range, but is certainly not low on performance.

The Fluke 8000A is a 3½ digit, five function multimeter with autopolarity and manual range selection. Its 26 ranges allow measurements of up to 1200 volts ac or dc, 2 amps ac or dc, and resistances up to 20 meg ohms. On the lowest ranges it has a resolution of 0.1 mV, 0.1μA and 0.1 ohm. A full list of ranges and accuracies is given in the specifications.

Fluke are one of the few companies which fully specify their instruments, with regard to both temperature and time. The accuracies quote are for temperatures between 15°C and 35°C for a period of one year from delivery. Undoubtably the instrument will retain its quoted accuracy for a much greater period than this. Such a guarantee is however comforting and is much more comprehensive than that offered by most other manufacturers.

OPTIONS

A number of options are available to extend the capability of the basic instrument:

Battery Pack Option

The rechargeable battery-pack option allows eight hours operation before recharging is necessary. The battery is automatically recharged in 14 hours when the instrument is connected to the mains.

Output Option

A data output option provides parallel, buffered BCD data for the

PRODUCT TEST

digital readout, polarity and overload. It is suitable for driving a printer or for input of data to other systems (eg data loggers).

High Current Option

This option extends the current measuring capability, on both ac and dc, to 20 amps.

Low Ohms Option

With this option two extra ohms ranges of two and 20 ohms full scale are provided. Nulling for the resistance of test leads is also provided as with this option the instrument is capable of resolving to 0.001 ohms.

The instrument has a very neat appearance, is housed in a clean and attractive plastic case and is fitted with a carrying handle. The carrying handle may be locked in several positions and thus doubles as an adjustable bench stand.

Internal construction is excellent. The majority of the electronics, including the range and function switches, is mounted on a single, fibre-glass printed-circuit board. The LED displays are connected to the main board by means of a flexible printed circuit board. The instrument supplied for test was fitted with the rechargeable battery pack, and the four, size D nickel-cadium cells are mounted at the rear of the unit.

With the battery-pack option the instrument derives its supply voltages via an inverter driven from the

Specifications (BASIC INSTRUMENT)

We have reproduced the Fluke 8000A specification in full as it is a model of how an instrument of this type should *be specified.*

DC VOLTAGE

Ranges	± 199.9 mV, ± 1.999 V, ± 19.99 V ± 199.9 V, ± 1199V
Accuracy (1 year, 15°C to 35°C)	± (0.1% of reading + 1 digit)
Temperature Coefficient: (−10°C to 15°C and 35°C to 55°C)	± (0.01% reading/°C + .005% F.S./°C)
Input Impedance	10 MΩ, all ranges
Normal Mode Rejection	Greater than 60 dB @ 50 Hz, 60 Hz
Common Mode Rejection (1 kΩ unbalance)	Greater than 120 dB @ dc and 50 Hz, 60 Hz
Response Time	½ second
Maximum Input Voltage	1200 V rms, all ranges

AC VOLTAGE

Ranges	199.9 mV, 1.99 V, 19.99 V, 199.9 V, 1199 V
Accuracy (1 year, 15°C to 35°C)	45 Hz to 10 kHz ± (0.5% of reading + 2 digits) 10 kHz to 20 kHz ± (1% of reading + 2 digits)
Temperature Coefficient: (−10°C to 15°C and 35°C to 55°C)	± (0.01% reading/°C +0.005% F.S./°C)
Input Impedance	10 MΩ in parallel with 100 pf
Common Mode Rejection (1 kΩ unbalance)	Greater than 60 dB @ 50 Hz, 60 Hz
Response Time	3 seconds, worst case
Maximum Input Voltage	1200 V rms, not to exceed 10^7 volt Hz product on 20,200, 1200 V ranges. 500 V rms on 200 mV and 2 V ranges.

DC CURRENT

Ranges	± 199.9 μA, ± 1.999 mA, ± 19.99 mA, ± 199.9 mA, ± 1999 mA
Accuracy (1 year, 15°C to 35°C)	± (0.3% of reading + 1 digit)
Temperature Coefficient: (−10°C to 15° and 35°C to 55°C)	± (0.015% reading/°C + 0.005% F.S./°C)
Voltage Burden	0.22V maximum up to 200 mA; 0.45V at 2 amps
Response Time	⅓ second
Maximum Input	2 amps rms (fuse protected)

AC CURRENT

Ranges	199.9 μA, 1.999 mA, 19.99 mA, 199.9 mA, 1999 mA
Accuracy (1 year, 15°C to 35°C)	45 Hz to 10 kHz ± (1% of reading + 2 digits) except 2000 mA range: 45 Hz to 3 kHz ± (1% of reading + 2 digits.
Temperature Coefficient: (−10°C to 15°C and 35°C to 55°C)	± (0.015% reading/°C + 0.005% F.S./°C)
Voltage Burden	0.22V maximum up to 200 mA; 0.45 V at 2 amps
Response Time	3 seconds, worst case
Maximum Input	2 amps (fuse protected)

RESISTANCE

Ranges	199.9Ω, 1.999 kΩ, 19.99 kΩ, 199.9 kΩ, 1999 kΩ, 19.99 MΩ
Accuracy (1 year, 15°C to 35°C)	± (0.2% of reading + 1 digit) all ranges except: ± (0.5% of reading + 1 digit) on 20 MΩ
Temperature Coefficient: (−10°C to 15°C and 35°C to 55°C)	KΩ ± (0.015% reading/°C + 0.005% F.S./°C) 10 Meg ± (0.02% reading/°C + 0.005% F.S./°C)
Response Time	½ second, all ranges except: 4 seconds on 20 MΩ range
Current through Unknown	200Ω range, 1 mA 2 kΩ range, 1 mA 20 kΩ range, 100 μA 200 kΩ range, 1 μA 2000 kΩ range, 1 μA 20 MΩ range, 0.1 μA
Maximum Input Voltage	200Ω and 2 kΩ ranges, 130 V rms 20 kΩ through 20 MΩ ranges, 250 V rms

GENERAL

Max. Common Mode Voltage	1200 V peak
Operating Temp. Range	−10°C to +55°C
Storage Temp. Range	−40°C to +75°C (−40°C to +60°C with batteries)
Humidity Range	0 to 80% RH
Display	7 − segment LED 0.30" character height
Size	8½" wide x 2½" high x 10" deep (22 cm x 6 cm x 25 cm)
Weight	2¾ pounds (1.2 kilograms) without batteries 4 pounds (1.8 kilograms) with batteries
Power	100-115-230V ac, 50 to 400 Hz, 2 watts
Battery Option (−01)	8 hour minimum operation on internal rechargeable batteries.

45,000 USERS CAN'T BE WRONG !

THE FLUKE 8000A LOOKS AND PERFORMS LIKE A PRECISION MULTIMETER SHOULD.

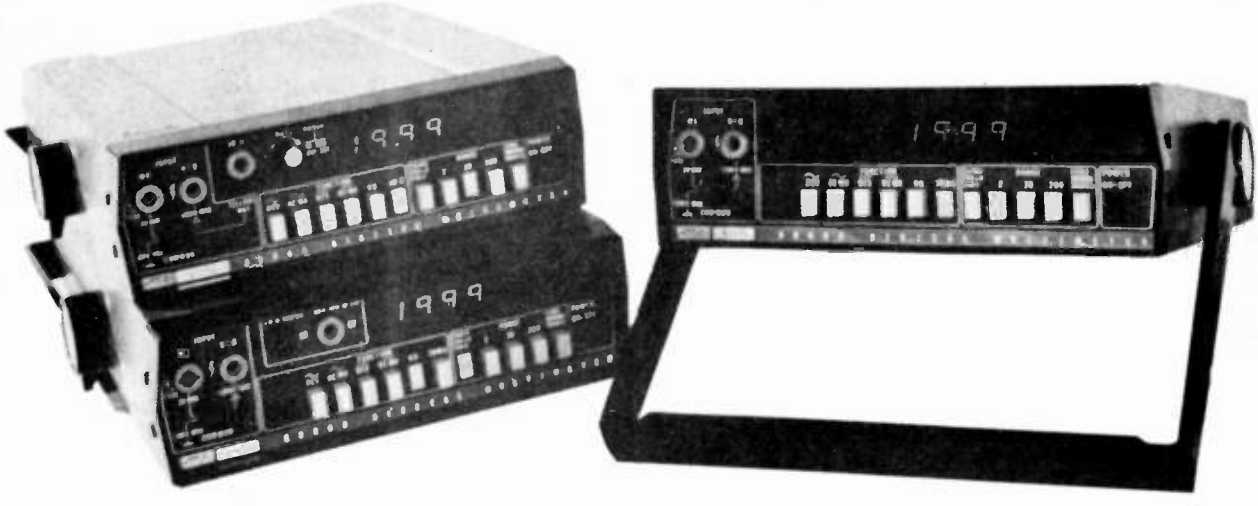
Check these facts.

BASIC INSTRUMENT FEATURES:–

- 2000 Counts
- 26 Ranges of AC/DC Voltage, Current and Resistance
- 0.1% Basic DC Accuracy
- Full Overload Protection
- Lightweight, Rugged Design
- Wide Range of Accessories Available

OPTIONS:–

- 10 Amp AC/DC Current Range
- 2Ω and 20Ω Low Ohms Range
- Rechargeable Battery
- Data Output



ELMEASCO Instruments Pty. Ltd.

P.O. Box 334, Brookvale, N.S.W. 2100 – 939 7944.

Melbourne: 26 6658; Adelaide: 264 3296; Brisbane: 36 5061; Perth: 25 3130; Wellington N.Z.: 6 3976

FLUKE MODEL 8000A MULTIMETER

batteries. The batteries are recharged automatically whenever the instrument is plugged into the mains — whether the instrument is switched on or not. An automotive-type globe is used as the charging ballast and this also indicates that the unit is plugged into the mains.

Unlike most other digital multimeters, within this price range, the Fluke 8000A uses the voltage-to-frequency principle, for analogue to digital conversion, rather than the cheaper (and hence more usual) dual-slope principle. The use of the V-F technique, in conjunction with other circuitry, allows effective and automatic compensation for voltage drift and offsets which could lead to zero errors in the instrument. Thus the instrument may be switched on and off, and from range to range, without re-zeroing; and in fact, a front panel zero is not provided.

Range and function selection is performed by push buttons and these make operation of the instrument very simple. Over range is indicated by a full scale reading which flashes at about 0.5 Hz. In all the instrument is a delight to use. Its 6.4 mm high display characters are bright 7-segment LEDs which can be easily read even from quite oblique angles.

The only annoying feature was the settling time required on ac volts. A maximum settling time of three seconds is quoted in the specification, which is correct — provided that there is no dc component in the waveform. But in practice settling times of up to six seconds were recorded when measuring a small ac voltage superimposed on a relatively large dc voltage.

The accuracy of the instrument was checked and was found to exceed the specification in every case. Thus the user can be assured that he is obtaining the quoted accuracy and will continue to do so for at least a year without recalibration.

We thoroughly recommend this instrument. In fact, we had to buy the one supplied for test. Our design engineer refused to part with it! ●

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BELT-DRIVE TURNTABLES

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$119	**$139**

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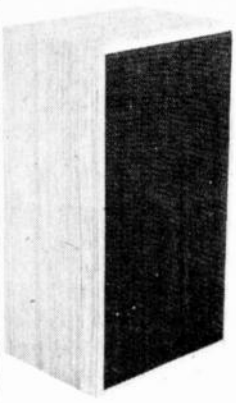
Both models come complete with base, cover and magnetic cartridge AT NO EXTRA COST.

Despite a 12% devaluation in late '74, we will be able to maintain these old prices until the end of February. Other dealers have probably increased prices immediately. Apan Turntables have been voted by HI-FI sound buffs "the best value-for-money around", so, if you want to update or even start a new system, get in on the act now. A deposit of only $5.00 will secure yours now before prices rise again.



8 inch 3 way system kit

NEW MODEL SP853
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Size only 53 x 29 x 22 cms.

Ready-built cabinet. Simply mount speakers.

Speakers specially chosen for this sytem comprise 8 inch "free edge" acoustic suspension woofer (bass), 5 inch squawker (mid-range) and 3 inch cone tweeter for super "hi's". Overall response is 35 Hz — 20 kHz, crossover frequencies 2 kHz, 7 kHz with inductive/capacitive network. Power handling 20 watts. To save time, we have had the cabinets already made for you to mount and wire-in the speakers and crossover. Cabinets are walnut-finished with black grille cloth.

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Ideal for compact stereo systems, rear channel or extension speakers. Attractively finished in walnut with colourful grille cloth. Houses full-range 8" speaker with "whizzer" cone for extended high frequency response. 60 Hz — 12 kHz, 8 ohms impedance. Size 30 x 30 x 24 cms.

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We call it the Hi-Lo HI performance, LO price.

- 12W per channel (8 ohms)
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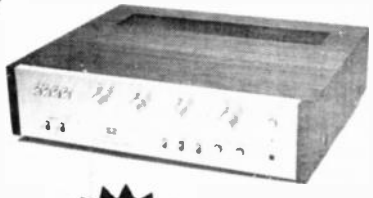

$133

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12 inch deluxe 3-way, 4 speaker kit with L-C network for accurate crossover frequencies. The kit comprises a 12" bass driver with acoustic suspension cone and massive ferrite magnet, 6" sealed-back mid-range, and two 3" tweeters for super high frequency response, plus crossover, wiring diagram and recommended enclosure diagram to build your own cabinets. Big 30 Hz — 20 kHz response, 8 ohms imp, 30 watt power rating.
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When you're on a budget, you want the best sound for the smallest money, and that's what we've got. A 12 inch acoustic suspension speaker and two 3" cone tweeters cover the full audio spectrum from 35 Hz — 19 kHz in recommended enclosure. 30 watt rating and 8 ohm impedance suits most amplifiers, crossover frequency 5 kHz, sensitivity 100 dB. Build your own cabinets and save big money — we provide details. We know stocks won't last, so if you like, we'll lay-by your set today on $5.00 deposit.
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10 WATT RMS STEREO KIT
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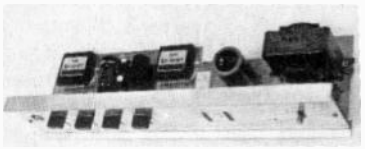

$33 P & P $3

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Our newest amplifier kit with full 10 watts rms per channel output, modern extruded aluminium front panel and 45 mm slider controls. Build your own cabinet to save extra expense or mount amp under record player.

Any turntable will give satisfactory performance (we recommend our Supraphon HC-12) while speakers should be 8 ohms (see below). It is possible to use a magnetic cartridge with the addition of a magnetic pre-amp, however, we have obtained very good results with a ceramic cartridge.

The quality sound of the SANKEN Hybrid Amplifier S1010Y will truly amaze you and this low price is possible only because of our 10 store bulk-buying power.

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Add on to your stereo system for 4 dimension sound.

- 2 or 4 channel switch
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Recording and Playback Pre-Amp for VORTEX Cassette Deck . . .

$97 Complete Kit

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Built your own Cassette Tape Deck for less than $100 complete. High quality recordings are now possible at a cost approximately 50% cheaper than comparative commercial models. As featured in the August and October issues of this magazine, the Kit is complete with Metalwork, P.C. Boards, Cassette Deck, Transformer, Hardware, etc.

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Complete kit — $97 P&P $3.00. Vortex deck only $29 P&P $1. Pre-Amp only (no metalwork or Vortex deck) — $59.00 P&P $2.00. Metalwork only — $18.50 P&P $2. Send for itemised price list NOW.

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HI-FI Quality TURNTABLE

Supraphon Model HC-12

Direct Import Special only **$29.95**

Pack and Post $2.00

SPECIFICATIONS:
3 speeds (16, 33, 45 r.p.m.), 4 pole induction motor, 240V, 50Hz operation, power consumption 16VA, low rumble content, performance complies with standards CSN36 7000, CSN36 8401.

FEATURES:
Includes ceramic cartridge (180mV output), manual operation only, hydraulic lowering device fitted, complete with mains and output leads.

Available in base/cover, ready to connect to amplifier or tape recorder, only $49.95.

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Add extra $9 for perspex covers

CORAL 12. $35

Don't worry about the low price tag, this "little brother" 8" 2 way system rivals many larger speakers for deep bass and overall performance too! An 8" acoustic suspension speaker with "whizzer" cone covers the range 45Hz to 16KHz, while the 3" super tweeter goes up to 20KHz. Not bad, eh! Even 5 watt amplifiers seem like 10 watters with this high efficiency 8 ohm system. Diagrams are provided so you can build your own cabinets too.

Pack/Postage $2.00 each.

CORAL 10. $25

From one of Japan's leading makers, the model 8SA-1 Kit is an 8 inch 3 way 3 speaker system with capacitive crossover and capable of 70Hz to 20KHz response in recommended cabinets. Power rating 35W peak, 17.5W average, sensitivity 93 dB, crossover frequencies 4KHz, 9KHz, impedance 8 ohms. Complete to the last detail with wire, screws, terminals, cabinet instructions and badge. Speakers: 8" woofer, 4" mid-range, 2½" tweeter. Easily assembled and good value for money.

Post/Package $2.00 each

CORAL 8. $15

A fine 10" 3 way speaker system from Coral Audio Corporation (10SA-1), capable of 50W peak, 25W average power, and wide 40Hz — 20KHz frequency response. The capacitive type crossover network operates at 2KHz, 6KHz for smooth response and distinctive performance from each speaker individually. Comprises 10" free-edge woofer, 5" mid-range and 2½" tweeter, plus all accessories. Comprehensive instructions are provided. Impedance 8 ohms.

Post/Package $2.00 each.

ECONOMY 8. $12.

The Coral 12SA-1 3 Way 4 Speaker System is rated at 70W peak, 35W average and includes the high performance L-C crossover. The 12" bass speaker, with free-edge, high compliance cone, the 5" heavy duty mid-range and the two 2½" tweeters are prefectly matched, and in the recommended cabinet design, provide 30Hz-20KHz hi-fi response, 8 ohms. The "do-it-yourself" instruction book, plus all accessories, are included.

Post/Package $2.50 each.

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THE STATE OF THE ART

MODERN CRYSTAL OSCILLATORS

CRYSTAL OSCILLATORS, in one form or another, are fundamentally associated with virtually all transmitting and receiving equipment. Basic circuitry and circuit techniques, and the fundamentals of quartz crystals are discussed at various length by both the ARRL and RSGB handbooks, Pat Hawker's 'Amateur Radio Techniques', the various VHF handbooks by Jessop (RSGB) and Tilton (ARRL) as well as 'The Radio Handbook' by Bill Orr (Editors and Engineers). A useful, and more recent discussion on the subject of crystals and crystal oscillators is contained in the 'Ham Notebook' from the editors of the American journal 'Ham Radio'. For a deeper appreciation of the subject, references (1) to (4) are recommended.

Basic solid state crystal oscillator circuit techniques are by now well established, most circuits being adaptations of the well-known vacuum tube technology such as the Pierce, Hartley, Clapp and Butler oscillator and use both bipolar and FET devices. Whilst these circuits basically fulfil their intended purpose, there are many applications which require something different or where performance needs to be reliably characterised.

Presented here are a variety of circuits, for a range of applications from LF through the VHF range, that are not commonly found in current amateur use or literature.

MODES OF OPERATION

A point not often appreciated, or just forgotten, is that quartz crystals can oscillate in a *parallel* resonant mode *and* a *series* resonant mode. The two frequencies are separated by a small amount, typically 2-15 kHz over the frequency range. The series resonant frequency is *lower* in frequency than the parallel. A crystal specified and calibrated for use in the parallel mode may be satisfactorily used in a series resonant circuit if a capacitor equal in value to its specified load capacitance (usually 20,30, 50 or 100 pF) is connected in series with the crystal. Sadly, you can't invert the process for series resonant crystal in parallel mode circuits. The series mode crystal will oscillate higher than its calibrated frequency in this case and it may not be possible to capacitively load it down sufficiently.

Overtone crystals operate in the *series* mode usually on the third, fifth or seventh overtone, and the manufacturer normally calibrates the crystal *at the overtone frequency.* Operating a crystal in the parallel mode and multiplying the frequency three or five times produces quite a different result from operating the same crystal in the series mode on its third or fifth overtone. When ordering overtone crystals avoid confusion and specify the frequency you want, *not* the apparent fundamental frequency. Reference (4) makes this point quite clear.

Fundamental crystals in the range 500 kHz to 20 MHz are usually specified for parallel mode operation but series mode operation can be requested. For low frequency crystals, up to 1 MHz, either mode can be specified. Overtone crystals generally cover the range 15 MHz to 150 MHz.

WIDE RANGE or A PERIODIC OSCILLATORS

Oscillators that do not employ tuned circuits can be very useful, whether they are simply used as 'crystal checkers' or some other purpose. Particularly for LF crystals, tuned circuits can be bulky. However, they aren't without their traps. Some crystals are prone to oscillation on unwanted modes, particularly the DT and CT cut crystals used for LF quartz oscillators. It is wise to check that the output is on the correct frequency and no mode instability is evident. Reducing feedback at the higher frequencies usually cures this. In extreme cases, the idea has to be abandoned and an oscillator having a tuned circuit used instead, (LF crystal oscillators are discussed later).

The first circuit is an emitter-coupled oscillator, a version of the Butler circuit. The basic circuit first appeared in VHF Communications in 1970 (p.240) as portion of a VHF-UHF calibration spectrum generator. Versions have subsequently been published in the 'VK5 Bulletin' (S.A. Div. WIA) in 1972 and 6UP, August issue, 1974. Lane (3) discusses a variation of this circuit (Fig. 2).

The output of the circuit in Fig. 1 is

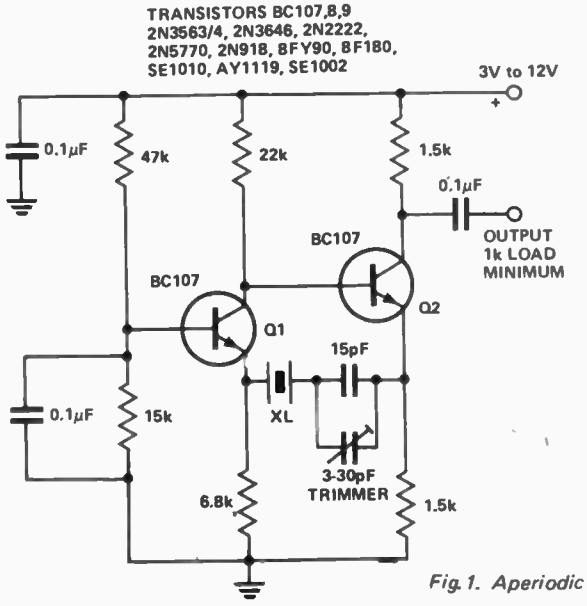

Fig. 1. Aperiodic Butler oscillator (series mode)

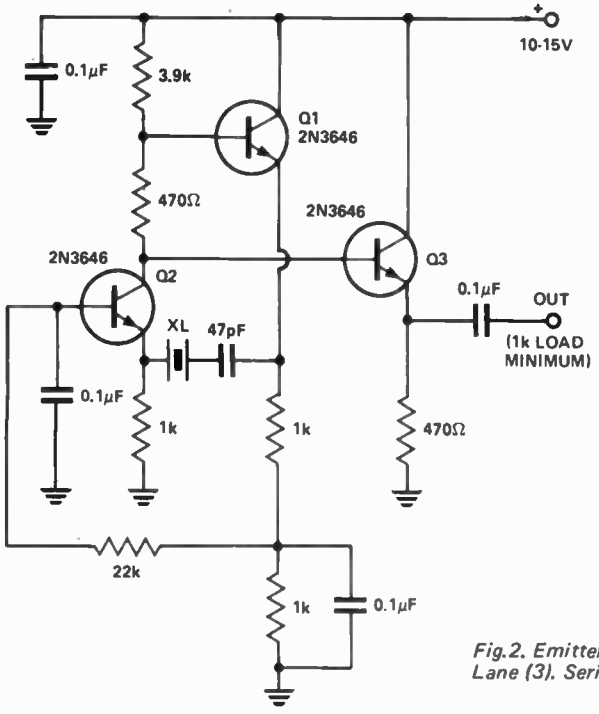

Fig.2. Emitter-coupled oscillator – after Lane (3). Series mode.

essentially sine wave; reducing the emitter resistor of Q2 increases the harmonic output. By doing this, a 100 kHz crystal produces good harmonics through 30 MHz. It is a series mode circuit.

A variety of transistors may be used. For crystals above 3 MHz, transistors with a high gain-bandwidth product are recommended. For crystals in the 50 kHz to 500 kHz range, transistors with high LF gain, such as the 2N3565 are recommended. Also, for crystals in this range, permissable dissipation is usually less than 100 microwatts and amplitude limiting may be necessary. Low supply voltage, consistent with reliable starting, is recommended. Modifying the circuit by the addition of diodes – as shown in Fig. 3 – is a better method, and starting performance is improved. The circuit will oscillate up to at least 10 MHz with appropriate transistors and emitter resistor values. An emitter follower or source follower buffer is recommended. Similar comments to the above apply to Fig. 2. An emitter follower buffer is included in this circuit. Both circuits are slightly frequency sensitive to power supply voltage changes and load variations. A load of 1 k or greater is recommended.

TTL IC can be used in crystal oscillator circuits but many published circuits have poor starting performance or suffer from non-repeatability owing to wide paramater spreads in IC's. The circuit in Fig. 4. is by K1PLP from QST, Feb. 1974 (5) and is after Weggeman (6). This circuit has been tried by the writer over the range 1 MHz to 18 MHz and can be recommended. It is a series mode oscillator and suits AT-cut crystals. The output is about 3 volts peak to peak, square wave up to about 5 MHz beyond which it is becomes more like half-sine pulses. Starting performance is excellent, often a critical factor with TTL oscillators.

LOW FREQUENCY CRYSTAL OSCILLATORS

Crystals in the range 50 kHz to 500 kHz require special considerations not encountered with the more common AT or BT cut HF crystals. The equivalent series resistance (which determines 'activity' – that figure of merit of days of old) is much greater and their permissable dissipation is limited to less than 100 microwatts, preferably 50 microwatts or less.

The circuit in Fig. 5. is a series mode oscillator described by Lane (3). It has the advantage of ot requiring a tuned circuit, and has a choice of sine or square wave output. For crystals in the range 50-150 kHz, 2N3565 transistors are recommended although the author has found BC107's satisfactory. Either type will suffice for crystals in the range 150 kHz to 500 kHz. If you find the crystal will not start reliably, most likely the crystal has a very high equivalent series resistance, in which case increase R1 to 270 ohms and R2 to 3.3 k (as recommended by Lane). For square wave operation, C1 is 1 uF (or a value close to, or above it). For sine wave output, C1 is not in circuit. Amplitude limiting is unnecessary. Sine wave output is about 1 V rms, square wave output about 4 V peak to peak.

The circuit in Fig. 6 is also described by Lane (3) and can be recognised as a modified form of the Colpitts oscillator, with the addition of resistor Rf to control feedback (it works the same way as Eno's). Capacitors C1 and C2 should be reduced by preferred values as the frequency is increased. At 500 kHz, values for C1 and C2 should be around 100 pF and 1500 pF respectively.

The circuit as shown gives sine wave output with the second harmonic

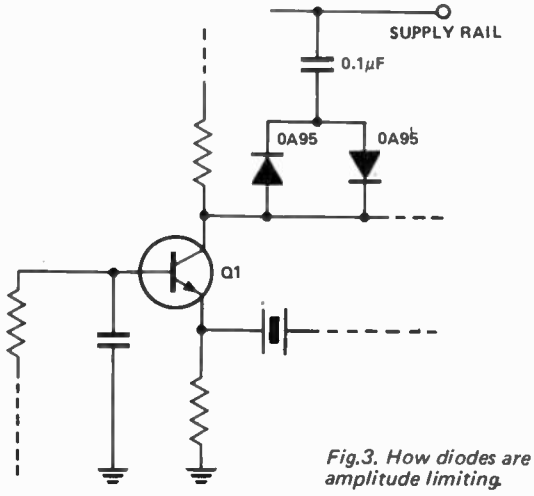

Fig.3. How diodes are used for amplitude limiting.

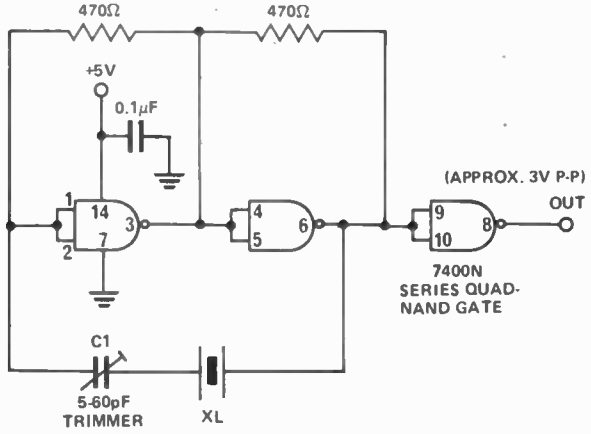

Fig.4. Reliable TTL crystal oscillator.

MODERN CRYSTAL OSCILLATORS

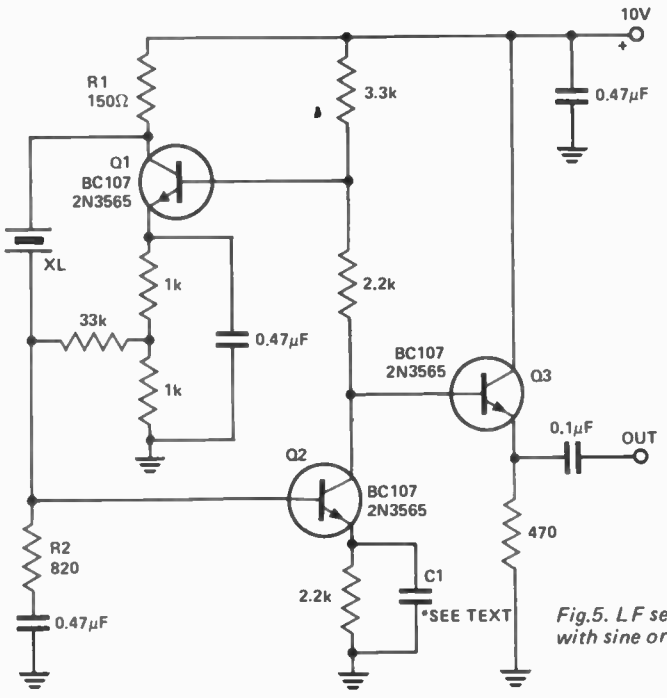

Fig.5. LF series mode oscillator with sine or squarewave output.

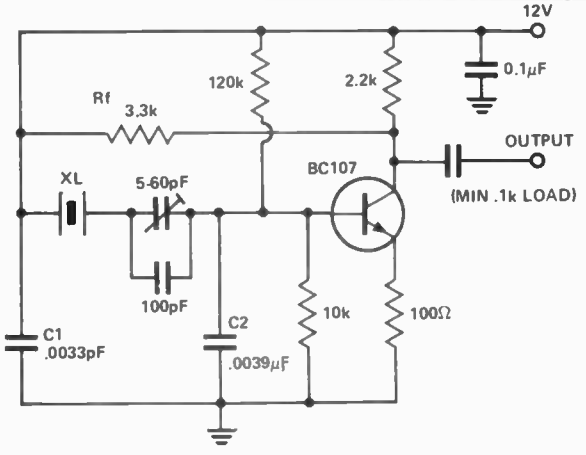

Fig.6. Parallel mode LF oscillator.

about 40 dB down (or greater). This can be reduced by careful trimming of Rf and C1. Note that, at the reduced level of feedback necessary to achieve this, it takes some 20 seconds for the oscillator to reach full output. Output is about 2 to 3 volts peak to peak.

If you need an output rich in harmonics, the simple addition of a 0.1 uF capacitor across the emitter resistor will achieve this. Output then rises to about 5 V peak to peak. Power supply voltage can be reduced in this case to lower crystal dissipation.

Other transistors can be used, but bias and feedback may have to be adjusted. For cantankerous crystals determined to oscillate in modes other than those you wish, the circuit of Fig.7 is recommended. Feedback is controlled by tapping down the collector load of Q1. Amplitude limiting is necessary to keep the crystal dissipation within limits. For 50 kHz crystals the coil should be 2 mH and its resonating capacitor 0.01 uF. Output is about 0.5 V rms, essentially sine wave. The use of an emitter follower or source follower buffer is recommended. If a parallel mode crystal is used the 1000 pF capacitor shown in series with the crystal should be changed to the crystal's specified load capacitance (usually 30, 50 to 100 pF for these crystals).

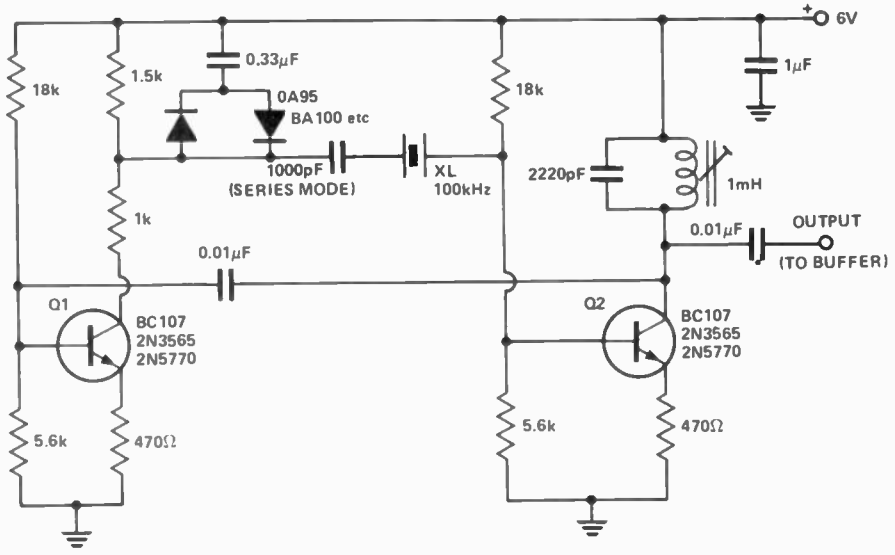

Fig.7. 100 kHz crystal oscillator (with tuned circuit).

HF CRYSTAL OSCILLATOR CIRCUITS

Solid state circuits for the popular AT-cut HF crystals are legion. However, results aren't always what one would expect. Most fundamental crystals up to 20 MHz are ,usually specified for parallel mode operation. However, such crystals can be used in series mode oscillators by putting the specified load capacitance in series with the crystal as mentioned previously. Both types of circuit are detailed here.

A useful oscillator for the range 3 to 10 MHz that does not require a tuned circuit is given in Fig. 8 (a). It is, of course, the same circuit as Fig.6. The circuit can be used down to 1 MHz if C1 and C2 are increased to 470 pF and 820 pF respectively. It can be used up to 15 MHz if C1 and C2 are reduced to 120 pF and 330 pF. Respectively. This circuit is recommended for non-critical applications where high harmonic output is wanted, or not a consideration.

The addition of a tuned circuit as in 8(b) reduces harmonic output considerably. A tuned circuit with as high a Q as possible is recommended. In a 6 MHz oscillator, I have obtained the following results. With a coil Q of 50 the 2nd harmonic was 35 dB down. With a Q of 160, it was −50 dB! Resistor Rf can be adjusted (increase slightly) to improve this. The output is also increased with a high Q coil. As previously noted, with reduced feedback it takes some tens of seconds to each full output from switch on, however, frequency stability is excellent.

Operation at other frequencies is accomplished by changing the capacitors and coil appropriately.

This circuit (Fig. 8) can also be turned into a very effective VXO. A small inductance is placed in series

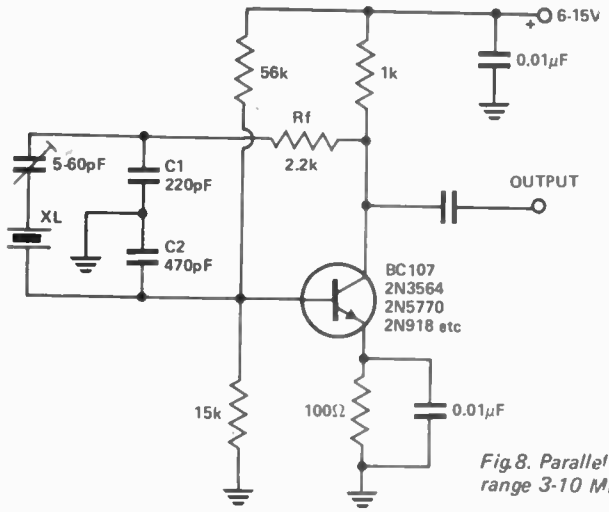

Fig.8. Parallel oscillator for the range 3-10 MHz.

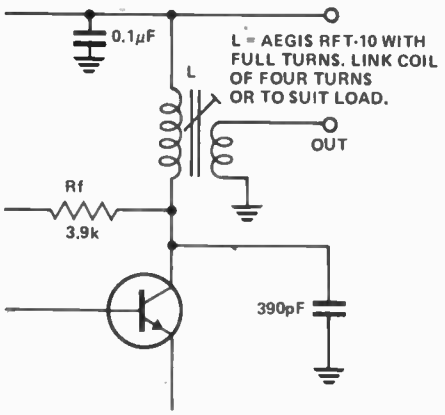

Fig.8b. Adding a coil to the circuit shown in Fig.8.

with the crystal and one of the capacitors in the feedback circuit is made variable. An ordinary two-gang 10-415 pF (or thereabouts) broadcast tuning capacitor will do the job nicely. Both gangs are paralleled. The tuning range depends on the crystal used, the inductance of L1 and the frequency. A greater range is usually obtainable with the higher frequency crystals. Stability is excellent, approaching that of the crystal.

Another variation of this circuit is shown in Fig. 10. This circuit may allow more 'pull' on the crystal, but stability is poorer. For both Fig's 9 and 10 the trimmer is to set the nominal frequency at some position of the tuning capacitor. For both circuits also, especially for Fig.10, the output varies across the tuning range.

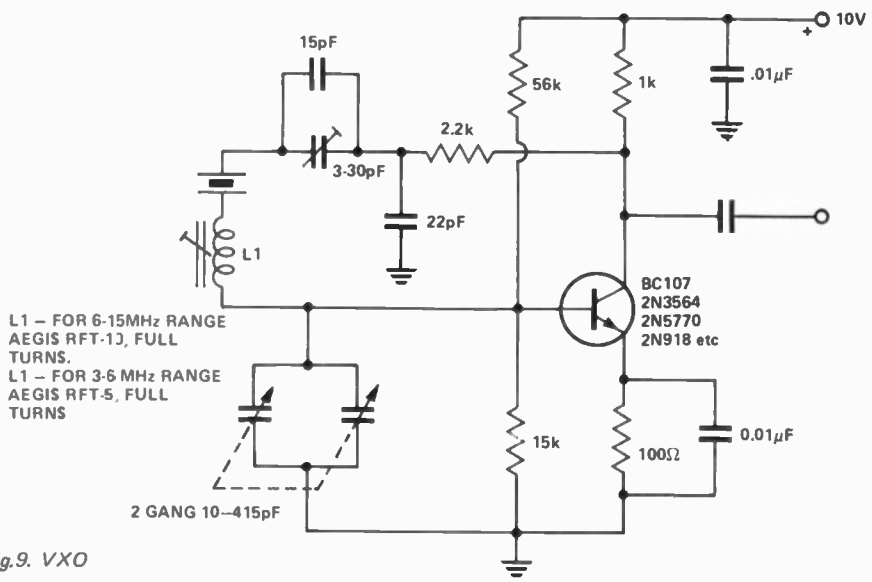

Fig.9. VXO

A VHF OSCILLATOR-MULTIPLIER

The circuit in Fig.11 is a modification of the 'Impedance Inverting' overtone oscillator discussed by Rankin (4), who also describes a similar circuit (albeit outdated – using an OC171 – even Dick Smith no longer stocks them!) Normally, with the impedance inverting circuit, the collector is either untuned or grounded for RF. The collector can be tuned to twice or three times the crystal frequency To reduce the output at the crystal frequency, a double tuned circuit is recommended. DO NOT tune the collector to the crystal frequency, otherwise the circuit will oscillate at a frequency not controlled by the crystal. It is advisable to keep the collector lead as short and direct as possible.

Results with this circuit are excellent. All outputs other than the wanted output were at –60 dB or greater. Noise output is at least 70 dB below the wanted output. It makes an excellent conversion oscillator for VHF/UHF converters. Almost 2 V of RF is available at the hot end of L3

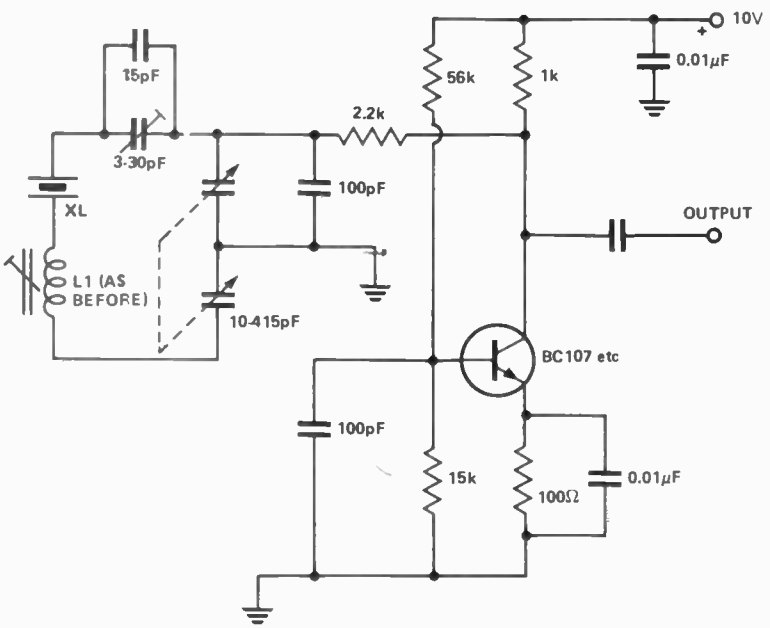

Fig.10. Alternative version of circuit shown in Fig.9.

MODERN CRYSTAL OSCILLATORS

(author's prototype at 30 MHz). A Zener regulated supply is recommended. As indicated on the diagram, different circuit values are necessary for different transistors. Strays in individual construction may also necessitate variations. L1 can be used to pull the crystal onto frequency.

Slight variations in frequency (about 1 ppm) occur when tuning L2 and L3 and also with load variations. However, in practise, these turn out to be of no consequence.

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(4) 'Overtone Operation of Quartz Crystals' D. Rankin (VK3QV), Amateur Radio, March and May 1967.

(5) 'A TTL Crystal Oscillator', K1PLP, QST February 1974, p.34.

(6) 'IC-Compatible Crystal Oscillator', The Electronic Engineer, May 1969.

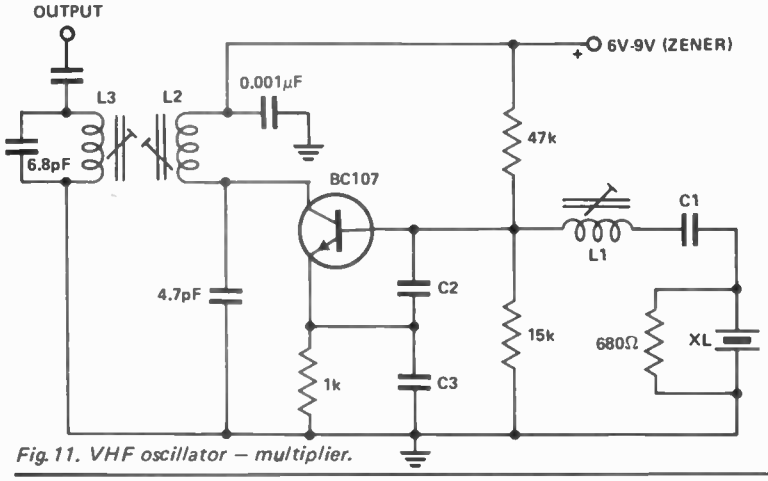

Fig. 11. VHF oscillator – multiplier.

65 MHz Xtal 130 MHz OUTPUT
L1 = NEOSID AZ ASSEMBLY (4mm FORMER & F29 SLUG) WOUND WITH 12 TURNS OF 4.55 mm ENAMEL WIRE, CLOSEWOUND

L2/3 = NEOSID, DOUBLE ASSEMBLY 7300 CAN, TWO 722/1 FORMERS, F29 SLUGS, WOUND WITH 5 TURNS, 0.63mm ENAMEL, CLOSEWOUND

C1 = 33 OR 39 pF

43 MHz Xtal 130 MHz OUTPUT
L1 = 20 TURNS 0.4mm AS ABOVE
L2/3 = AS ABOVE
C1 = 56pF

38MHz Xtal 116 MHz OUTPUT
L1 = 24 TURNS 0.4mm AS ABOVE
L2/3 = 9 TURNS 0.63mm AS ABOVE
C1 = 68pF OR 100pF

XL	C2	C3	
65mHz	8.2pF	5.6pF	BC107
43mHz	15pF	10pF	
38mHz	22pF	18pF	
65mHz	18pF	12pF	2N3564 2N5770
43mHz	33pF	18pF	
38mHz	56pF	39pF	

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Efficiency is higher than might be expected from a sealed cabinet and power handling is 20-25 watts r.m.s. **$34.50**

12" The model B122/10LR is a 12" bass speaker featuring a rubber suspension which allows a fundamental resonance of 17Hz in free air. This low-resonance, combined with a 2" voice coil working within a carefully selected magnet structure makes the speaker ideal for a sealed cabinet of about 2 cu.ft. capacity. Efficiency of the B122/10LR is surprisingly high for this type of loading and the speaker is ideal for amplifiers with an output of 20-25watts r.m.s. per channel at 8ohms. **$39.50**

12" The model B122/12LR, like the B122/10LR described above, is also suitable for sealed cabinets but because of its more powerful magnet structure a volume of about 3 cu.ft. is required to ensure the speaker gives its optimum performance. **$49.50**

15" The Fane model B152/12LR is a 15" bass driver with a fundamental resonance of 15Hz in free-air. Once again a sealed cabinet provides ideal loading for this unit and the volume can be varied from 3 to 5 cu.ft. The performance in 5 cu.ft. is particularly outstanding as the resonance is kept in the region of 30Hz. This results in firm, non-resonant bass without any of the "boxiness" often associated with conventional speakers. Efficiency is reasonably high and power-handling is up to 30watts r.m.s. at 8ohms. **$59**

5" The Fane 505 x 5" mid-range loudspeaker employs a special cone material which is doped to remove any irregularities in response. Useful frequency range is 400-4,000Hz and sound quality is very neutral. **$24.50**

1" The Fane 1" Dome Tweeter DD1 is a newly developed soft-dome tweeter with a useful frequency response from 4,000Hz to 20,000Hz. Efficiency is medium to high. **$23.50**

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- Tone arm features anti-skate, lateral balance and removeable headshell fitted with magnetic cartridge. Fully adjustable counter balance weight with independent scale allows easy adjustment of stylus pressure.
- All connecting cables and plugs are fitted to the turntable.
- 12 month guarantee.
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CHALLENGE H-22 DOME TWEETER

The development of dome tweeters has been a major project of most loudspeaker manufacturers of recent years. The H-22 dome is one of the latest designs. The 1" diaphragm is made of carefully selected metallized polyester material which is of very small mass to allow maximum efficiency. **$8.50**

SPECIAL MID-RANGE SPEAKER

An outstanding 5" mid-range loudspeaker developed by one of Germany's leading loudspeaker manufacturers. It employs carefully selected cone material and a special cone termination to ensure flat response and high efficiency. A protective cover is fitted to the rear of the loudspeaker to prevent interference from air pressure developed within the cabinet by the bass speaker. **$15.90**

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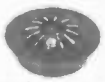
This robust 10" unit features a 4 layer wound 1½" voice coil which allows it to handle 30 watt r.m.s. comfortably. The combination of extremely rigid cone and low-fundamental resonance of 35 Hz in free-air ensures deep, positive bass when used in the recommended enclosure sizes. **$16.90**

CHALLENGE HP 1 HIGH-POWER CROSSOVER NETWORK features 4 inductors including a high-efficiency air-wound 3.55 Mh choke in series with the bass speaker. 3 crossover capacitors are also used. Crossover points are 500 Hz and 4 000 Hz and the rate of roll off is 12dB/oct. **$14.50**

The **CHALLENGE SYSTEM** 1 can be purchased as components only as above or completely assembled and tested in 2 cu.ft. walnut veneered cabinets at **$179 pair**

FANE 15" 3-WAY SYSTEM

HOKUTONE HT-60 1" DOME TWEETER



This magnificent unit features a combination of aluminium diaphragm and powerful magnet structure to produce an exceptionally clear non-resonant treble response. Efficiency is very high and dispersion is enhanced by the special acoustic diffuser surrounding the diaphragm. **$13.50**

Special Mid Range Speaker

Details as above in system 1. **$15.90**

FANE B152/12LR 15" WOOFER

Details as per FANE advertisement on this page **$59**

CROSSOVER NETWORK $14.50

This system, based on the Fane 15" woofer, can be purchased as components only as above, or completely assembled and tested in 3 cu.ft. walnut veneered cabinets for **$300 pair**

CROSSOVER CAPACITORS

Our wide range includes 2.2 mfd mylar film **$1.20** each, 3.3 mfd mylar film **$1.40** each, 5 mfd NP Electrolytics **40c** each, 10 mfd NP Electrolytics **45c** each, 16 mfd NP Electrolytics **50c** each, 30 mfd NP Electrolytics **60c** each and 60 mfd NP Electrolytics **90c** each.

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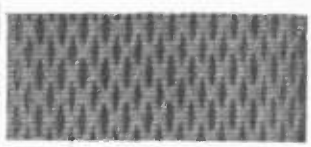

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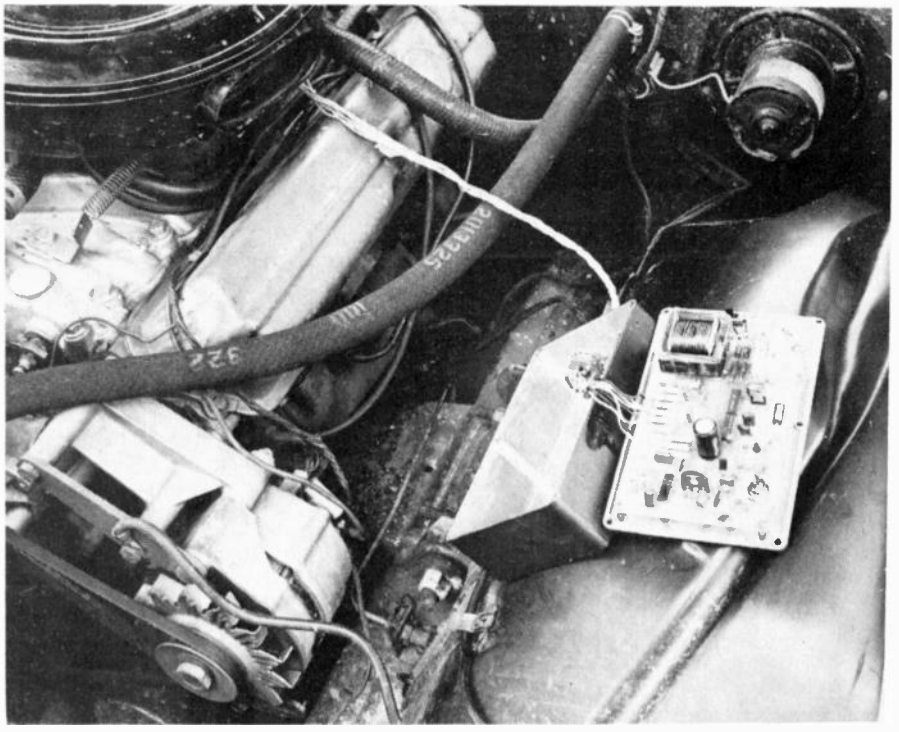
ELECTRONIC IGNITION SYSTEM

PROJECT 312

PART II

Constructional details of ETI's outstanding CDI/tacho system — designed and developed by Barry Wilkinson.



IN LAST month's issue we traced the historical development of electronic ignition systems, detailed many of the failings common to existing CDI (Capacitor Discharge Ignition) designs, and introduced the ETI system which effectively overcomes these failings.

Here are full constructional details for our ignition system.

CONSTRUCTION

Construction of the unit is considerably simplified by the use of a printed circuit board and this is strongly recommended.

All components should be mounted on the printed circuit board in accordance with the component overlay diagram. Take particular care with the orientation of transistors, diodes, ICs and electrolytic capacitors. In addition, note the differing connections of the BC548 and 558 transistors from different manufacturers and position of the heatsink mounting surfaces of Q3, Q6 and IC1.

Wiring between the printed circuit board and external components is illustrated in Fig. 5. The switch used in our prototype was mounted internally (it is only used in initial setting up) by soldering it onto the screws which mount the power transistors. If this method of mounting the switch is used, the screws to which it is mounted must be insulated (by insulated mounting washers on both sides of the transistor) from the transistor case. The other two transistor mounting screws should be insulated from the box lid but not from the transistors. When drilling the lid of the box check that the distance

SPECIFICATION

SUPPLY VOLTAGE

Nominal	+ 12 Volts
Maximum	+ 16 Volts

CAPACITOR VOLTAGE

8 to 16 volt input	350 volts (nominal)

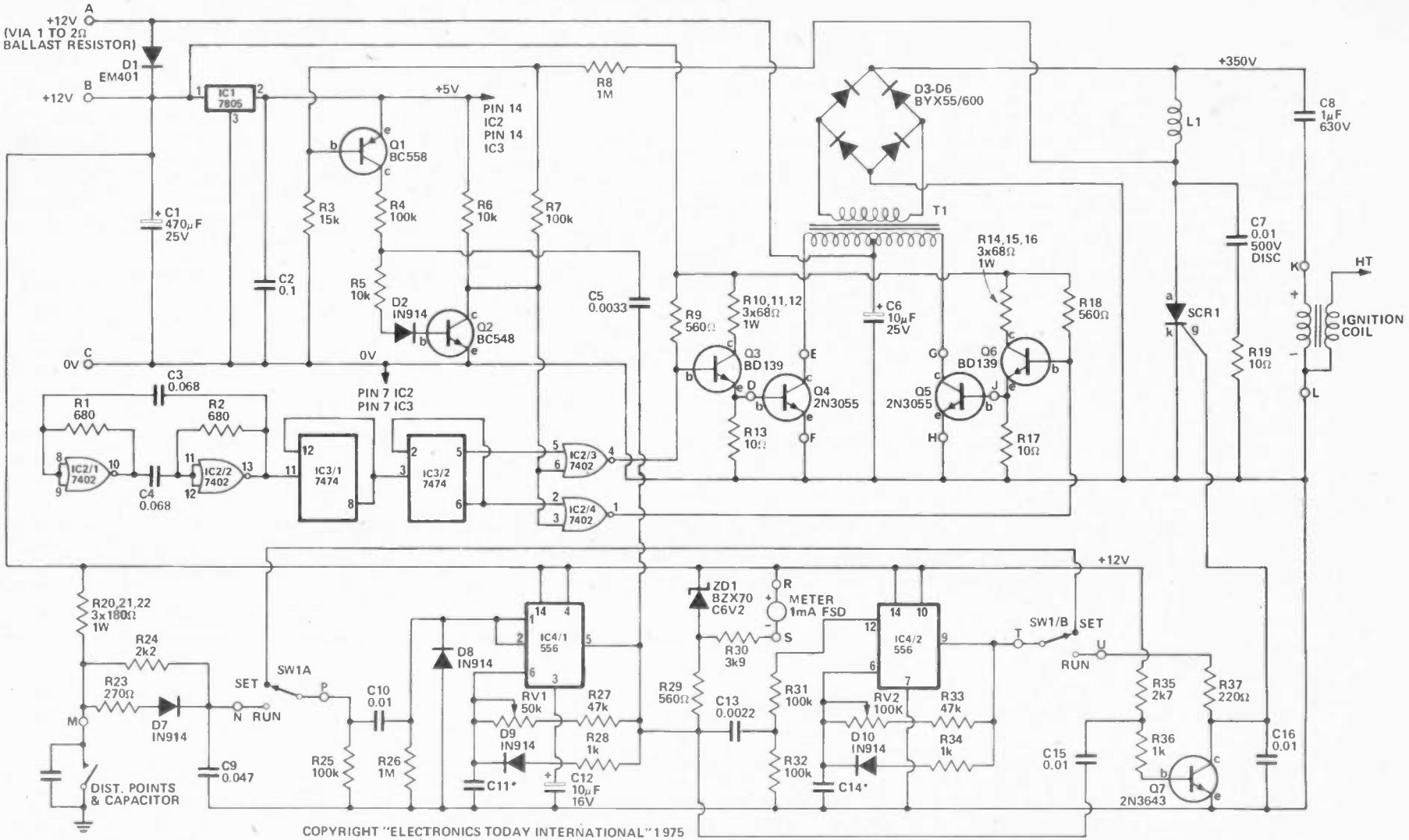
POINTS CURRENT 200 mA (non-inductive)

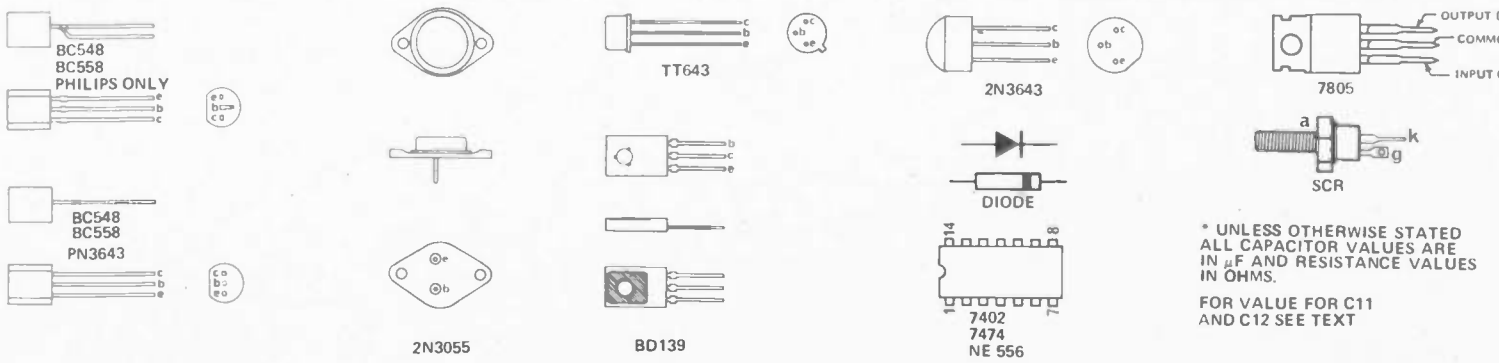
SUPPLY CURRENT*

RPM			CURRENT
8 cyl	6 cyl	4 cyl	
1500	2000	3000	1A
3000	4000	6000	2A
4500	6000	9000	2.8A
6000	8000	12,000	3.2A
7500	10,000		4A
9000			4.4A

* ballast resistor of one ohm

ELECTRONIC IGNITION SYSTEM





* UNLESS OTHERWISE STATED ALL CAPACITOR VALUES ARE IN μF AND RESISTANCE VALUES IN OHMS.

FOR VALUE FOR C11 AND C12 SEE TEXT

Fig. 1. Circuit diagram the CD1 system incorporating tacho and rev limit.

HOW IT WORKS ETI 312

The general block diagram and principle of operation was given last month and we now treat this in greater detail.

Integrated circuits IC2/1 and IC2/2 form a multivibrator which runs at about 26 kHz. The output of the multivibrator clocks the D-type flip-flop IC3/1, the D terminal of this IC is coupled to the $\bar{Q}$ output and the result is that the output is half the frequency of the input. This frequency division is necessary to provide an absolutely symmetric square wave which cannot otherwise be guaranteed from the simple oscillator used. The output of IC3/1 is divided again by 2 by IC3/2 reducing the frequency to about 6.5 kHz. The second division is used because we have two flip-flops available in the 7474 package and this allows us to use a higher frequency oscillator and hence smaller values for capacitors C3 and 4.

The Q and $\bar{Q}$ outputs (these are the same frequency but out of phase, (i.e. when Q is high, $\bar{Q}$ is low) are fed to the gates IC2/3 and IC2/4. If the control input (pin 3 and 6) is low these gates simply pass the 6.5 kHz with just a phase inversion. If however the control is high the output of the two gates will be low irrespective of the other inputs.

The output of these gates control Q3 and Q6 which in turn control Q4 and 5. If the gate output is low all current is shunted away from the base of the appropriate transistor turning it and the transistor it controls off. If the output is high this current will turn the transistor on. With the control voltage low the transistors are switched alternatively on and off at the 6.5 kHz rate. If the control is high then all transistors will turn off.

The transistors Q4 and Q5 control the primary of the transformer whose centre tap goes to +12 volts via a ballast resistor. This resistor is either the one fitted in the wiring-loom of the car, or, if not an additional one ohm resistor will need to be fitted. This ballast resistor allows the transistor to fully saturate by limiting the peak current even when driving into the effective short circuit of the discharged capacitor (C8).

The output of the transformer is rectified by D3-D6 and C8 is charged up via the primary of the ignition coil. This current is small (less than 150 mA) and has no effect on operation of the coil. If allowed, this capacitor would charge to about 450 V using a 12 volt input, however, the output voltage is measured and the inverter is stopped when 350 V is reached. Transistors Q1 and Q2 form a schmitt-trigger circuit where Q2 goes high if the voltage on C8 goes above 350 volts and reverts to a low state if the voltage falls below 325 volts. The reference for this circuit is the 5 volts supplied by the 7805 regulator which also supplies the TTL circuitry. This effectively maintains constant voltage on the capacitor over inputs from 8 to 16 volts.

The SCR1 is what actually controls the output to the ignition coil since if it is triggered on it effectively discharges the energy in C8 into the ignition coil primary. The transformer action of the coil gives the required high voltage for the spark plugs. The inductor L1, along with R19 and C7 protect the SCR from voltage transients which could damage it.

When the distributor points open the voltage at point M rises rapidly to +12 volts, whereas, the voltage at point N rises over a period of about 50 μs. When the points close the voltage at point N requires about 0.5 mS to revert to zero. This helps prevent point bounce. With SW1 in the run mode the rising voltage of the points opening is coupled, via C10, to the input of IC4/1. The output of this IC is normally high (+12 V) and if this voltage at pin 2 goes above two thirds of the supply volts the output will be triggered low. It will remain low until the voltage at pin 6 falls below 1/3 supply voltage when the output will revert to high. When the output goes low C11 will be discharged via RV1 and R27. The IC itself draws virtually no current, therefore, the time to reach 1/3Vs is dependent entirely on the value of C11 and the associated resistors. When the output goes high capacitor C11 is charged rapidly by R28 and D9 ready for the next cycle.

The tacho movement is driven by this IC and, every time the monostable is triggered, a 2 mA pulse is passed through the meter. Since the mono is triggered every time the points are opened the current in the meter will be proportional to the engine speed. When running (if possible) at the maximum tacho reading, the mono on time will be equal to the off time corresponding to 1 mA through the meter.

When the output of IC4/1 reverts to the high state it triggers IC4/2 which is a monostable similar to the first half. The output of this also starts at +12V drops to 0V and reverts to +12V again. The output occurs at the end of the output of IC4/1. The SCR is triggered by a monostable formed by Q7. The transistor derives its power, and that used to trigger the SCR, from the output of IC4/2. The input of the transistor, which is normally held on due to R35/36, is controlled via C15 from the output of IC4/1. The sequence of operation is as follows.

When the points open there is a delay of about 50 μs before IC4/1 is triggered. When the output goes low capacitor C15 couples this fall to Q7 turning it off. If the output of IC4/2 is high the SCR will be triggered activating the coil. If however the points have opened before the expiry of the sum of the delays of IC4/1 and IC4/2 there will be no current available to trigger the SCR, since the output of IC4/2 will be 0 V, and no ignition will result until the engine speed drops. Normally however this would only mean one or two cylinders not firing as the motor will slow down rapidly without ignition.

To calibrate the unit we first adjust RV1 so that the tacho reads the same as some known standard (your local garage will have a tacho) then with the motor stopped, but ignition on, switch SW1 to SET. This will cause the tacho to indicate the preset rev limit. Adjusting RV2 will give the desired limit. The indicated reading may be about 100 RPM lower than the actual limit set but for normal use this should be sufficiently accurate.

Also from IC4/1, we have a capacitor going into the schmitt trigger. Transistor Q2 forms a monostable with this capacitor, which switches off the invertor, or at least holds it off, while the SCR is on and therefore prevents the invertor running into a short circuit. This effectively reduces the power drawn from the battery.

between the two mounting screws is the same as the hole spacing on the switch so that it will fit.

To facilitate easy change over, between standard and CDI ignition, an octal plug and socket is used to connect the unit, and a second socket for the standard system. Whilst our prototype may be seen to have both octal sockets mounted on the box, it is recommended that the second socket be mounted by a separate bracket on the car firewall, etc, so that the unit may be removed completely if desired without interfering with normal operation of the car.

CALIBRATION

This may be performed in either of the two ways:—

1. Obtain, or borrow, an accurate tachometer (one which will work with CDI systems). Connect and run the motor at a reasonably high rate and adjust RV1 to obtain the same reading as displayed on the master tacho.

2. Build either of the circuits shown in Fig. 4 and use together with a reference from the 50 Hz mains or a separate oscillator. If 50 Hz is to be used the second circuit is preferable as it gives a higher reading on the meter. To calibrate set RV1 such that the appropriate reading is obtained as detailed in the Table below.

Calibration against 50 Hz

	4 cyl	6 cyl	8 cyl
Circuit A	1500	1000	750
Circuit B	3000	2000	1500

If an oscillator is used the calibration may be performed at a point nearer the top end of the meter scale and the frequency to be used calculated as follows:—

$$\text{Input frequency} = \frac{\text{RPM} \times \text{N}^{\text{o}} \text{ of cyl}}{120}$$

(4 stroke only)

Using this method, the power to the inverter may be removed (detach the wire to pin 2 of the socket) which eliminates the need for connecting the ignition coil. Do not run the unit too long in this condition as resistors R10, 11, 12, 14, 15 and 16 run hot in this mode.

To set the rev limit, simply switch SW1 to SET (power should previously have been applied to the unit) and adjust RV2 to the desired limit as indicated on the meter.

▼

ELECTRONIC IGNITION SYSTEM

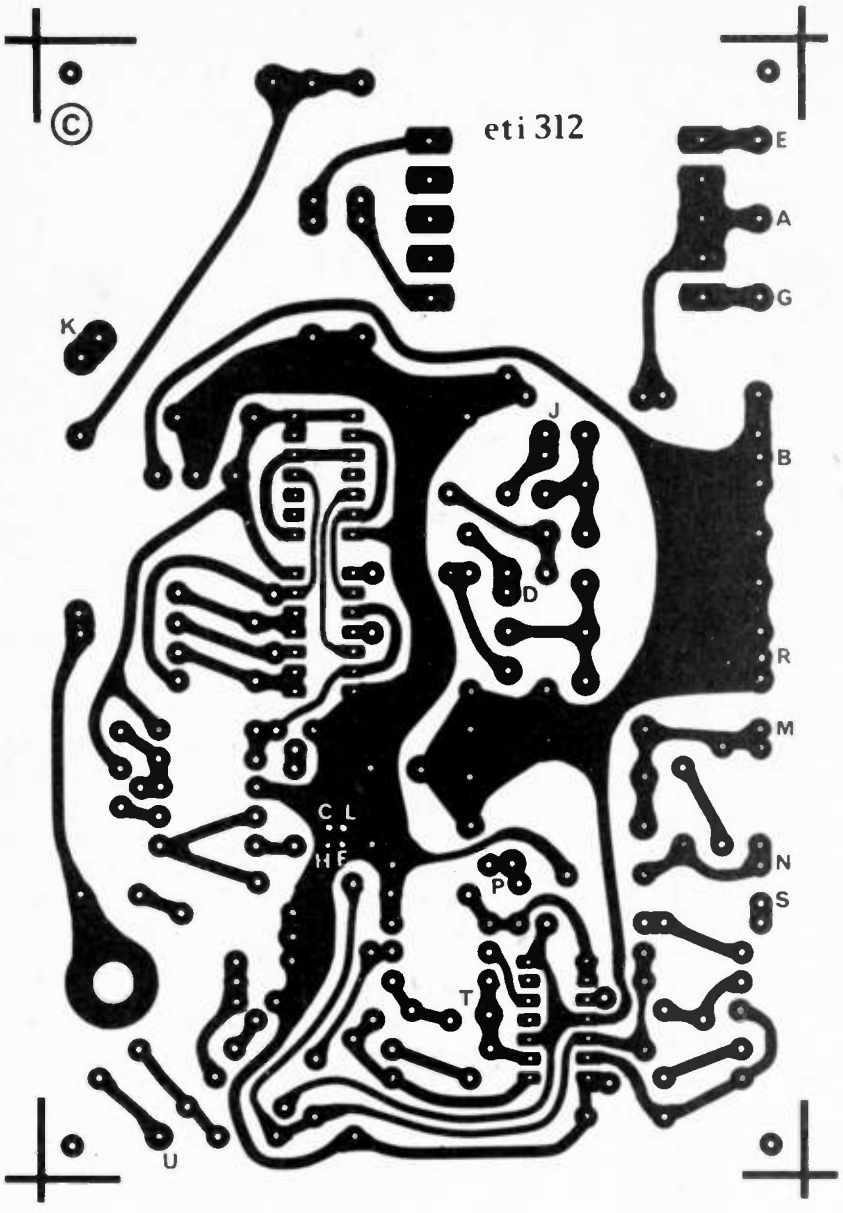


Fig. 2. Printed circuit board layout. Full size 149 x 100 mm.

CHOOSING CAPACITORS FOR CDI

The main discharge capacitor C8 must be capable of withstanding continuous high peak currents without failure. We have tested a number of brands for reliability and recommend the following alternatives:—

SHIZUKI (Allied Capacitors)

1μF 630 V
1.5μF 630 V
2 x 0.47μF 630V in parallel
2 x 2.2μF 200V (in series with 1 megohm resistor across each)

SOANAR

2 x 0.47μF 630 V

DUCON

1μF 600 V type 3510 (oil filled)
1μF 1000 V type 3510 (must be mounted external to printed circuit board)

As capacitors of this type are difficult to obtain we have provided several series parallel combinations which may be used if necessary.

INSTALLATION

A standard ignition system, illustrated in Fig. 6, usually has a ballast resistor which is either a separate wire-wound resistor, or is built into the wiring loom in the form of a resistive lead. In either case the power for the inverter must be tapped off the *battery* side of this resistor so that a solid +12 volts is obtained. If the resistor is in the wiring loom it may be easier to use another circuit (eg, reversing lights) which is only on when the ignition switch is on.

The connection socket should be wired into the standard circuit as shown in Fig. 7. If the car does not have a ballast resistor, then the power

PARTS LIST ETI 312

R13,17,19	Resistor	10	½W 5%
R10,11,12	"	68	1W 5%
R14,15,16	"	68	1W 5%
R20,21,22	"	180	1W 5%
R37	"	220	½W 5%
R23	"	270	½W 5%
R9,18,29	"	560	½W 5%
R1,2	"	680	½W 5%
R28,34,36	"	1k	½W 5%
R24	"	2k2	½W 5%
R35	"	2k7	½W 5%
R30	"	3k9	½W 5%
R5,6	"	10k	½W 5%
R3	"	15k	½W 5%
R27,33	"	47k	½W 5%
R4,7,25	"	100k	½W 5%
R31,32	"	100k	½W 5%
R8,26	"	1M	½W 5%
RV1,	Potentiometer	50k	Trim
RV2	"	100k	Trim

C13 Capacitor 0.0022 μF polyester
C5 " 0.0033 μF polyester
C10,15,16 Capacitor 0.01 μF polyester
C7 Capacitor 0.01 μF 500V disc ceramic
C9 " 0.047 μF Polyester
C3,4 " 0.068 μF Polyester
C2 " 0.1 μF Polyester
C6 " 10 μF 25V electrolytic
C12 " 10 μF 16V pc mounting electrolytic
C1 Capacitor 470 μF 25V pc mounting electrolytic
C8,11,14 See Text.

Q1 Transistor BC558, BC178 or sim.
Q2 " BC548, BC108 or sim.
Q3,6 " BD135, BD137, BD139 or similar
Q4,5 " 2N3055
Q7 " 2N3643 PN3643 or similar.

IC1 Integrated circuit 7805C
IC2 Integrated circuit 7402
IC3 Integrated circuit 7474
IC4 Integrated circuit NE556

D1 Diode EM401, IN4005 or similar
D2,7,9,10 Diode IN914 or similar
D3,4,5,6 Diode BYX55/600
ZD1 Zener Diode BZX79 C6V2

SCR1 Thyristor 16A 400V C164D, 2SF206 etc.

T1 Transformer See Text.

L1 Inductor See Text.

PC Board ETI 312
DPDT slide switch or toggle switch.
Die-cast box 190 x 120 x 50mm. Eddystone 6827.

2 Octal sockets
1 Octal plug and cover
4 spacers 12mm long plain
8 screws 20mm long screws & nuts
2 insulation kits for 2N3055s
Wire etc.
If the car does not have an internal ballast resistor a 12Ω 20 watt.

M1 1 mA FSD meter scaled to RPM required Ferrier CS-260-T or similar (if you already have a tacho the meter may well be a 1 mA unit and could be used).

is taken to pin 1, and a one ohm, 20 W resistor connected between pins 1 and 2. In addition the standard ignition socket should use pins 1 and 3 rather than 2 and 3.

Mount the unit in the coolest possible place whilst at the same time not making the leads too long. The changeover socket should be mounted on the car in close proximity to the unit.

USE OF REV LIMIT

The rev-limiter is designed to prevent engine revving beyond its safe operating speed. IT IS NOT INTENDED TO ACT AS A SPEED LIMITER. Nor should it be regarded as an infallible watchdog. It is intended solely to limit engine speed if the safe limit is exceeded inadvertently.

Clearly some people *will* use the device as a 'continuous limiter' — racing and rally drivers, motor boat race drivers for instance. In such applications no engine damage should occur, but the muffler (if fitted) may be damaged as *some* fuel will be burnt in the tail pipe.

The device should never be used in this manner on the road. It wastes fuel and it is potentially dangerous as there is no reserve power available to cope with possible emergencies.

TABLE I

TACHO Value of C11

Full scale	8 cyl	6 cyl	4 cyl
5000	0.027 μF	0.039 μF	0.056 μF
6000	0.022 μF	0.033 μF	0.047 μF
7000	0.022 μF	0.027 μF	0.039 μF
8000	0.015 μF	0.022 μF	0.033 μF
10 000	0.012 μF	0.018 μF	0.027 μF

REV LIMIT Value of C15

	8 cyl	6 cyl	4 cyl
4000	0.039 μF	0.047 μF	0.082 μF
5000	0.027 μF	0.033 μF	0.047 μF
6000	0.022 μF	0.033 μF	0.039 μF
7000	0.022 μF	0.027 μF	0.033 μF
8000	0.015 μF	0.022 μF	0.033 μF

TABLE 2
Transformer Winding Details

WINDING	TURNS	WIRE SIZE	NOTES
Secondary	600	0.315mm (28 B&S)	layer wind and use 0.05 mm insulation every 150 turns
	interwinding insulation 0.25mm		
Primary 1 Primary 2	15 15	1mm (18 B&S) 1mm (18 B&S)	Bifilar wound (i.e. wind both primaries together as a pair)

Terminate secondary on pins 6 and 10. Terminate primary 1 "start" on pin 1, primary 1 "finish" on pin 2, primary 2 "start" on pin 4, primary 2 "finish" on pin 5.

CORE
Philips E core 4322-020-34720 2 required

FORMER
Philips 4322-021-31830

ASSEMBLY
Insert cores into bobbin after winding. Tape them together and then glue (5 min epoxy) the cores onto the bobbin to hold them in position.

CHOKE DETAILS
BOBBIN 1W Resistor >1 kΩ. Winding single layer 0.315 mm wire approx 30 turns.

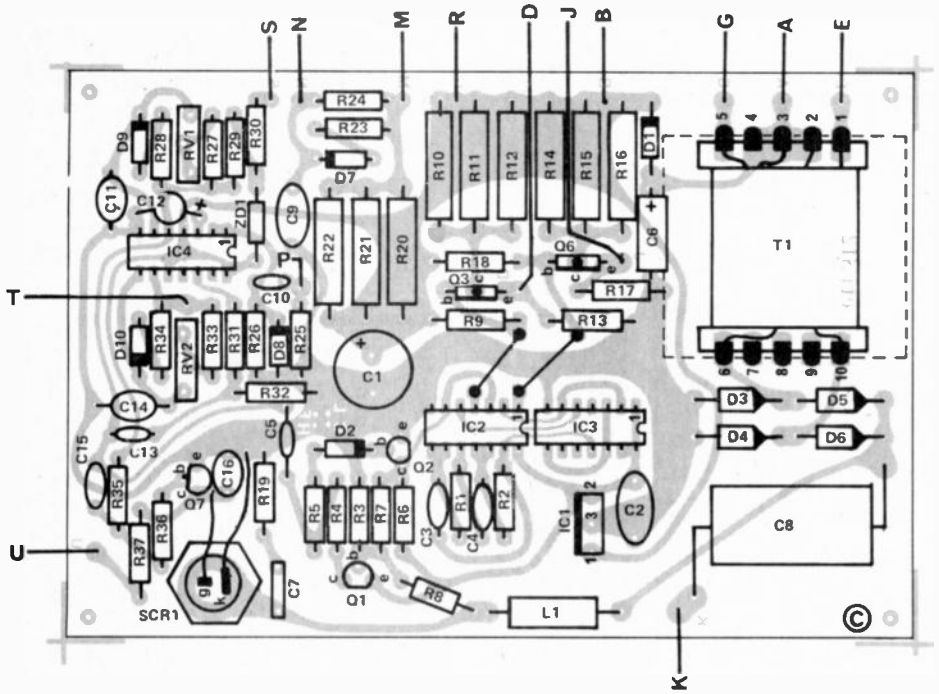


Fig. 3. Component overlay.

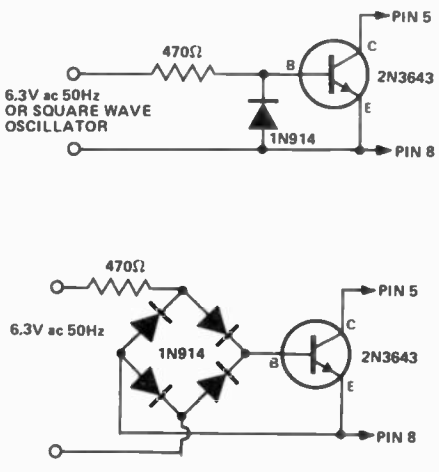
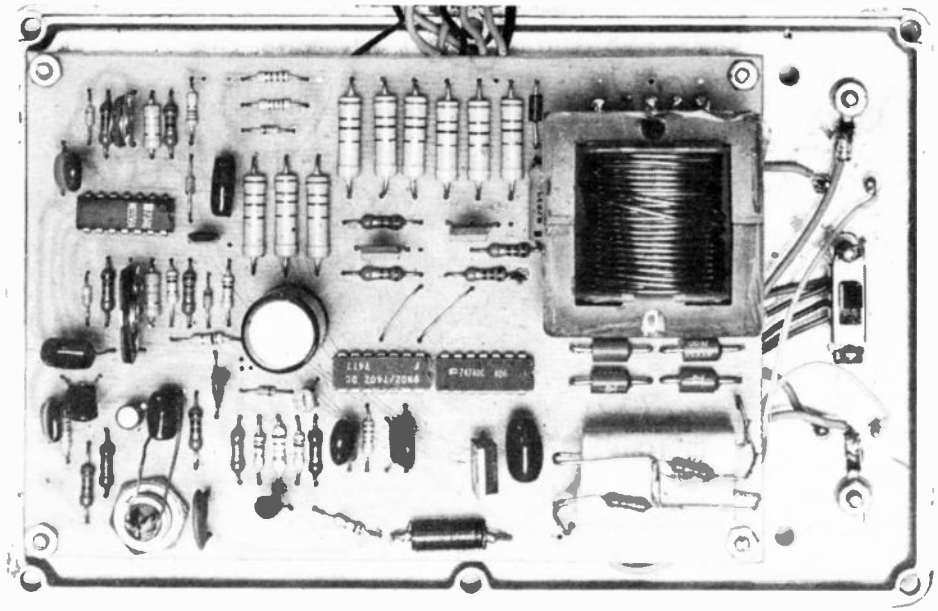


Fig. 4. Two circuits which may be used to calibrate the unit of a reference tacho is not available. The second circuit should be used if a mains transformer is used to supply the 6.3 volts. (See text).

ELECTRONIC IGNITION SYSTEM



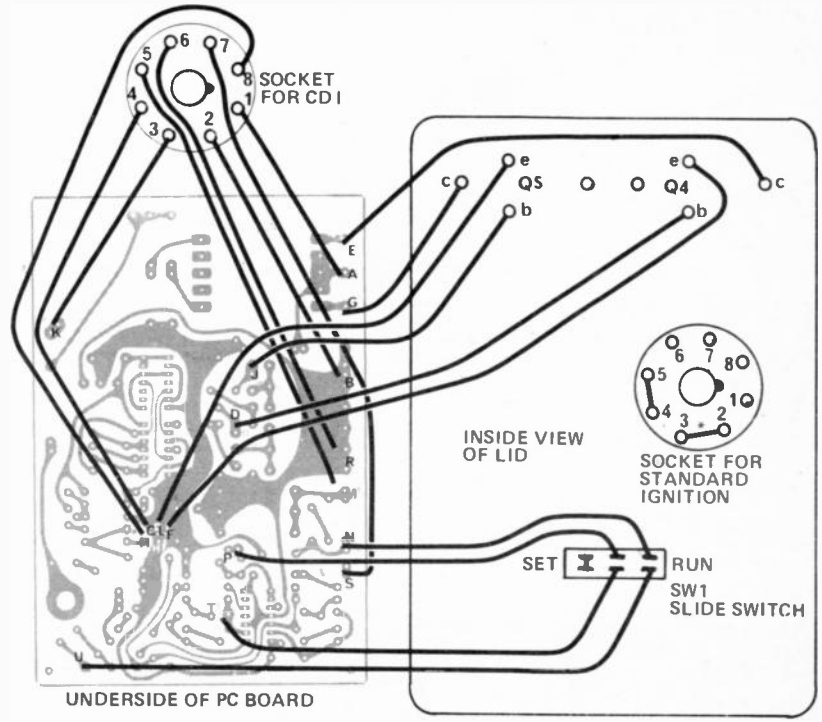


Fig. 5. Wiring diagram — printed circuit board to front panel components.

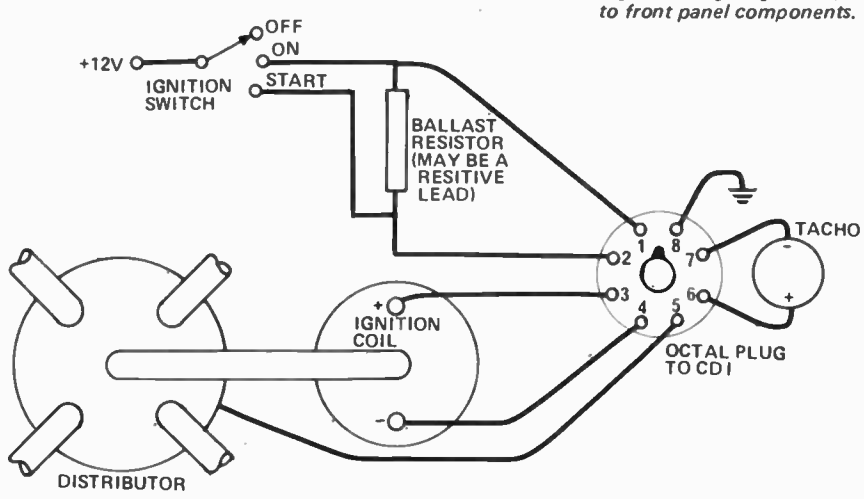


Fig. 7. Method of connecting octal plug into existing ignition system.

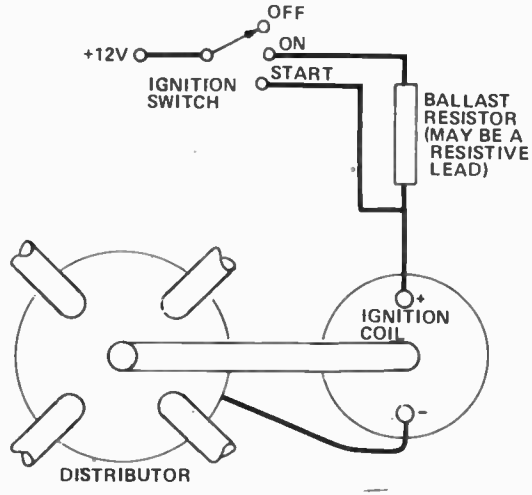
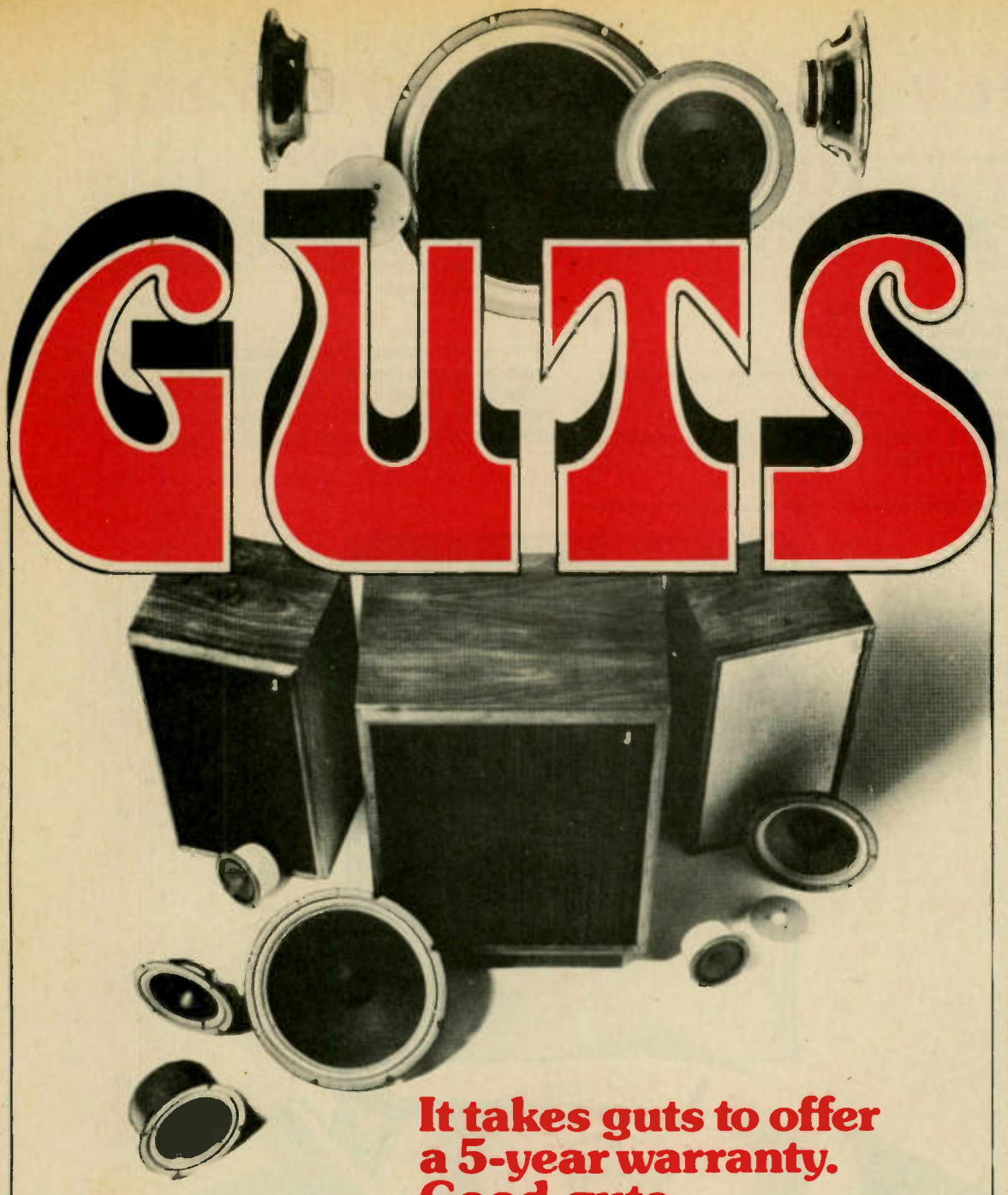


Fig. 6. Standard ignition system.



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Magnetic Sound – Sydney 29-3371.
Dynamic Sound – Newcastle 21-188.
HIFI House Wollongong 286-661.
Pee Jay Sound Centre – Broken Hill 7303.

ACT:
Douglas Hi-Fi – Fyshwick 95-3459.

VIC:
Douglas Hi-Fi – Melbourne 639-321.
R & G Appliances – Geelong 915-24.
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TAS:
Teak House – Hobart 433-249.
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WA:
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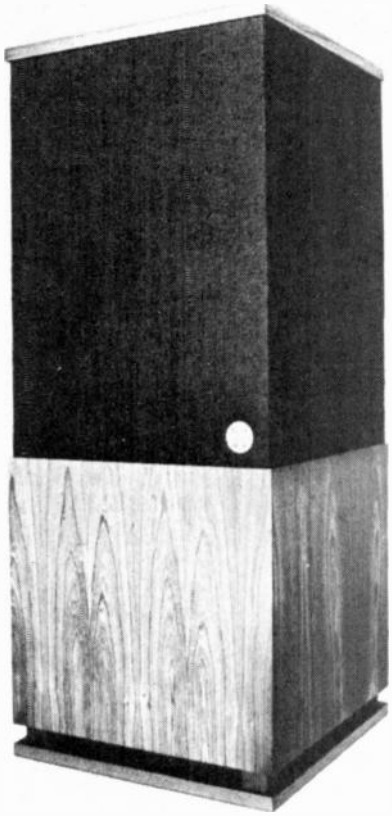


A NEW CONCEPT

The RTR columns are a new concept in transducer application. Each elegant walnut enclosure houses multiple ultralinear butyl edge suspension woofers, one of which is planar resistive loaded. This technique yields maximum acoustic low frequency coupling, increased damping and a very smooth response curve. This powerful low frequency concept is the cornerstone of the RTR column speaker systems. The ideal speaker system should radiate uniformly hemispherically, and a RTR column achieves this ideal at the low frequency end of the spectrum. To achieve "total dispersion" at the high end of the spectrum, high frequency drivers are employed on three faces of the columns to produce an incredibly uniform polar energy response plot.

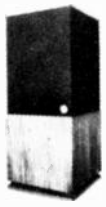
RTR column speakers, a "concert hall experience".

MODEL 88/D

Freq. Resp:– 40-18500 Hz. Size:– 11" x 26¼" x 11" Deep. Rec. Amp. Power:– 20-60 WRMS

MODEL 180/D

Freq. Resp:– 28-18500 Hz. Size:– 14" x 33¼" x 14" Deep. Rec. Amp. Power:– 25-60 WRMS



MODEL 280/DR

Freq. Resp:– 22-25000 Hz. Size:– 16½" x 39" x 16½" Deep. Rec. Amp. Power:– 25-100 WRMS

Go to your nearest RTR dealer, and have a "musical experience".

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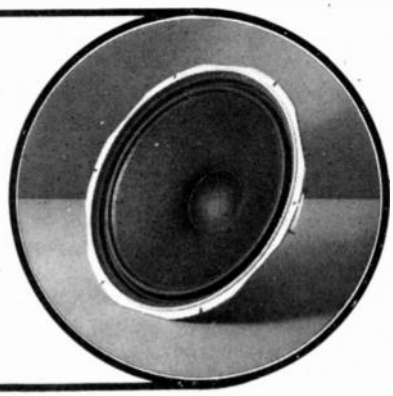
The Magnum 25 is the largest transducer RTR builds . . . a 25" woofer with a 6" voice coil. It is the world's finest woofer and has no parallel.

SPECIFICATIONS

Power Handling:–	150 watts RMS
Free Air Resonance:–	12 Hz
Impedance:–	8 ohms
Freq. Response:–	15-800 Hz, properly loaded
B/L Product:–	7.5 pounds/amp.



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$899

including D150 front panel

SPECIFICATIONS:

IC150

Frequency Response:— HI-LEVEL ±0.6 db 3 Hz-100 kHz; PHONO ±0.5 db of RIAA, calibrated. **Hum and Noise:**— HI-LEVEL 100 db below 2.5V, "A" weighted; PHONO 80 db below 10 MV input. **Distortion:**— THD essentially unmeasurable; IM .003% at rated output. **Phono Input:**— Sensitivity 1MV at 1kHz for 2.5V out; Overload 33-330 MV at 1kHz (adjustable). **Output:**— Rated at 2.5 volt, typically 10V before overload. **Volume Control:**— Over 60 db dynamic range with calibrated tracking. **Loudness:**— Excellent simulation of Fletcher Munson curves down to 60 phono, co-ordinated with volume control. **Phase Shift:**— Typically + 1° to —12° 20Hz to 20 kHz. **Tone Controls:**— ± 15 db at 30 Hz to 15 kHz. **Filters:**— (High and low filters).

D150

Frequency Response:— ± 0.1 db 20-20 kHz at 1 watt into 8 ohm; ± 1 db 4-100 kHz. **Power Output:**— 100 watt RMS into 8 ohm, both channels operating. **Power Bandwidth:**— ± 1 db, 5-20 kHz at 75 watt RMS into 8 ohms. **Distortion:**— THD typically 0.002%. (At .01 to 75 watts) IM typically 0.005%. **Damping Factor:**— Greater than 200 from zero to 1 kHz 8 ohms. **Weight:**— 25 lbs.

THE AMCRON PHILOSOPHY

"While the plastic generations of audio equipment come and go, the steadfast performance, the unflinching quality, and the unparalleled construction of all Amcron equipment will remain."

Audio Magazine said:— "IC150 — We were all able to measure hum and noise levels of approximately — 93 db below 2.5 volts output, and phono noise of about .50 microvolts — D150 — at a typical output of 75 watts (8 ohms) IM was measured at 0.002%, by implication, THD might be expected to be approx. 0.0005% which neither Amcron nor we could measure. If you want the very best, our endorsement of the IC150/D150 is completely given without any reservations.

Stereo Review said:— IC150 "We found the frequency response to be down only 0.3 db at our lowest limit of 5 Hz and 1 db at 225 kHz. The RIAA equalization was so accurate (±0.25 db) that we may have been checking the residual errors in our setup."
D150 — "There are not many speaker systems capable of absorbing the full output of the D150, but since its distortion at any level, can only be measured with the most advanced test equipment, one would expect it to sound first rate, and indeed it did."

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FLIP-FLOP FLASHER

by A.J. Lowe

This simple effective unit could save your life

A MOST DANGEROUS situation for a motorist is changing an offside wheel at night on a dark road. The FLIP FLOP FLASHER provides protection by flashing a 'bouncing' red light warning signal to other drivers. As can be seen from Fig 1, two red accessory tail lamps are mounted on an aluminium tripod about 500 mm high. They are fed through a long lead from the car's cigarette lighter socket. The tripod may be stood on the road or on the roof of the car to give greater range.

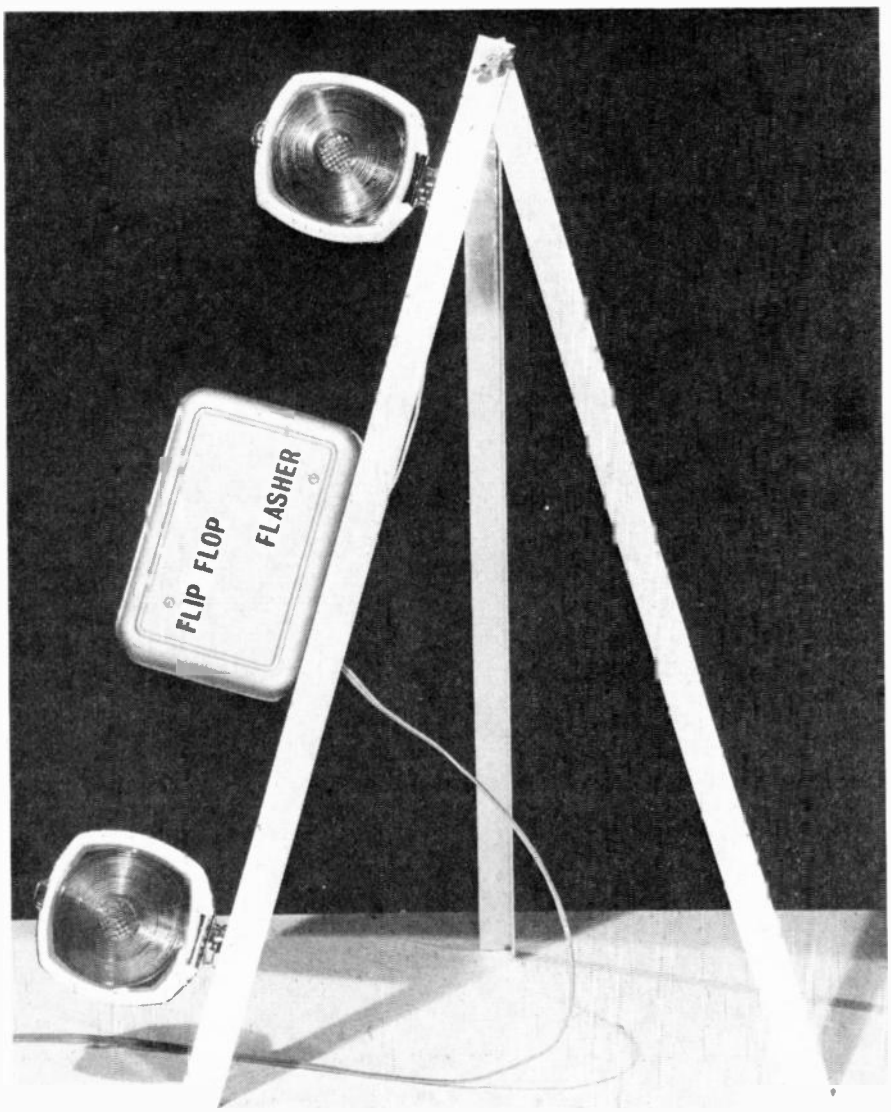
The tripod may be folded for easy stowage as shown in Fig 2.

The flashing action is provided by a simple astable multivibrator timed to give a flashing rate of about 60 flashes for each lamp per minute.

As one side of each tail lamp is connected to the metal tripod and may be stood on the vehicle, it is necessary to provide two circuits — one to suit cars with a positive earth system, and one for cars with a negative earth.

The circuit for positive earth systems uses NPN transistors and is shown in Fig 3. The other uses PNP transistors and is shown in Fig 4.

From these it will be seen that there is no danger of a short circuit if the tripod is in contact with the vehicle metal work.



CONSTRUCTION

The few components of the electronic part of the device can be easily attached to a single tag strip as shown in Figs 5 and 6 for the positive earth system, and in Figs 7 and 8 for the negative earth system.

The tag strip may be mounted in a suitable tin box attached to one leg of the tripod. Toffee tins, or other tin boxes with tight fitting lids are ideal for this purpose. The mounting of the prototype using the negative earth tag strip is shown in Fig 9.

The tripod is constructed from three strips of 20 mm aluminium angle. The front legs are bolted together with a bolt and wing nut. The rear leg of the front pair is shaped at the top corner so that, with the bolt in position, the legs can separate by an angle of only about 32 degrees. The third leg is attached to a small bracket made from the same aluminium angle, and shown in Fig 10. The bracket is attached to the front legs by the bolt and wing nut which holds them together. The rear view arrangement is shown in Fig 11, and from this it can be seen how the rear leg is kept central.

Main text continued on page 65

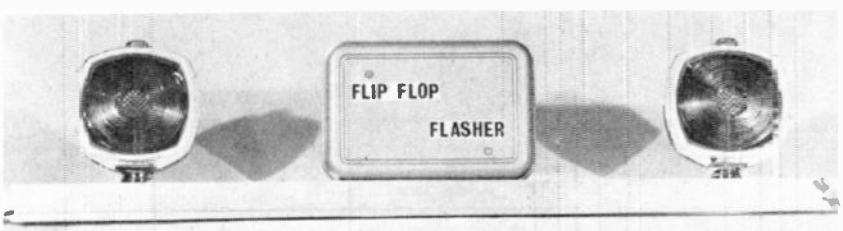


Fig. 2 The unit with its legs folded

eti PROJECT 231

FLIP-FLOP FLASHER

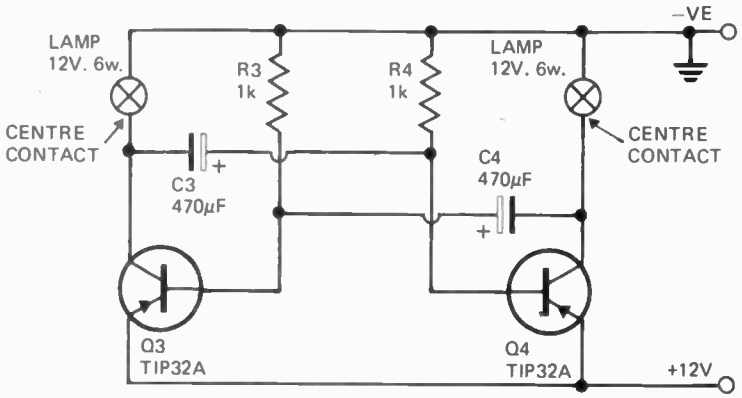
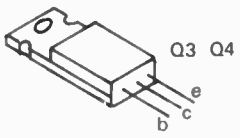


Fig. 3 Circuit of positive earth version



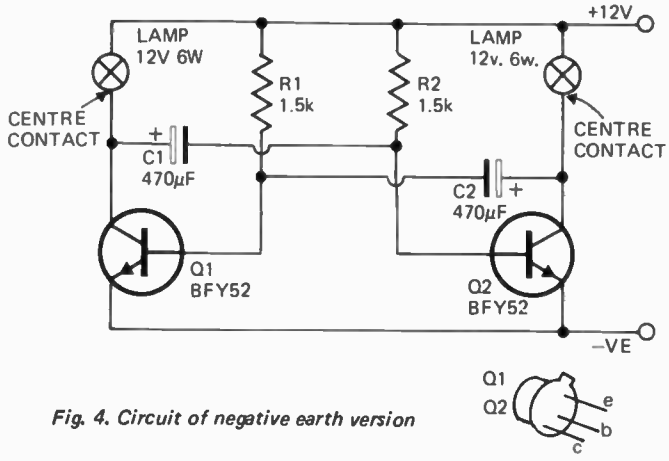


Fig. 4. Circuit of negative earth version

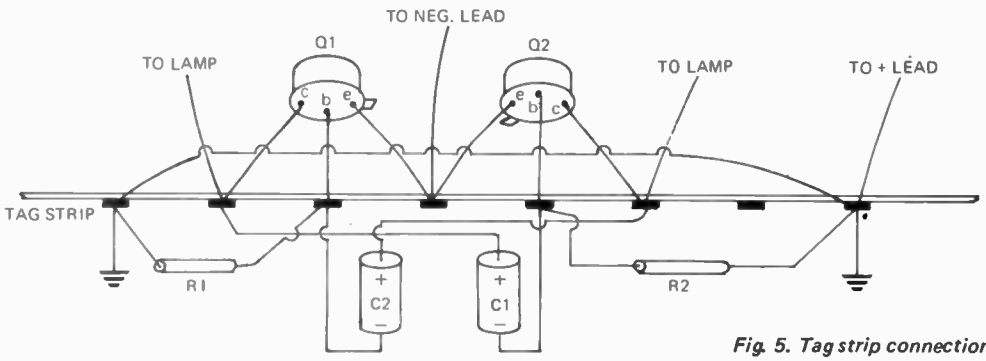


Fig. 5. Tag strip connections of positive earth version.

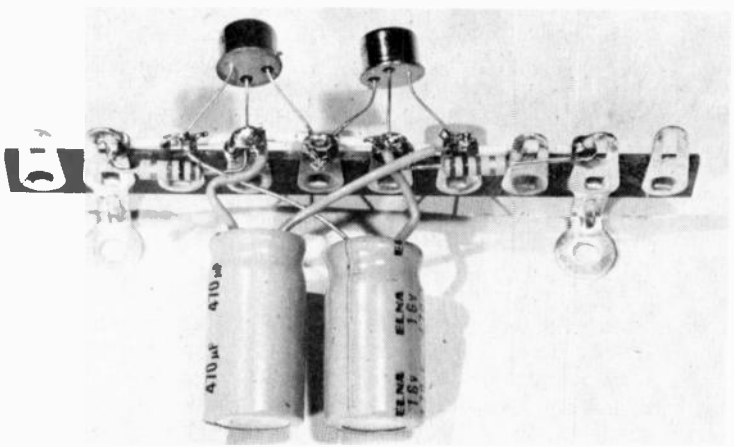


Fig. 6. Actual tag strip for positive earth version. Note the wire joining the two tags above the mounting feet.

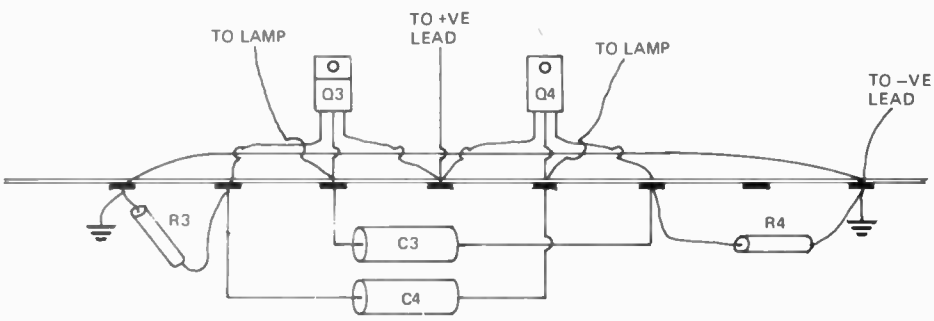


Fig. 7. Tag strip connections of negative earth version.

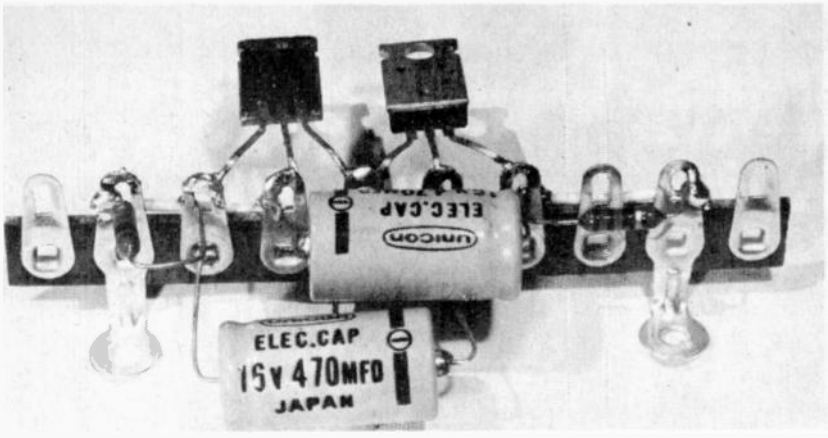


Fig. 8. Actual tag strip for negative earth version. Note the wire joining the two tags above the mounting feet, and also the use made of the lower holes in the tags.

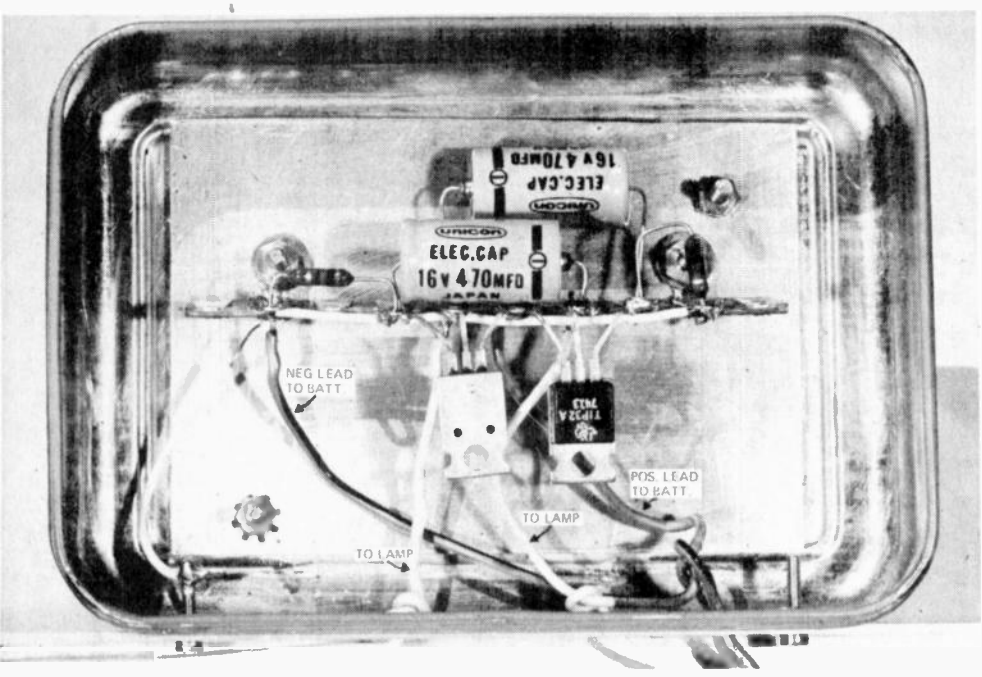


Fig. 9. The negative earth version mounted in a tin box.

Continued from page 63

The lamps used were inexpensive accessory tail lamps available from motor accessory shops. They are fitted with 12 volt 6 watt lamps. If you wish to fit more powerful lamps then the circuits would need redesigning to cope with the extra current.

TESTING

It is important that, when the transistors are 'on', they should be fully on, i.e. saturated. This limits power dissipation to a proper level. To check this the voltage across each transistor in its on condition should be measured. It should not exceed about 1 volt. To keep a transistor on long enough to measure the voltage, all that is necessary is to remove one of the lamp bulbs. This holds on the transistor associated with the other bulb.

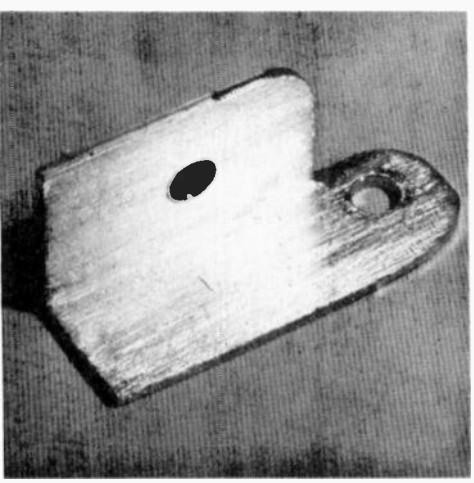
If you have a very low gain sample of transistor then the voltage may be excessive. In this case the base resistor of that transistor should be reduced until the voltage is satisfactory. If this changes the evenness of flashing, then the other base resistor should be reached to the same value. ●

PARTS LIST

POSITIVE EARTH VERSION
R1 R2 Resistors 1500 ohms ¼ watt
C1 C2 Capacitors electrolytic 470 µF 16 volt
Q1 Q2 NPN Transistors BFY52 or equivalent.
Tap strip — 10 lug as shown
Lamps — two 12 volt 6 watt bulbs
Aluminium angle about 1.7 m

NEGATIVE EARTH VERSION
R3 R4 Resistors 1000 ohms ¼ watt
C3 C4 Capacitors electrolytic 470 µF 16 volt
Q3 Q4 PNP transistors TIP32A or equivalent
Other parts as above.

Fig. 10. The bracket for mounting the rear leg.



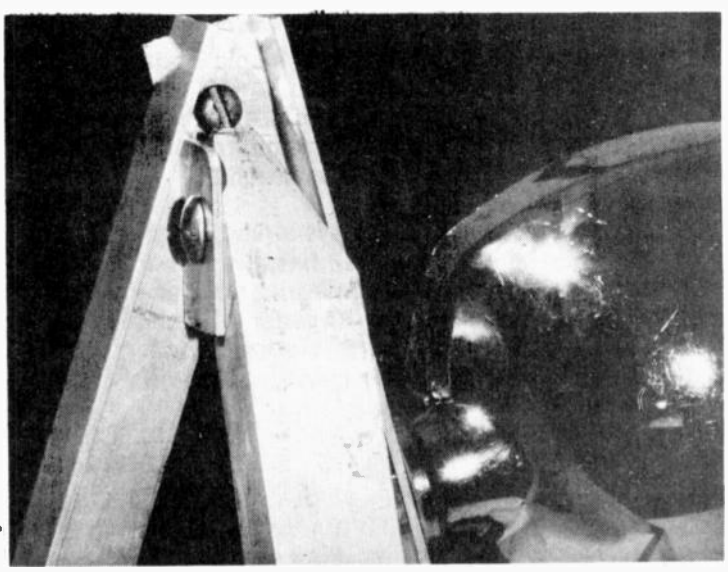


Fig. 11. Rear view of the the tripod joint.

Slowly but surely, sales of Electronic Today International are increasing.

Of course we are delighted — but an ever more serious world shortage of paper means that we must reduce wastage as much as possible.

In some areas, the magazine is already in short supply, and the situation may become worse.

There are two ways to ensure that you receive a regular copy: place a regular order with your newsagent, or take out a subscription which will cost you a bit more for postage, but will guarantee you your copy.

eti

Subscription Dept.,
Electronics Today International
15-19 Boundary St.,
Rushcutter's Bay, NSW.

Here is my cheque/postal order for $9.60 (including postage) for my annual subscription to ETI starting with next available issue.

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INTRUDER ALARM

A simple burglar alarm with superior performance.

PROJECT 528

AT THE beginning of this century there were only three crimes a year for every one thousand people. By 1971 there were three for every one hundred – ten times as many. In the UK, statistics have shown that from 1964 to 1970 the number of indictable offences rose by 50% – and the rate is steadily increasing.

This increase in crime rate is common to the entire western world, and seems to be related to affluence rather than to poverty as was previously thought by many.

Hence, these days, the chances of your home being burgled are high indeed, and getting higher. Each householder should therefore give serious consideration to protecting his home by an effective alarm system.

A burgler alarm for the home should preferably be battery operated (as it is quite easy to switch off the power from outside most houses), should be reliable over long periods and should not be subject to false alarms.

In the ETI 528 Alarm the CMOS IC has sufficiently low power drain (less than 1 mA) to make battery operation feasible. And by virtue of the high noise immunity of CMOS (half supply voltage) the unit is not susceptable to false alarms due to lightning flashes etc. Add to this the inherent reliability of integrated circuits and you have the basis of a very simple, but very effective system.

Three modes of operation are built in to the unit which functions as follows.

ALARM MODE

Microswitches or reed relays fitted to each window and door are arranged to have closed contacts when the door, etc, is shut. All contacts are wired in a series loop such that if any door or window is opened, the loop will be broken activating the alarm. The series loop should be wired between the 'external loop' and 'common' terminals shown in Fig. 4.

SILENT ENTRY

This mode of operation allows the owner, when leaving the premises, 30 seconds to open and close the front door before the alarm mode is activated. Additionally it allows the owner 30 seconds to disable the alarm after entering through the front door. Thus the front door microswitch is not included in the normal alarm loop but to its own 'silent entry' loop. The silent entry switch should be wired between 'silent entry' and 'common' – see Fig. 4.

EMERGENCY

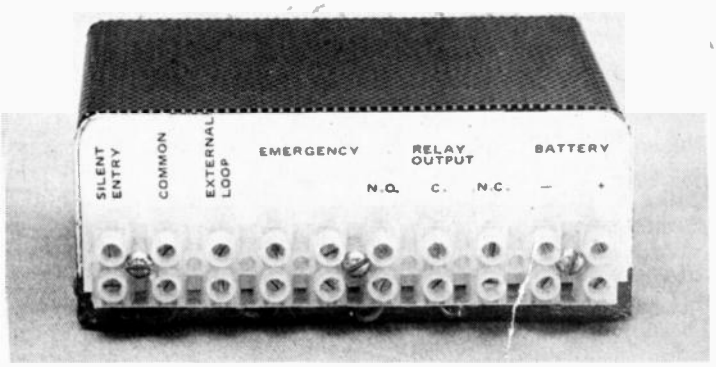
In this mode, any contact closure from a switch or sensor (eg fire, smoke or gas detector) will immediately sound the alarm. Wire switch/s across 'emergency' terminals (Fig. 4).

CONSTRUCTION

Assemble all components to the printed circuit diagram in accordance with the component overlay diagram, Fig. 3. *Do not* fit the CMOS IC until all other components are in place. Make sure that the diodes, the transistor and the tantalum capacitors are all orientated correctly before

SPECIFICATIONS

Power requirements	12 volts
Current consumption	1 mA
Silent entry delay	30 seconds approx.
Alarm circuits	Normally closed
Emergency circuits	Normally open
Alarm output	Relay change over contacts



INTRUDER ALARM

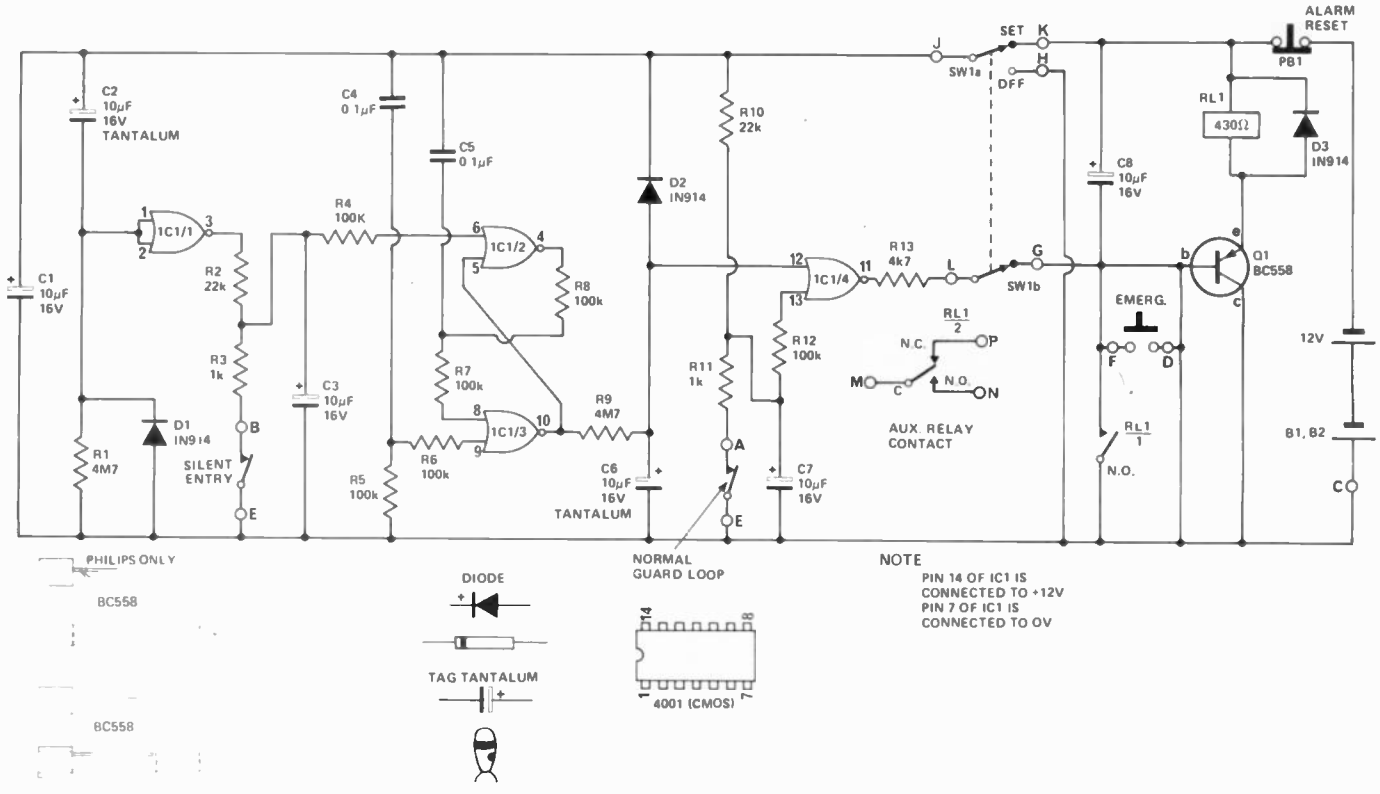


Fig. 1. Circuit diagram of the ETI Burglar alarm.

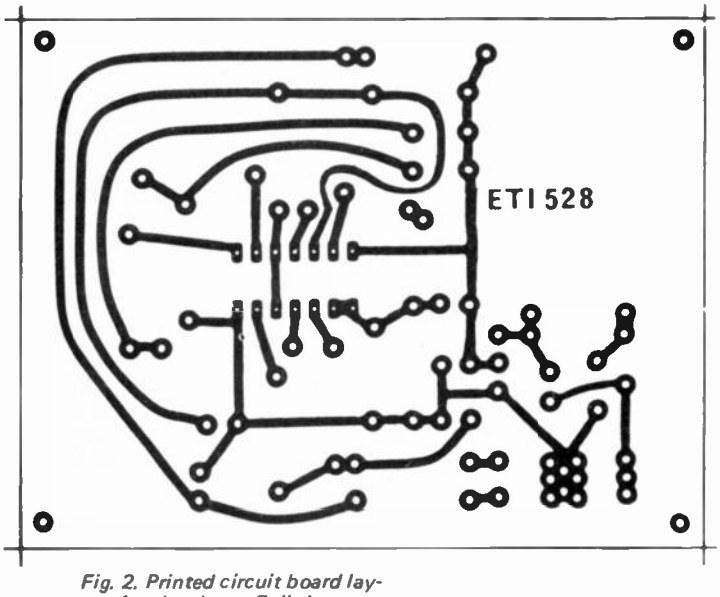
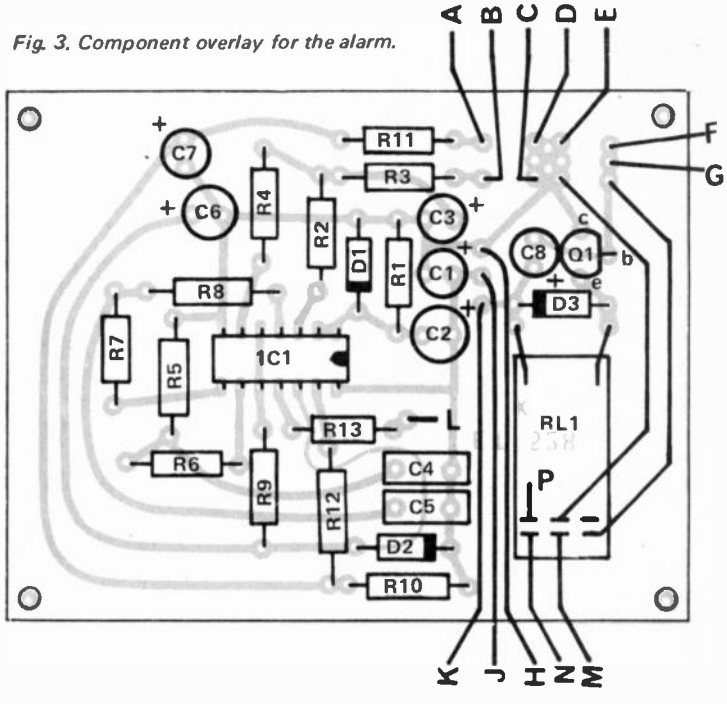


Fig. 2. Printed circuit board lay-out for the alarm. Full size 90 x 70 mm.

Fig. 3. Component overlay for the alarm.



soldering. The relay should be cemented in position on the board with a little contact cement or 5-minute epoxy.

CMOS integrated circuits are supplied with their pins inserted into black conductive foam. The ICS should be left in this foam, which protects them from damage due to static electricity, until you are ready to insert them into the printed circuit board. On no account should the devices be stored in ordinary polythene foam (the static electricity generated by withdrawing the device may well destroy it).

To insert the device into the printed circuit board, first check the orientation of the device, avoid touching the IC pins and insert as quickly, and with as little fiddling, as possible. Then using a lightweight soldering iron (with a clean tip) solder pins 7 and 14 first. These pins are the

supply rails and their connection allows the internal-protection diodes to safeguard the gates against electrostatic damage. The remaining pins may then be soldered.

The completed printed circuit board should then be assembled into the box, together with the switches and terminal block, and the complete unit wired with reference to the component overlay and the wiring diagram Fig. 4.

The completed alarm unit should be located in a reasonably well concealed position close to the 'silent entry' door.

The alarm bell is best located in a high, well concealed and not readily accessible position. As very high voltages are generated across the bell 'make and break' contacts it is preferable to use a separate bell battery of suitable voltage rather than to connect it across the main system battery.

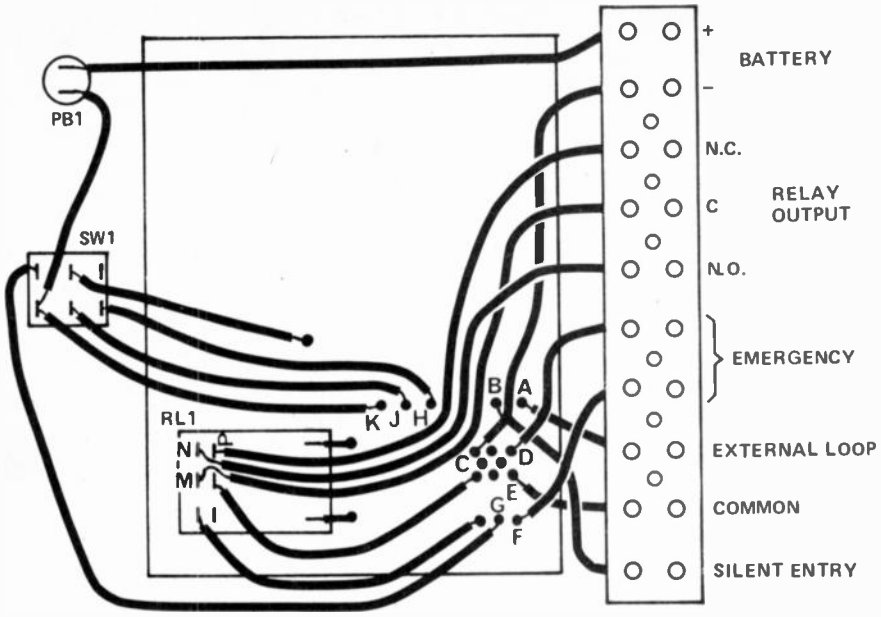


Fig. 4. Wiring diagram showing connections from printed circuit board to switches and connector strip.

HOW IT WORKS ETI 528

The alarm has three different modes of operation as described in the text.

When power is first applied, i.e. normal alarm mode enabled, capacitor C2 initially has no charge. This momentarily lifts the inputs of IC1/1 to +12 volts. The capacitor then charges slowly via R1 and the voltage presented to IC1/1 falls exponentially to zero. The output of IC1/1 will be zero if the input is over 7 volts, and at +12 volts if the input is less than 5 volts. There is a small linear region, around 6 volts, in which the output changes from zero to +12 volts. With the values given to C2 and R1 a delay of 30 seconds is provided which may be altered, if required, by changing C2. During this delay opening or closing the silent entry door will not affect the level presented to pin 6 of IC1/2.

An RS flip-flop is formed by IC1/2 and IC1/3 in which the control inputs (pins 6 and 9) are normally low (zero volts). On first switch-on pin 9 is pulled up momentarily to +12 volts by C4 before returning to zero. This presents a "1" to the input of IC1/3 and therefore its output will be low (see Table 1). Since pin 7 is at zero, and pin 5 is also at zero, (connected to pin 10) the output of IC1/2 will be high. Since this is coupled to the input of IC1/3 the flip-flop will be locked into the state where IC1/3 output is low.

The only way the flip-flop can be reversed is for the input to pin 6 to go high. However during the first 30 seconds, as explained above, the output of IC1/1 is low. Hence, opening or closing the silent entry door during this time will not set the flip-flop and activate. the alarm.

After this 30 second period, opening the silent entry door will present a "1" to pin 6 which will cause the flip-flop to change state. Closing the silent entry door will now have no effect and the flip-flop will remain set.

The high output of IC1/3 will allow C6 to charge slowly to +12 volts via R9. When this voltage reaches 6 volts (about 30 seconds) it will cause the output of IC1/4 to go low (assuming the normal alarm loop is closed). The low output of IC1/4, via emitter follower Q1, pulls in relay RL1 activating the alarm. When the relay closes contacts RL1/1 cause it to latch on, and only removing power by pressing PB1 will reset it.

If at any time the normal guard loop is broken, when the alarm is activated, a "1" is presented to pin 13 of the IC1/4 causing the output to go low and the relay to close.

When the emergency switch is closed the base of Q1 is taken to zero and the relay closes and latches. This action will take place regardless of whether the alarm is enabled or not.

Diodes D1 and D2 discharge capacitors C2 and C6 respectively via SW1 when it is in the "off" position, thus ensuring that the 30 second delay is always obtained. Resistors R6, 7 and 12 protect the CMOS IC against voltages in excess of the supply rails. Capacitors C3, 5, 7 and 8 add further protection against false triggering due to lightning etc.

INPUT		OUTPUT
A	B	
0	0	1
1	0	0
0	1	0
1	1	0

TRUTH TABLE FOR
2 INPUT NOR GATE
4001 (CMOS)

NOTES
INPUT
1 means $>$ 55% supply voltage
0 means $<$ 45% supply voltage

INTRUDER ALARM

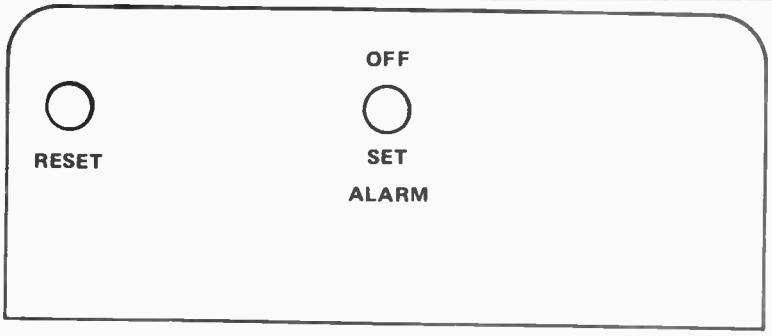
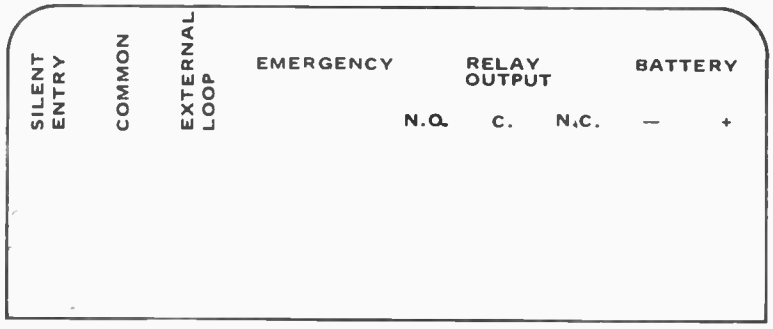
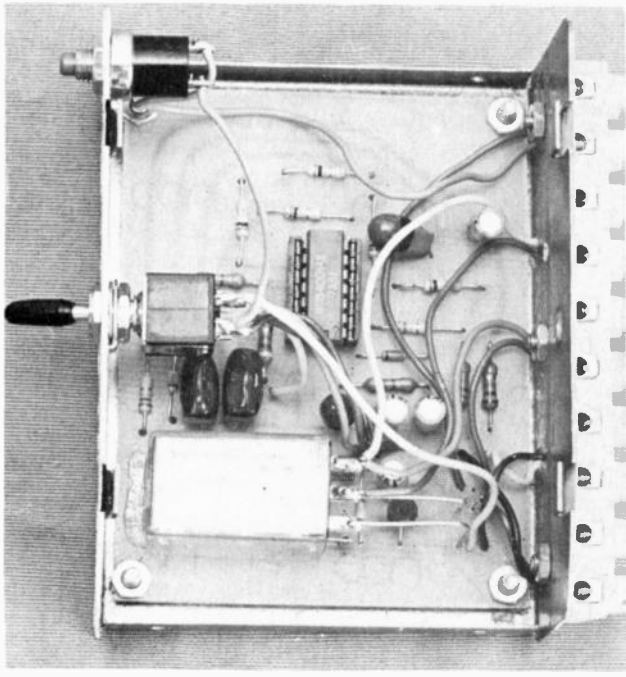


Fig. 5. Front panel artwork.

Fig. 6. Rear panel artwork.





ETI 258 INTRUDER ALARM PARTS LIST

R1, R9	Resistor	4M7 ohm ¼W 5%
R2, R10	"	22k ohm ¼W 5%
R3, R11	"	1k ohm ¼W 5%
R4, R5, R6, R7, R8, R12	"	100k ohm ¼W 5%
R13	"	4k7 ohm ¼W 5%
C1,C3,C7,C8	Capacitor	10μF 16v electrolytic
C2,C6	"	10μF 16v tag tantalum
C4,C5	"	0.1μF polyester.
D1,D2,D3	Diode	IN914
Q1	Transistor	BC 558, BC 178 or equivalent
IC1	Integrated Circuit	SCL4001A, MC14001, etc.
SW1	Switch	DPDT subminiature
PB1	Switch	Push button switch NC.
RL1	Relay	Miniature cradle relay, 430 ohm coil, two c/o contacts.

PC Board ETI 528, box 200B Venticase (CELOTEK) or similar, 10 way nylon terminal block, two 6 volt lantern cells, hookup wire.

Mr. Hi~Fi, Sells and recommends Lenco

LENCO L85

The L85 is a new top-ranking product amongst Hi-Fi Studio Record Players. It combines the most modern technology: a 16-pole synchronous motor, belt-driven turntable, an electronic fine speed control for the exact adjustment of the individual speeds, automatic shut-off as well as lift off of the pick-arm from the record, a viscously damped spring suspension system which permits the exact levelling of the unit, a built-in and illuminated stroboscope at the edge of the turntable for checking the speed, and an antiskating device. The well-styled control knobs facilitate the operation of the L85. This unit is of extremely high quality, and can be counted amongst the luxury class. It is supplied either as a chassis for building in, or mounted on a wooden plinth finished in white, Palisander or walnut together with a matching dust cover.

LENCO L75

The sophisticated Lenco L75 is a superb turntable unit which was developed for the discriminating music lover. The achieved specifications exceed in all cases the values stipulated by the DIN standard for high quality record players.

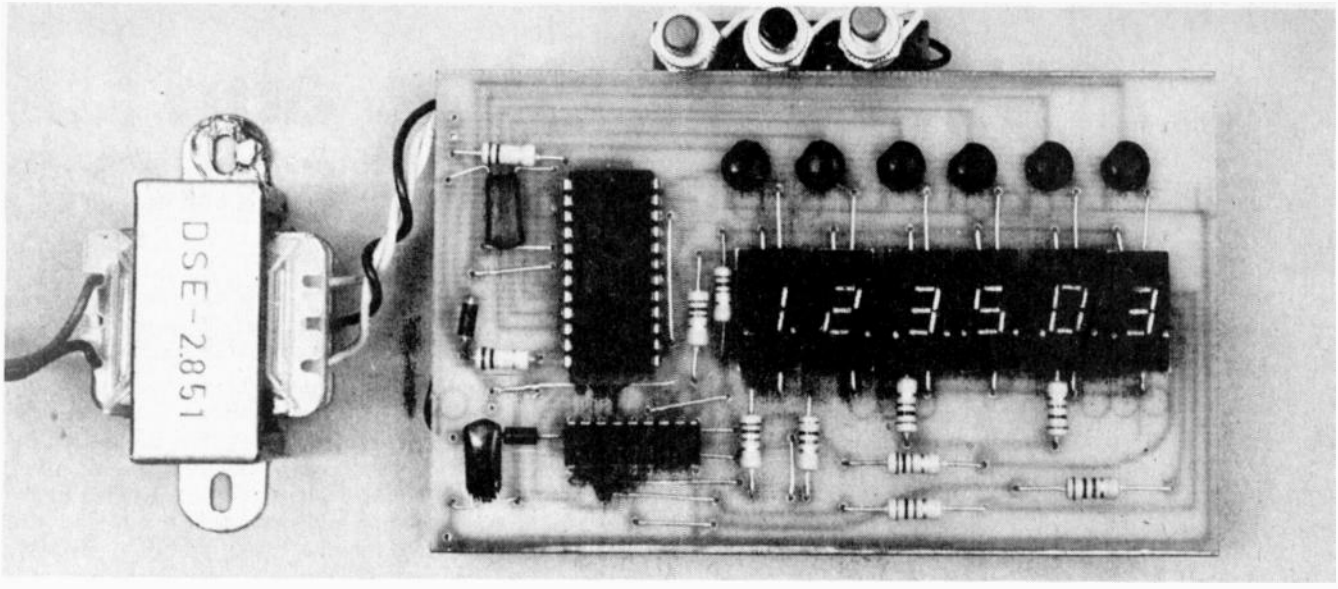
The technical advantages of the L75 are as follows:

– Dynamically balanced non-magnetic turntable diecast from zinc alloy weighing 4 kg, with a large diameter of 312 mm.
– Infinitely variable speed adjustment.
– High quality 4-pole motor with conical rotor shaft.
– Lightweight tubular pick-up arm employing friction-free knife edge bearings.
– Calibrated stylus pressure adjustment of 0.5 to 5 p. by sliding counter weight.
– Stylus position adjustment in plug-in shell to give minimum tracking error for any cartridge.
– Antiskating bias compensation to minimise inner groove distortion.
– Accurate and gentle pick-up lowering by hydraulically operated lift/lower device.

LENCO L78

The new Lenco L78 is a further development of the proven L75 and can be counted amongst the top rank of transcription quality turntable units. All the requirements of DIN 45000 are exceeded and the technical innovations increase the sound quality and also simplify the operation of the unit.

The drive through the 4-pole motor and the conical spindle allows for infinitely variable speed adjustment. The pick-up arm, which can be balanced out in every plane, has low inertia and a friction-free movement through its knife edged bearings and adjustable stylus pressure from 0.5-5 grams and assures faultless reproduction with minimum record wear. The pick-up arm is raised from the record automatically at the end of play. The chassis is fitted with four viscously damped mounting springs which can be adjusted for levelling the unit. Due to a built-in friction the hinged dust cover of the L78 will stay open in any position down to 20°.



The clock is shown here complete with (optional) 'seconds' readout. In standard form hours and minutes only are shown.

LOW-PRICE DIGITAL CLOCK

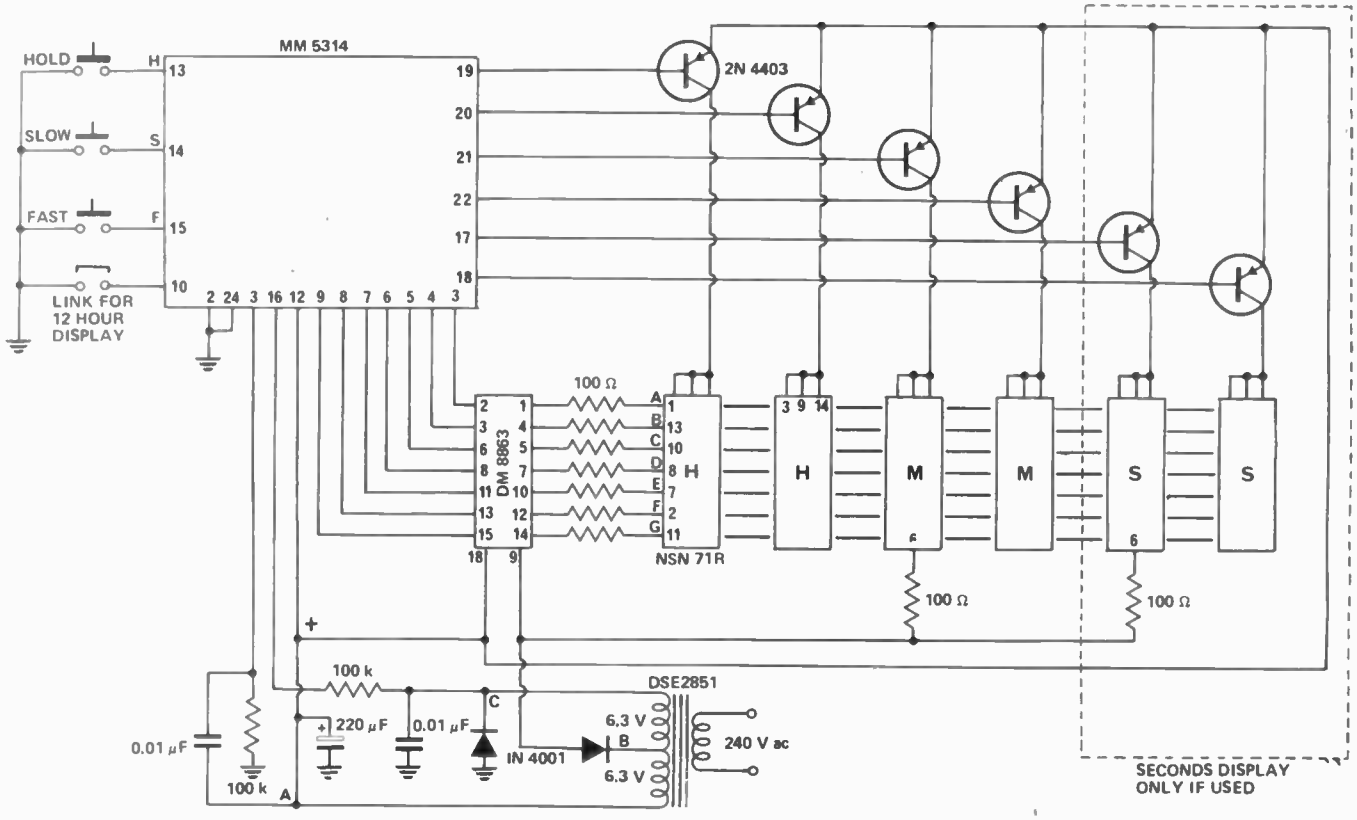
A simple inexpensive clock for beginners.

FEW PROJECTS can rival clocks for the sheer fascination, pleasure and satisfaction that they give the builder.

But in the past, these clock projects have not really been suitable for novices because of their complexity and high component cost.

Here is one which is different, it's well within the means and ability of the average beginner – yet offers performance adequate enough to satisfy the most critical of builders.

It is not an ETI project in the normal way. The design has been undertaken by Dick Smith Electronics, in



conjunction with National Semiconductor, who are offering the unit in kit form at a very attractive price. (Readers can of course also assemble the unit from parts bought elsewhere if they don't want to take up the offer.)

Apart from two integrated circuits and the indicators, all that is needed is a printed circuit board, a few resistors and a simple power supply.

Facilities are built into the clock chip for fast or slow time setting and for a time 'hold' function. Additionally, simply linking pin 10 to earth changes from 24 hour timing to 12 hour timing.

The printed circuit board allows the seconds displays to be fitted if required, for very little extra cost. In standard form however, only hours and minutes are shown (i.e. there are four digits).

The kit is supplied complete with everything you need to get it going. Full assembly instructions are included. Choice of a suitable housing for the clock is left to you. A little ingenuity could result in a very attractive, as well as functional clock.

PARTS LIST

1 x MM5314 MOS Clock IC
1 x DM8863 Segment driver
4 x NSN 71R LED displays
4 x 2N 4003 transistors for equivalent 1
2 x 1 amp diodes, (IN4001 or similar)
1 x 220μF 25V electrolytic
8 x 100 ohm ½ W resistors
2 x 100k ½ W resistors
1 x pc board
3 x single momentary contact push button switches
1 x power transformer (DSE 2851 or similar)
1 x mains connector
1 x mains cord and plug
Hook up wire, tinned copper wire etc.

Extra parts for six digit operation

2 x NSN71R displays
2 x 2N4403 transistors
1 x 100 ohm ½ W resistor.

OPERATION

Before plugging in check the board for shorts, wrong connections or dry joints. When first switched on the clock will present a completely random time and it is possible that all the displays will not light.

To set the correct time use the switches as follows:

FAST – gives a speeded up count and will cover the 12 hours in quite a short time. Press this button till you are close to the right time.

SLOW – gives a slower count, but is still faster than normal. If you overshoot –

HOLD – holds the display until released. Set the clock by the radio time pips. The true time is given by the final pip.

WARNING

The MM5314 Clock IC used in this kit is a MOS device and should be handled with extra care. If you haven't used MOS ICs before, follow the instructions very carefully. LEAVE THE MM5314 IN ITS SPECIAL PROTECTIVE FORM until you are about to insert it. Any static charges may destroy the device. DO NOT HOLD IT BY THE PINS. Be sure you only hold it by the ends and insert it GENTLY and EVENLY into the board. You will see that it is the last device to be placed on the circuit board. Solder the pins quickly using a minimum of heat and preferably with your iron disconnected from its supply.
Because the suppliers have no control over the insertion of this device they cannot guarantee replacement in the event of failure.
Replacement devices are available at $5,00 each. National Semiconductor assured us that they have experienced no problems with this IC to date. Use a low wattage iron up to 25 W max.

HOW IT WORKS

The project is based on the National Semiconductor clock chip, type MM5314. This is an MOS (Metal Oxide Semiconductor) device housed in a 24-pin pack. The device contain all the logic necessary to generate a multiplexed-time code from an input of 50 Hz derived from the mains.

Multiplexing the output allows the device to be packaged with far less pins than would otherwise be required. That is, pins 3 to 9 inclusive output one digit of the display at a time in sequential order starting from the units of seconds and progressing through each of the six digits in turn. The output is in a form suitable to drive seven – segment displays but must be demultiplexed, that is the correct time-code group must be passed to the correct display chip.

The demultiplexing is performed by two sets of outputs from the clock chip, one group selects the segments of the display which are to be illuminated and the second set of outputs selects the appropriate display chip. A DM8863 driver is used to buffer the segment-select outputs, and 2N 4403 transistors are used to buffer the chip-select output.

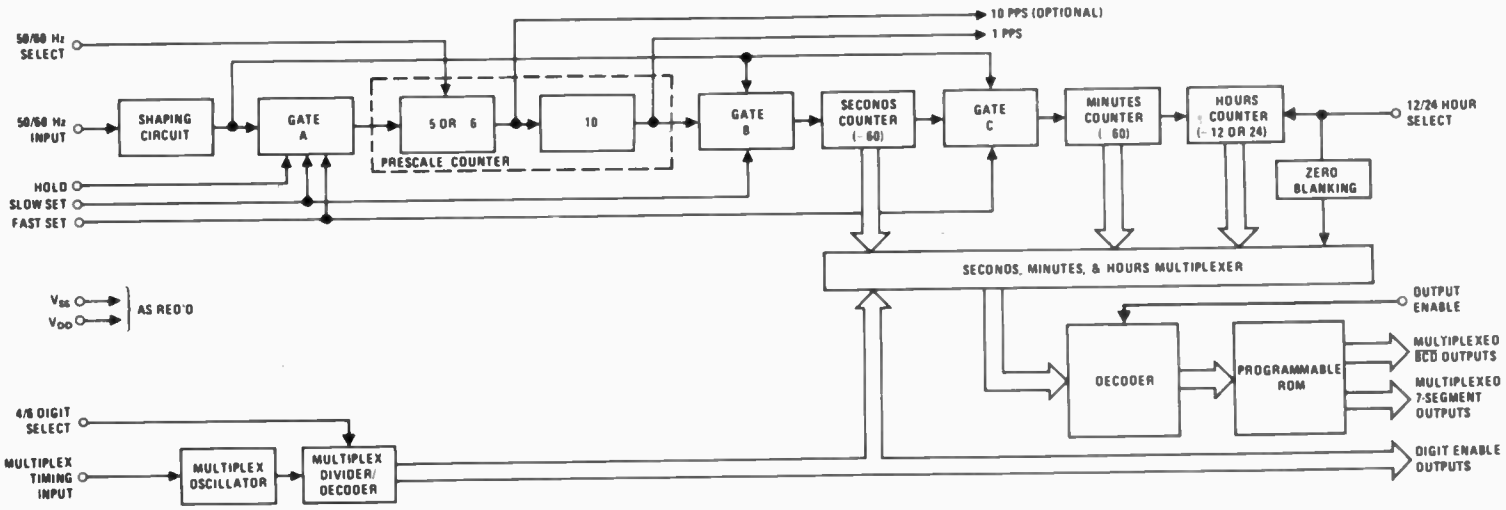
Apart from two integrated circuits and the indicators, all that is needed is a printed circuit board, a few resistors and a simple power supply.

Facilities are built into the clock chip for fast or slow time setting and for a time 'hold' function. Additionally, simply linking pin 10 to earth changes from 24 hour timing to 12 hour timing.

The printed circuit board allows the seconds displays to be fitted if required, for very little extra cost.

The kit is supplied complete with everything you need to get it going. Full assembly instructions are included. Choice of a suitable housing for the clock is left to you. A little ingenuity could result in a very attractive, as well as functional clock.

SEE ADVT. PAGE 37 FOR SPECIAL OFFER



MM5314 Digital Clock, Block Diagram

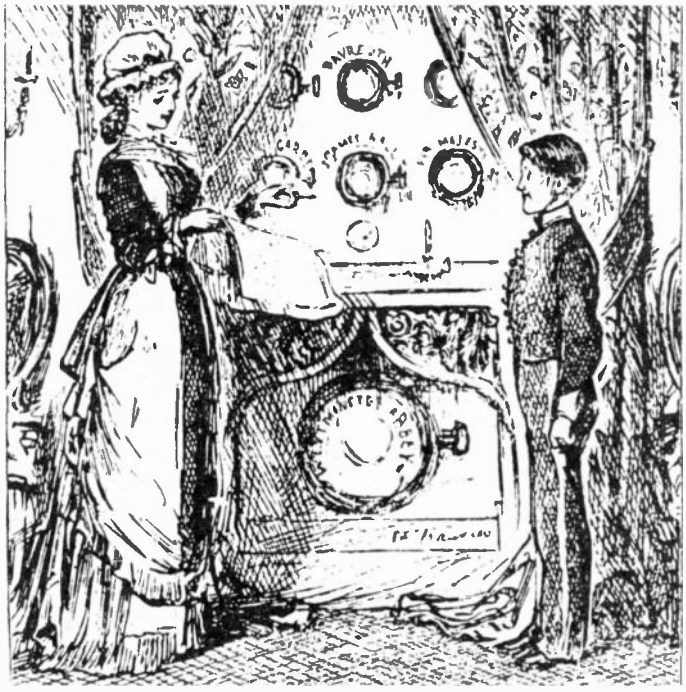
BROADCASTING 1878 STYLE

TODAY we accept recorded audio (and soon video) entertainment as a basic requirement of life that most people can easily afford and appreciate.

It has not always been so.

Before the advent of the record and the tape, audio entertainment was by necessity, only forthcoming when the performer was available in person. By today's standards, music and theatre in the late nineteenth century were experiences to be highly valued.

Then, as the practical uses that electricity could be put to were realised, Victorian inventors devised the gramophone, the tape recorder and established the basis of television.



Musical Mistress of House ("on hospitable thoughts intent"). "NOW, RECOLLECT, ROBERT, AT A QUARTER TO NINE TURN ON 'VOI CHE SAPETE' FROM COVENT GARDEN; AT TEN LET IN THE STRINGED QUARTETTE FROM ST. JAMES'S HALL; AND AT ELEVEN TURN THE LAST QUARTETTE FROM 'RIGOLLETTO' FULL ON. BUT MIND YOU CLOSE ONE TAP BEFORE OPENING THE OTHER!" *Buttons.* "YES,

The gramophone was introduced as an everyday device about 1880 — Edison's cylindrical recorder was first built in 1876: we are told it recorded the nursery rhyme "Mary had a little lamb."

Movie films were barely a glimmer in the inventor's eyes at the time of the first gramophone. Photography (begun around 1840) was advanced to a stage where, in 1880, the wet-plate process gave way to dry-plate use and eventually in 1890, the roll-film concept. Movies emerged from many intertwined ideas. The phantascope of Professor Plateau (1832); the thaumatropes of Roget and Herschel; Professor Marey's photographic gun (about 1880), Friese-Green's cinematography method (1889) and Edison's kinetoscope (1889) that finally could project the movie; each paved the way toward recorded visual sensation — paralleled by the growth of video-recording.

The tape recorder grew out of the telephone development. Philipp Reis, a German, built the first device calling it a telephone (around 1860). Out of this, plus the work of many others, grew the realisation that it was feasible to record telephone messages so that they could be posted. Poulsen and Pederson's devices, the Telegraphone for instance, used telephone components

to put speech onto wire, disk, drum and tape as early as 1898. But, in general, electrical recording on tape or wire was slow to develop, the main impetus occurring during the second World War. (Wire recorders were supplied to war correspondents in the battlefield).

So in 1880 – the year that Ned Kelly was hanged – three years before Adelaide got its first telephone exchange, when streets were lit by gas, and when trams were pulled by steam – recorded entertainment was just becoming accepted in gramophone and film forms.

This leads us to our cartoons – reproduced here from an 1878 edition of Punch magazine. The captions command attentive reading so that the true insight of the cartoonist can be realised.

We can't ask the artist what he really thought, but *we* surmise that his intention was satirical rather than visionary. I suggest that, having heard that the telephone converts sound into electricity, that electricity can be routed where needed by (telephone) exchanges and that electricity can be stored in bottled (Leyden jars were foil lined glass jars acting as capacitors), the artist put two and two together to come up with these cartoons. No doubt readers of the time had a good laugh at such a preposterous idea!

BY THE TELEPHONE SOUND IS CONVERTED INTO ELECTRICITY, AND THEN BY COMPLETING THE CIRCUIT, BACK INTO SOUND AGAIN. JONES CONVERTS ALL THE PRETTY MUSIC HE HEARS DURING THE SEASON INTO ELECTRICITY, BOTTLES IT, AND PUTS IT AWAY INTO BINS FOR HIS WINTER PARTIES. ALL HE HAS TO DO, WHEN HIS GUESTS ARRIVE, IS TO SELECT, UNCORK, AND THEN COMPLETE THE CIRCUIT: AND THERE YOU ARE!

UNDERSTANDING COLOUR TV

by Caleb Bradley

PART 3 The PAL System

THE SUBCARRIER which is added to the conventional monochrome television signal to convey colour information has to carry *two* streams of colour-difference information: ($E_R - E_Y$) and ($E_B - E_Y$). This is achieved in the PAL colour television system, invented in Germany by Dr. Bruch of Telefunken as an improvement on the American NTSC system, by 'synchronous modulation in quadrature' of the subcarrier by the colour difference signals.

SYNCHRONOUS MODULATION

Like amplitude or frequency modulations, this is a way of using a high frequency carrier to convey a signal which might be speech, music, a television waveform or in this case the colour difference signals.

Synchronous modulation is achieved by feeding the carrier and the modulating signal into a balanced modulator or signal multiplier. The output of this is at any time the algebraic product of the two input voltages. If either voltage is zero, e.g. when the carrier wave crosses zero or when there is zero modulating signal, the modulator output is zero hence the modulation is balanced or suppressed-carrier type. When the modulated carrier arrives at the receiver, the signal can only be properly recovered by demodulating the carrier in a second modulator, using a locally generated oscillation of exactly the same frequency and corresponding phase to the carrier source used at the transmitter. Although the frequency can be duplicated accurately by using a quartz-crystal oscillator, some form of synchronisation signal must be transmitted to ensure correct phase.

A simple system of synchronous modulation and demodulation is shown in Fig.15. The carrier oscillator at the transmitter produces a sinewave whose instantaneous value we can call '$\cos\theta$' i.e. the cosine of the angle θ whose value grows from 0° to 360° during each period of oscillation. This signal can be represented by a vector pointing upward on a vector diagram. This type of diagram is an easy way of showing phase differences between oscillations of the same frequency. Amplitude is represented by the length of a vector.

If the synchronisation between transmitter and receiver is effective the receiver's reference oscillator also produces ($\cos\theta$) and the original signal is correctly recovered. Before accepting the statement it is worth seeing the trigonometry which describes the process:

Modulated Carrier = $S\cos\theta$

local oscillator = $\cos\theta$

$\therefore$ demod product = $S\cos\theta \times \cos\theta$

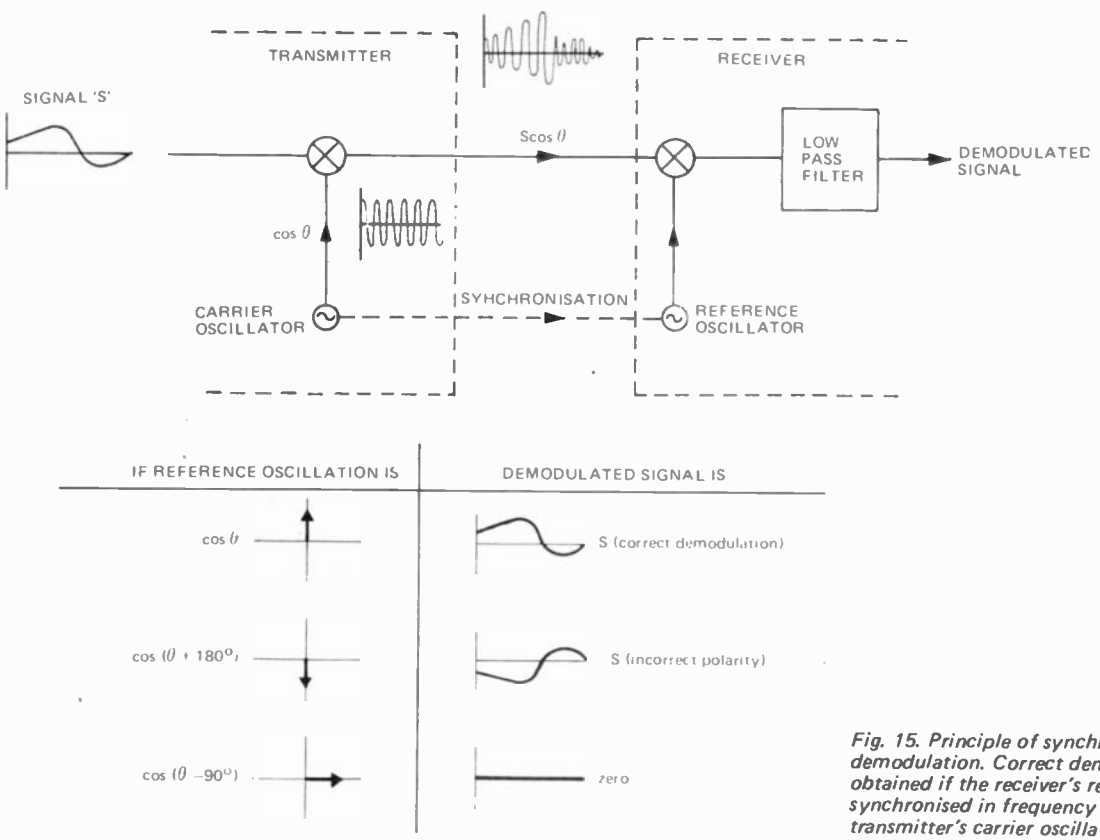


Fig. 15. Principle of synchronous modulation and demodulation. Correct demodulation is only obtained if the receiver's reference oscillator is synchronised in frequency and phase to the transmitter's carrier oscillator.

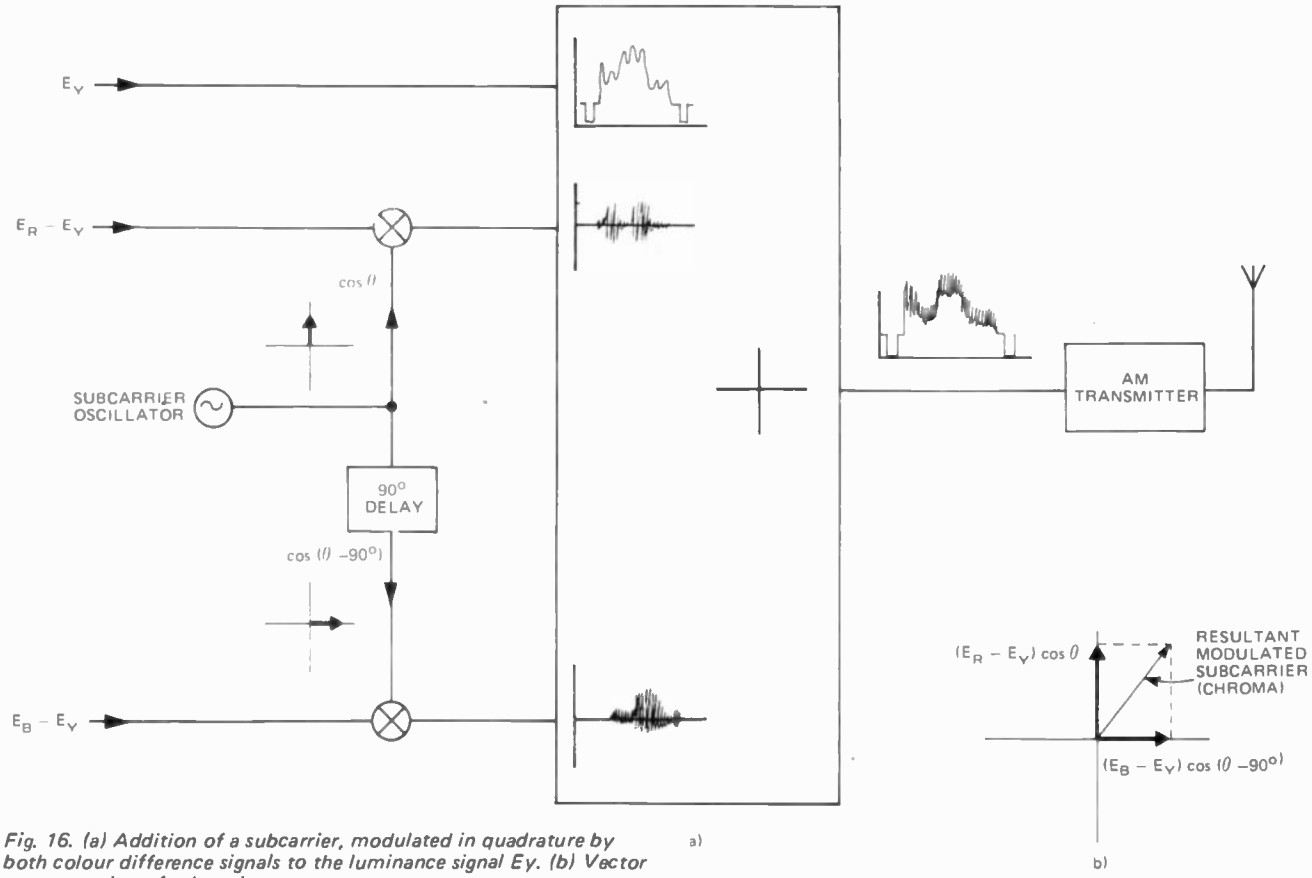


Fig. 16. (a) Addition of a subcarrier, modulated in quadrature by both colour difference signals to the luminance signal Ey. (b) Vector representation of subcarrier.

$= \frac{1}{2}S \cos 0^\circ + \frac{1}{2} S \cos 2\theta$

But as $\cos 0^\circ = 1$

$= \frac{1}{2}S + \frac{1}{2} S \cos 2\theta$

Thus we have the original signal (½S) plus an unwanted component at twice carrier frequency (½ S cos 2 θ). The twice frequency component is suppressed by means of a low pass filter as shown in Fig. 15.

This reveals an unwanted high frequency output from the demodulator which has to be suppressed by the low-pass filter in Fig.15.

It is particularly interesting to see what happens if the reference oscillator is *not* in correct phase.* Suppose it were out of phase by a whole 180°, i.e. generating cos (θ − 180°). This is the same as −(cos θ), a vector pointing downwards at 180° to the cos θ vector, and the signal would just be demodulated with wrong polarity. This would have disastrous effect on a colour difference signal, e.g. if $(E_R - E_Y)$ is inverted, red colours (positive values) swap places with blue-green or cyan colours (negative values). This fault can occur!

Alternatively suppose that the reference oscillator is exactly 90° out of phase i.e., cos (θ − 90°) = sin θ. Again using trigonometry:—

Modulated carrier = S cos θ
Local Oscillator = sin θ
∴ demodulation product = S cos θ x sin θ

$= \frac{1}{2}S \cos 90^\circ + \frac{1}{2} S \cos (2\theta - 90^\circ)$

But as $\cos 90^\circ$ = zero

$= \frac{1}{2} S \cos (2\theta - 90^\circ)$

Thus only the twice frequency component is generated and this is removed by the low pass filter. Hence there is no output if the reference oscillator and the modulated carrier are in quadrature.

This gives the clue that a synchronously modulated carrier can carry two different colour signals without interference if the cos θ and cos (θ − 90°) phases are separately modulated, known as *quadrature modulation*. It is easiest to think of two carriers of the same frequency but 90° phase difference which are separately modulated, then added together. This is shown in Fig.16 where, to remind us, the luminance signal E_Y is also brought into the addition.

When two signals of the same frequency but different phases and amplitudes are added together the result is a signal of the same frequency with new phase and amplitude. This happens when the two parts of the modulated subcarrier are added together, and for any instantaneous values of the colour difference signals the amplitude and phase of the sum can be found by extending parallel lines (dotted) on a vector diagram as in Fig.16 b). The quadrature-modulated subcarrier is called the *chroma* signal and appears as a fine 'fuzz' superimposed on the luminance waveform. Although the colour difference signals may seem inextricably mixed in the chroma-plus-luminance signal, a receiver with synchronous colour demodulation, as shown in Fig.17, can recover them perfectly.

HUE AND SATURATION

Returning to the vector representation of the chroma in Fig.16 b, it can be seen that since $(E_R - E_Y)$ and $(E_B - E_Y)$ can each have positive or negative values i.e. each vector may point either way along its axis, the chroma vector can have any phase or amplitude. Some examples to illustrate this are shown in Fig.18.

The phase angle of the chroma vector depends only on the ratio between $(E_R - E_Y)$ and $(E_B - E_Y)$ but this ratio also defines a particular *hue* in the colour triangle described in Part 1.

* *The phase delay along the transmitter-receiver path is ignored throughout on the assumption that it is the same for the carrier and the synchronisation signal.*

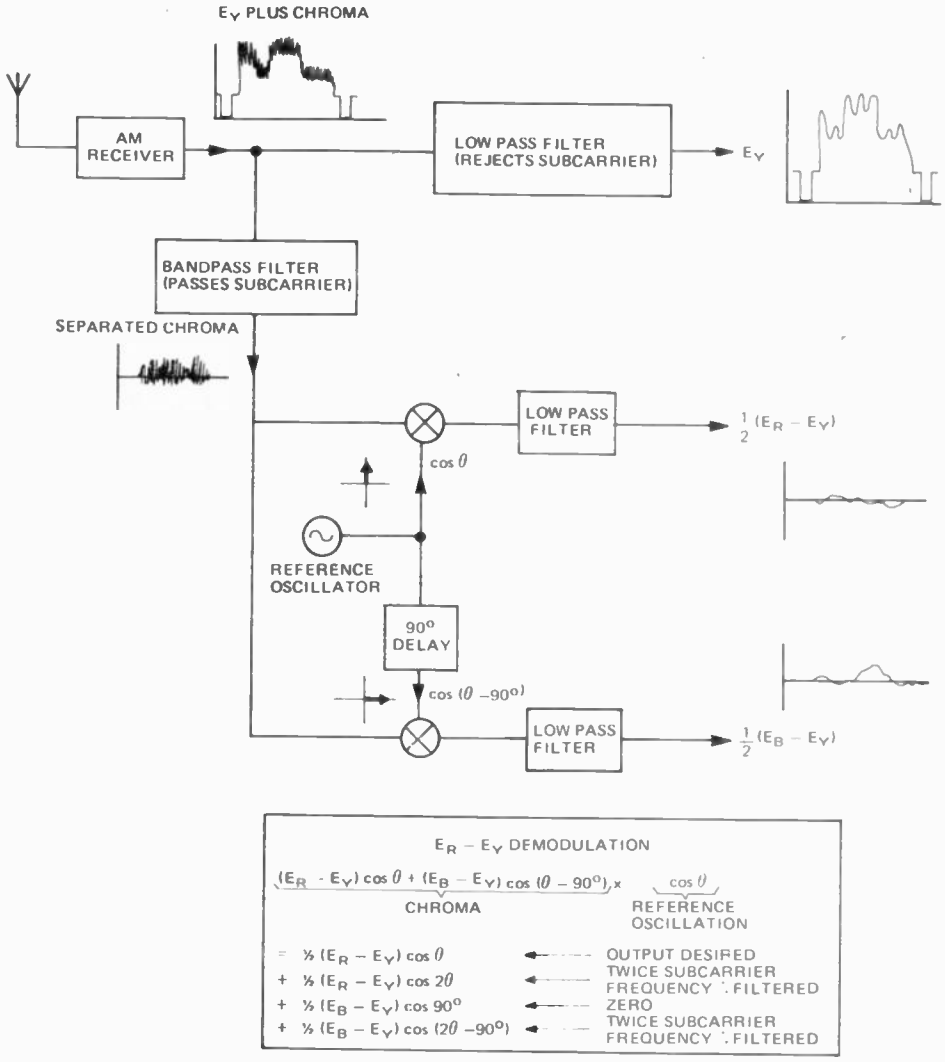


Fig. 17. A suitable receiver for the signal produced by Fig. 16. For correct colour demodulation the reference oscillator must be precisely phase-locked to the transmitter. The insert shows a full description of the $(E_R - E_Y)$ demodulator; the $(E_B - E_Y)$ demodulator works similarly.

Further, the length (amplitude) of the chroma vector can only be large if one or both $(E_R - E_Y)$ or $(E_B - E_Y)$ are greatly positive or negative, which implies colours far from white in the colour triangle i.e. strongly saturated colours. Thus a consequence of quadrature modulation is that the *hue* and *saturation* of a colour is directly defined by the *phase* and *amplitude* respectively of the chroma signal. The actual phase and amplitude values for the primary colours are shown in Fig.19. From the foregoing one would expect blue to lie exactly along the horizontal axis but in practice it is necessary to multiply $(E_R - E_Y)$ and $(E_B - E_Y)$ by reducing factors of 0.877 and 0.493 respectively to prevent overmodulation of the subcarrier by certain saturated colours. These 'weighted' colour difference signals are referred to as V and U in the PAL system and cause some rotation of the colour phases from their expected positions.

PHASE SYNCHRONISATION

The system of simultaneous colour modulation of a subcarrier or *colour coding* so far described was used for the first regular colour television broadcasts. It is the basis of the NTSC system developed by Radio Corporation of America and is still used there and in Japan. Provided the reference oscillators in receivers are accurately phase-locked to the transmitter's subcarrier oscillator, the colour difference signals are accurately decoded. This phase lock is provided by transmitting a short burst of unmodulated subcarrier just before each picture scanning line. Colour receivers use this burst to correct the phases of their reference oscillators. Unfortunately experience has shown that unless the receiver is sufficiently close to the transmitter to receive a very high quality signal, propagation effects can upset the accuracy of the phase lock. When this happens the effect on the viewer's picture is disastrous since all the chroma vectors are in effect rotated clockwise or anticlockwise by the angle of the phase error. People find these hue errors especially unpleasant when flesh tones veer towards blue or green!

When colour television was about to be introduced in Europe in the mid-60s the opportunity arose to standardise on a different colour system giving better colour under poor reception conditions. Unfortunately power politics prevented complete international agreement and a minority of countries, primarily France and USSR, opted for a system in isolation called SECAM. This has its own history of development and is briefly described in the insert; it is

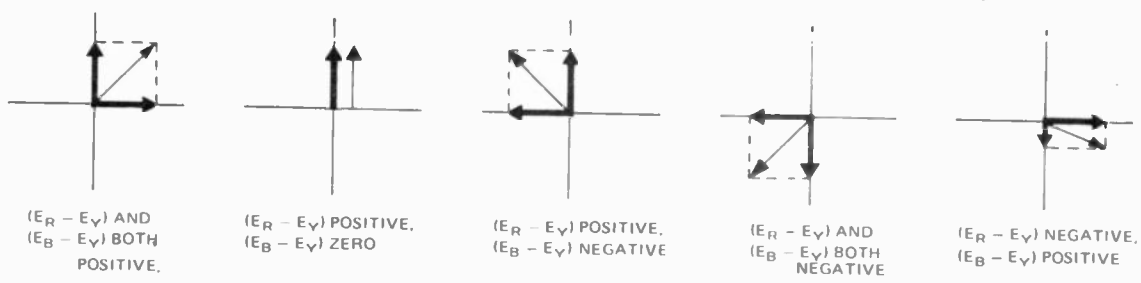


Fig. 18. Typical chroma vectors (thin arrow) produced by various values of $(E_R - E_Y)$ and $(E_B - E_Y)$ modulated as in Fig.16.

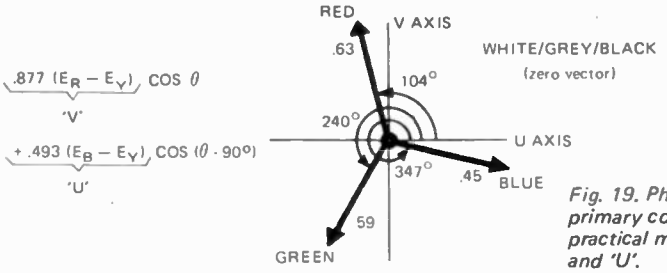


Fig. 19. Phases and amplitudes of primary colour vectors using practical modulation signals 'V' and 'U'.

unlikely to be chosen by many other countries.

PAL (Phase-alternate-line)

This is the colour system adopted by most of Europe, Australia and South Africa, and is most likely to be chosen by other countries in the future. It uses the same synchronously colour-modulated subcarrier as the NTSC system but with a simple trick added by Dr. Bruch which prevents phase errors causing incorrect hues. The trick is to send the V signal with *reversed Phase (polarity) on Alternate Lines* – hence 'PAL'. The arrangement to do this is shown in Fig.20.

The significance of this switching can be seen in Fig.21 where for simplicity both U and V have positive values. Demodulation is straightforward on the lines where U and V are modulated normally. On the alternate lines where V is inverted, the U demodulation is unaffected but −V needs to be reinverted in the receiver to +V. One way of doing this is to use a phase reversing switch similar to the one in Fig.20 to invert the reference oscillator feed to the V demodulator. This switch in the receiver must change at the start of every line in synchronism with the switch at the transmitter, i.e. at half-line frequency (7.8 kHz). This frequency is easily derived from the scanning circuits by a bistable. However it is necessary for the composite colour signal to contain information from which the receiver can ensure that its 'PAL bistable' is working in the right phase – if it happened by chance to start off on the wrong foot, V would be demodulated with the wrong polarity on every line giving grotesque colour errors. In fact the synchronisation is achieved as a result of the method used to lock the

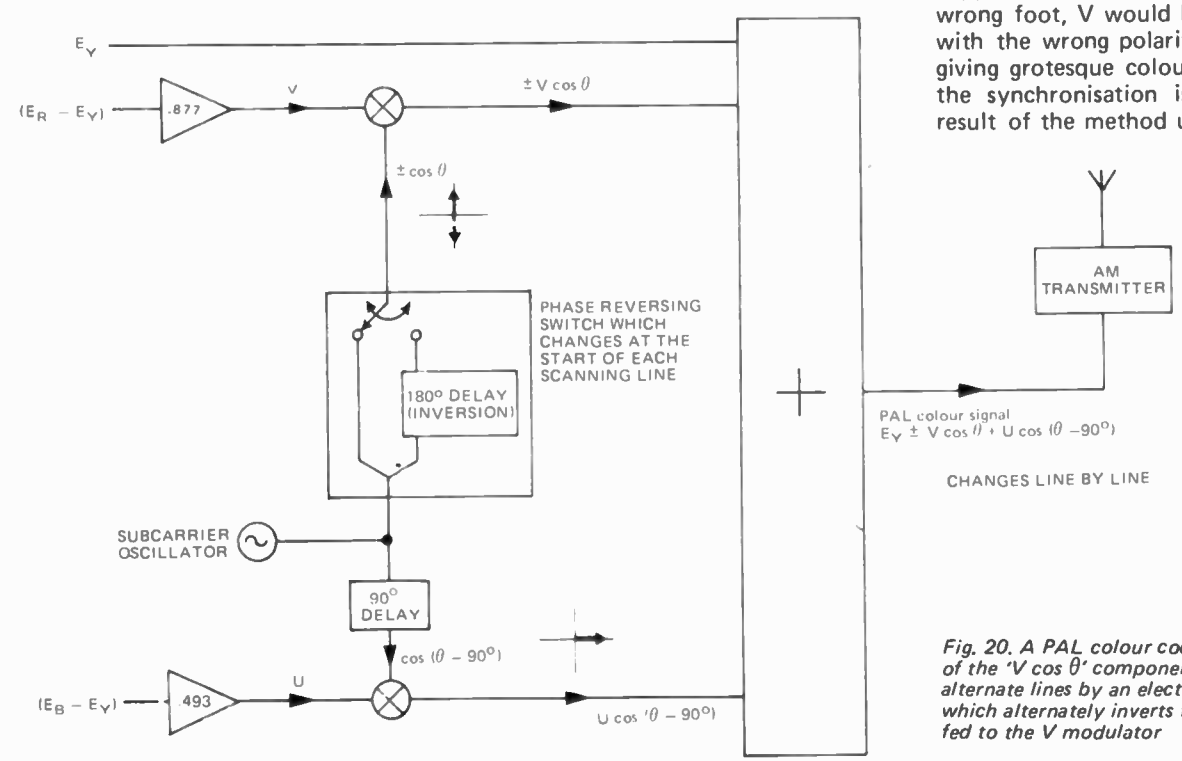


Fig. 20. A PAL colour coder. The polarity of the 'V cos θ' component is reversed on alternate lines by an electronic switch which alternately inverts the subcarrier fed to the V modulator

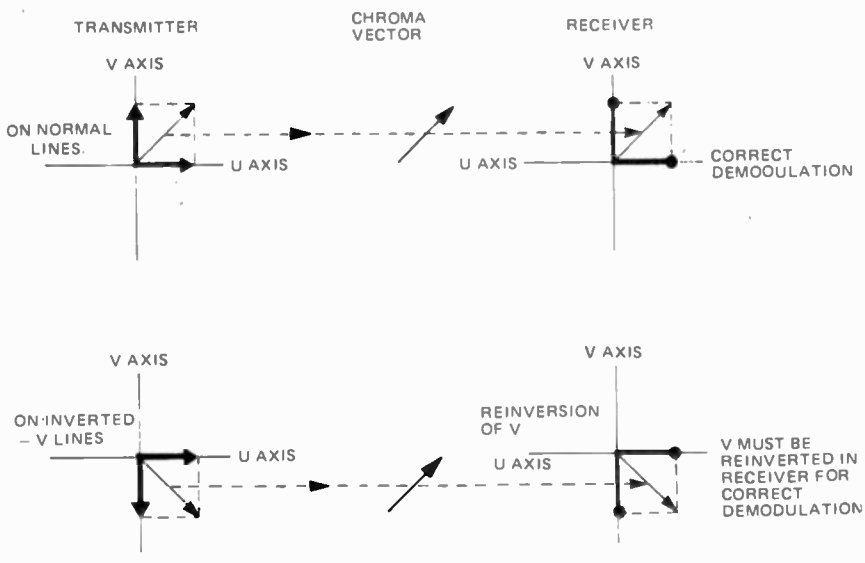


Fig. 21. Inversion of V signal on alternate lines in the PAL system.

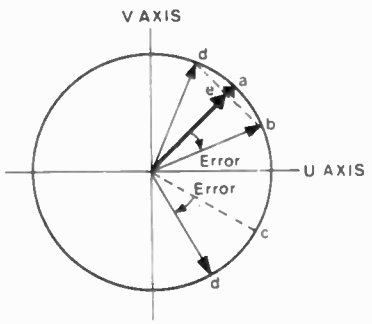


Fig. 22. Effect on two successive lines of the same colour of a demodulation phase error in the receiver. For explanation see text.

UNDERSTANDING COLOUR TV

receiver subcarrier oscillator to the right phase, to be explained next month.

PHASE ERROR CANCELLATION

Why does this extra complexity of alternate-line V reversing make the colour subcarrier immune to phase errors? The vector diagram in Fig.22 shows why.

Suppose a picture contains two successive lines of a particular colour whose hue and saturation are represented by the chroma vector a. Suppose there is a phase error present such that all colours are demodulated with slightly leading phase. Thus on the line of the pair where +V is transmitted, the receiver demodulates the vector b. On the next line where −V is transmitted the receiver, instead of demodulating c the V−inverted version of a, demodulates d which it V-inverts to d'. Therefore there are hue errors on both lines since neither b nor d' correspond with a. But note that they are at equal angles either side of a. A person viewing a television from a reasonable distance cannot resolve the colours of small areas (the property of the eye which makes low definition colour signals adequate) and in particular tends to see the *average* colour of a adjacent scanning lines. This colour-integrating action of the eye can be represented by taking the average of the vectors b and d'. The viewer sees the colour e. This has exactly correct hue (angle) but is a little shorter than a. Thus phase errors cause only a slight loss of saturation of the coloured parts of the PAL picture and viewers are unlikely to notice this.

If phase errors are really gross, a critical viewer inspecting the picture will notice the line-by-line errors. The interlaced scanning of two fields in each frame causes a stroboscopic effect such that pairs of differently coloured lines appear to crawl up the screen. These are known as Hanover blinds, named after the exhibition where they were first demonstrated. They can be completely eliminated by using a receiver decoder circuit with a refinement which integrates the colour of adjacent lines electrically instead of relying on eye resolution.

To be continued . . . ●

SECAM

This system also uses a subcarrier to convey both colour difference signals but to avoid the need for phase-sensitive demodulation the subcarrier is *frequency* modulated. Only one colour difference signal can be sent at a time in this way so ($E_R - E_Y$) and ($E_B - E_Y$) are sent on alternate scanning lines. The absent colour signal on each line is replaced in the receiver by the colour signal sent on the previous line (by means of a one-line delay unit) thus vertical colour resolution is halved. This does not matter and the system provides good pictures under reception conditions that would ruin NTSC colour.

Objections to the SECAM system are its incompatibility with other systems, the small number of countries using it, and the highly specialized equipment needed to handle and record SECAM signals at the transmitter.

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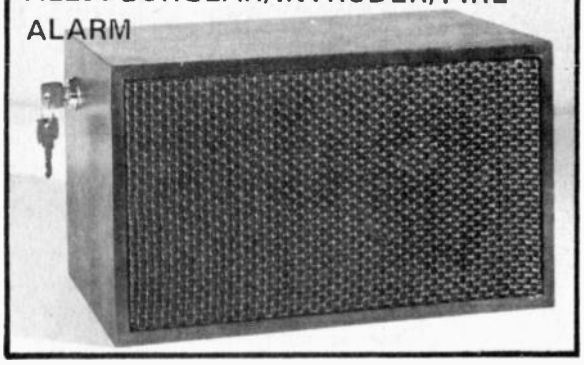

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XL250 BURGLAR/INTRUDER/FIRE ALARM

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The XL250 SECURITY SYSTEM offers the kind of professional protection you have been looking for at realistic prices. The "heart" of the system is the XL250 control module which uses custom designed CMOS technology to achieve the high reliability and low current drain essential for security systems. The XL250 can accept any sensor (open or closed circuit) and triggers instantly. A special feature is the programmable delay unit which can be added to the designated exit door to provide automatic exit/entry so the alarm can be set from within the house. The output of the alarm is an ear piercing electronic siren which automatically resets after about 10 minutes.

THE XL250 SYSTEM INCLUDES control console disguised as a loudspeaker box fitted with a key operated master switch with 2 keys, 5W horn loudspeaker (indoor/outdoor type), magnetic door/window switches, emergency push button, 100' hookup wire and security handbook. Operates on a standard 12 volt lantern battery.

12 months manufacturer's warranty: $66.00 incl. post and packaging.

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The RB200 SYSTEM INCLUDES RB200 alarm module, highly efficient electrical horn, on/off switch, wiring connectors, mounting hardware, 2 CARGARD warning decals and full step-by-step installation instructions.

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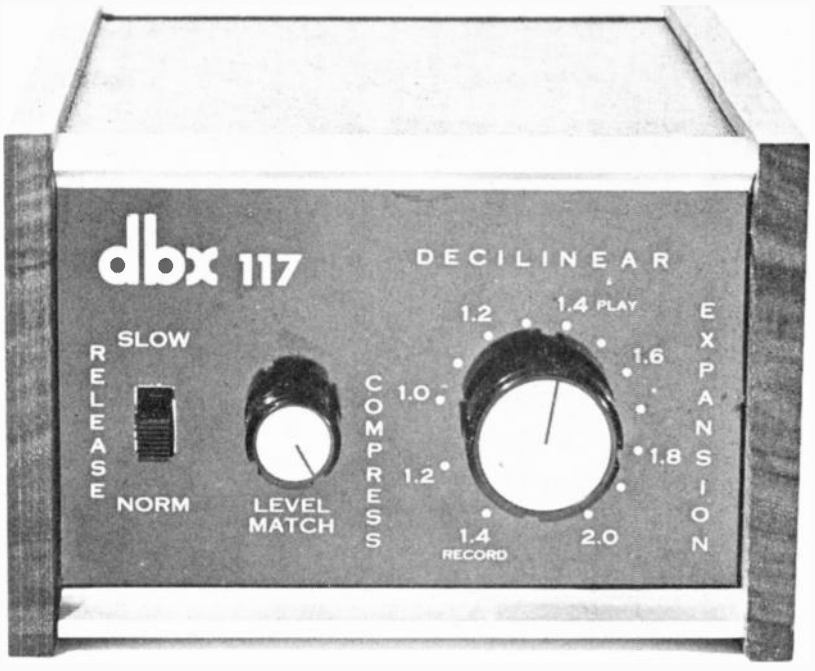
Enclosed is my cheque, postal note, money order for $..... I understand that the goods are covered by a 12 months warranty and a money back guarantee applies if I am not completely satisfied within 14 days of purchase.

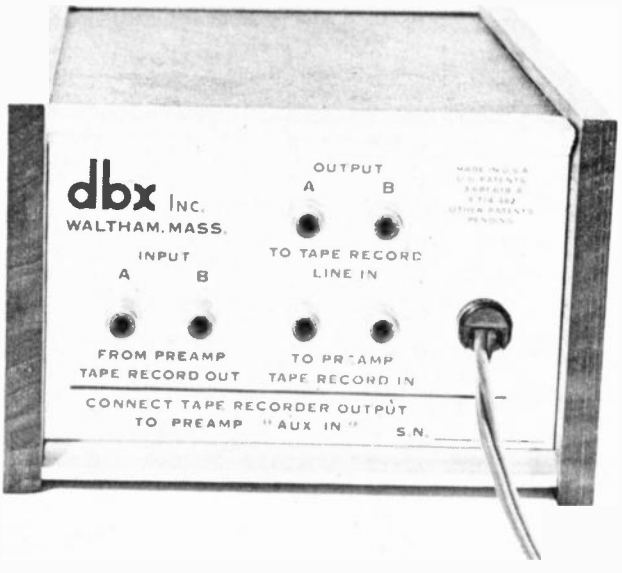
dbx 117 dynamic range enhancer



Recommended retail price $199

How to quieten noisy recordings

MANY OF US have tapes in either the reel to reel format or on cassettes which leave a lot to be desired in terms of signal to noise ratio. It is not that we necessarily made a bad job of the recording in the first place, but rather the limitations of our equipment and tape were generally just a little bit too much compared with what is available today. And because the signal to noise ratio is so poor, many of these tapes (and quite a few records as well) tend to lie on the shelf because of their audible inadequacies. Apart from this it is by no means unknown for commercially pre-recorded tapes and records to be below an acceptable standard.



Many people arbitrarily think that this problem is what the Dolby system is intended to resolve. But this is not so. The Dolby system helps *maintain* the original signal to noise ratio when recording from one medium to another but it has very little to offer when faced by *existing* inadequacies.

DYNAMIC RANGE

Another problem that plagues many of us is the poor dynamic range of our tape recorders or of the pre-recorded material that we buy. For example, the majority of cassette recorders are hard pressed to offer even a 55 dB dynamic range. Many of them offer little more than 40 dB. As if this were not bad enough, few records have a dynamic range exceeding 50-55 dB and even this is soon degraded to 40-45 dB decibels after a dozen or so playings in a dusty environment.

There are some records of course, such as the Sheffield Records 1, 2 & 3 with *Lincoln Mayorga and Distinguished Colleagues* which have a dynamic range in excess of 70 dB, but these are a exception to an otherwise general rule.

Clearly here are problems in search of a solution – and now somebody has come with a solution. It's called the dbx 117, and it's basically a device that expands the dynamic range of the signal and effectively reduces the apparent background noise of any audio signal.

The dbx 117 will be most commonly used for this purpose, but it may also be used to compress dynamic range – this may be useful for producing quiet background music or making recordings that will be used in areas with high ambient noise.

HOW IT WORKS

The basis for the dbx unit is the use of two distinct elements. The first is a very low noise controlled gain element with an exceptionally linear response. The second is a root mean squared detector (rms^2) which responds to the audio signal in a manner somewhat analogous way to that of the human ear.

Voltage controlled amplifiers control the input output current ratio for an

incoming signal. The outputs are connected to 741 integrated circuit operational amplifiers connected as a current to voltage converter.

The rms module has its circuitry arranged to have a similar offset tolerance to the 741s and has a virtual ground input type configuration. The 741's have the level of amplification and level match controlled by a simple circuit which controls a final 741 amplifier. This provides the expansion and compression ratio of the output.

The circuitry is capable of performing other functions. These include threshold type compression, limiting noise gating, multi-segment compression or expansion, etc.

The designers point out that two or more of these units may be operated in series to provide ranges of compression or expansion greater than that provided by a single unit. They are also quick to point out that such modifications, whilst feasible, should be avoided by all but those skilled in the art.

MECHANICAL CONSTRUCTION

The unit consists of a small wooden sided box and a black anodised front panel featuring only three controls. From left to right, a 'slow-normal' slider switch, a small level matching control the purpose of which is to adjust the output level so that it corresponds to the original input level during normal listening, and a somewhat larger knob which is calibrated for compression or expansion with graduations from 1.0 through to 2.0. The 1.0 corresponds to a 1:1 ratio of input to output signal, whilst the 2.0 corresponds to a 2:1 expansion ratio. Compression is limited to 1.4 which corresponds to a 20 decibel reduction in dynamic range with an original 70 decibel dynamic range input. Control is continuous but has calibrated steps at one-tenth points on the scale.

The back panel contains three sets of RCA coaxial sockets labelled input, output and line-in.

dbx suggest that the first two sockets be connected to the tape output jacks on your system, whilst the second pair be connected to the tape monitor jacks. The output from the tape recorder would then have to be connected to the auxiliary inputs on your main amplifier. In this manner the auxiliary switch mode would be used to play tapes and the tape monitor switch would effectively control the dbx 117.

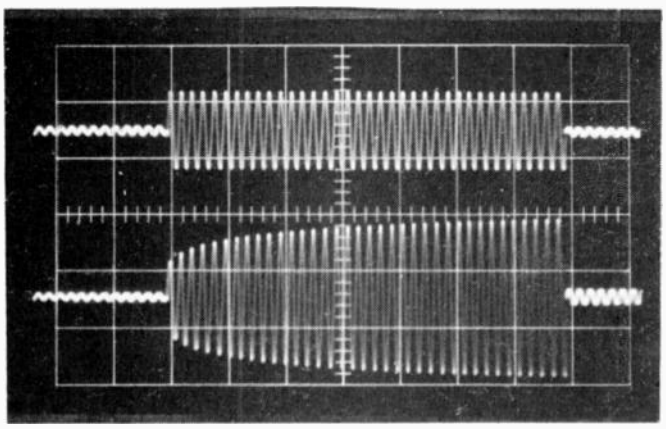
Where the unit is to be used with separate preamplifier and power amplifier, the dbx 117 may be interposed between the two thus leaving the tape monitor sockets free for their intended purpose.

The characteristics of the dbx 117 in terms of their compression and expansion are graphically portrayed below. It can be seen that significant expansion or compression can be achieved at the whim of the user.

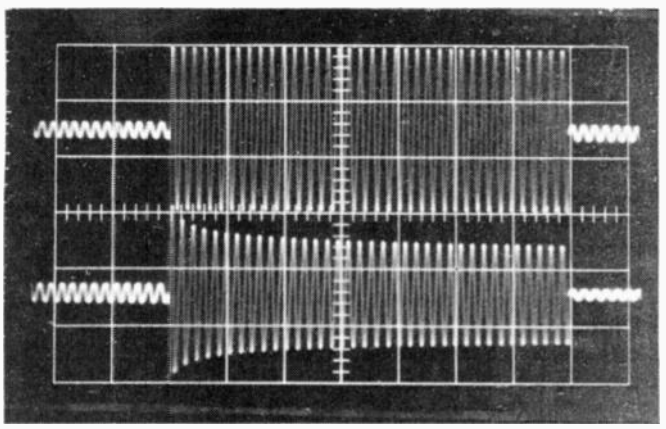
(As with all such equipment, the inveterate knob twiddler is warned that the unit can also produce results that are audibly inferior to the original sound unless proper and sensible control is exercised).

MEASURED PERFORMANCE OF dbx 117 DECILINEAR

Frequency Response:	20 Hz to 20 kHz ±1 dB	
Compression Expansion Ratio:	Continuous from 1.4 compression slope (14 dB output change for a 20 dB input change)	
	2.0 expansion slope (20 dB output change for a 10 dB input change)	
Dynamic Range:	Greater than 115 dB	
Signal to Noise Ratio: re 1 volt	110 dB	
Maximum Output Level:	10 volts rms (open circuit)	
Distortion:	Frequency	T.H.D.
(1.0 expansion ratio gain set for 1 volt output)	100 Hz	0.2%
	1 kHz	0.1%
	1.3 kHz	0.12%
Two:one expansion ratio (gain set for 1 volt output)	100 Hz	0.1%
	1 kHz	0.9%
	6.3 kHz	0.13%
compression ratio 1.1 (gain set for 1 volt output)	100 Hz	0.27%
	1 kHz	0.09%
	6.3 kHz	0.11%
Release Decay Time:	Constant rate of 140 dB/second in normal position or 50 dB/second in the slow position at 1.4 expansion ratio. (See photos)	
Dimensions:	145 mm x 96 mm x 230 mm	
Weight:	2 kg.	



1.4 expansion, 500 Hz at 10 ms/div (normal decay)



1.4 compression – other conditions as above.

The inside of the dbx 117 is neat and very professional, it consists of a high quality glass epoxy laminate printed circuit board featuring premium quality components, and three sealed boxes containing the rms2 amps which form the basis of the whole system. Two of these boxes have calibration sensitivities affixed showing that the respective units have been carefully matched for sensitivity.

The instruction manual has fifteen pages of useful information including circuit diagram, simple description of the circuit, and recommendations for trouble shooting.

HOW IT PERFORMED

We first used the dbx unit by playing ordinary records with average background noise. With an expansion ratio of 1.4 the original 50 dB dynamic range was expanded automatically to 70 dB decibels 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 – recorded at the Sydney Opera House. The tape used, whilst professional, was not one of the newer low noise tapes of the Scotch 206 or BASF LPR35 class, and was not Dolbyised as could have been expected. When played in the normal manner, tape hiss was quite prominent and the otherwise professional quality of the recording was significantly degraded. When played through the dbx 117 with an expansion ratio of 1.4 the problem all but completely disappeared and the music had a quality which could genuinely be described as sounding comparable with the original.

dbx suggest a number of other uses for this equipment. The first of these is to compress music which is intended to be used in background music systems. Having heard the standard programmes put out by Musak, Seeburg, and others, we tend to think that they have already utilised this or a similar concept. By using compression, the obtrusiveness of the music is reduced and its sense of envelopment and masking qualities enhanced. (*There are many people who object to this concept. We are not proposing it nor endorsing it as an acoustical panacea!)*

Like many good things the dbx 117 can be mis-used, particularly in the expansion mode. If the expansion ratio is taken much above 1.4 – 1.6, the quality of the sound is impaired and certain features of the music, particularly vocal pieces, sound unreal.

There is a general impression of instability and an unpleasant 'breathing' becomes only too apparent.

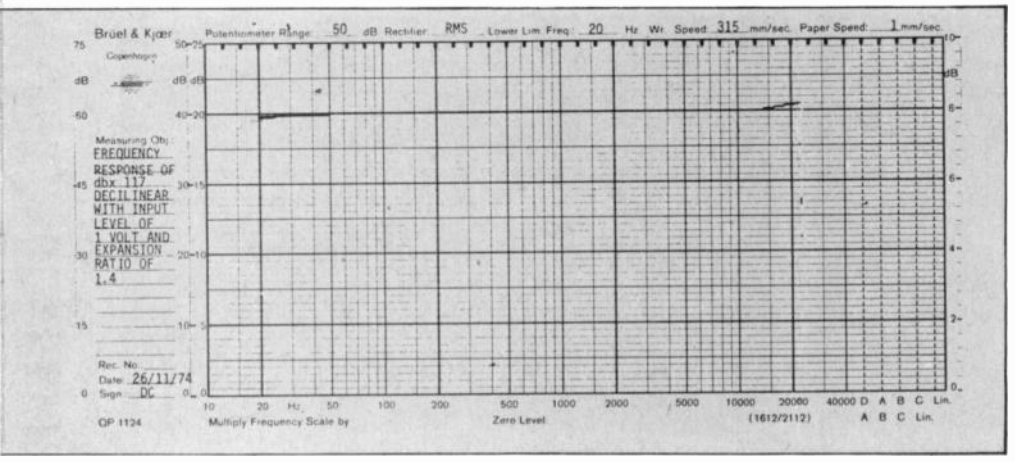
But used sensibly, the unit is a revelation – particularly when used with old or even antique recordings.

The electrical characteristics of the unit are particularly good. Although not highlighted by the manufacturers, distortion is particularly low, and, at the 1 volt level with expansion ratios lying between 1 and 2, or compression ratios down to 1.4, it does not exceed 0.3%.

The dynamic range, signal to noise ratio, and frequency response are right up to the manufacturer's claims and more than adequate for the majority of professional, quite apart from amateur, applications.

Used judiciously and with a little common sense this unit would be a particularly useful adjunct to either a recording system, playback system or home entertainment system.

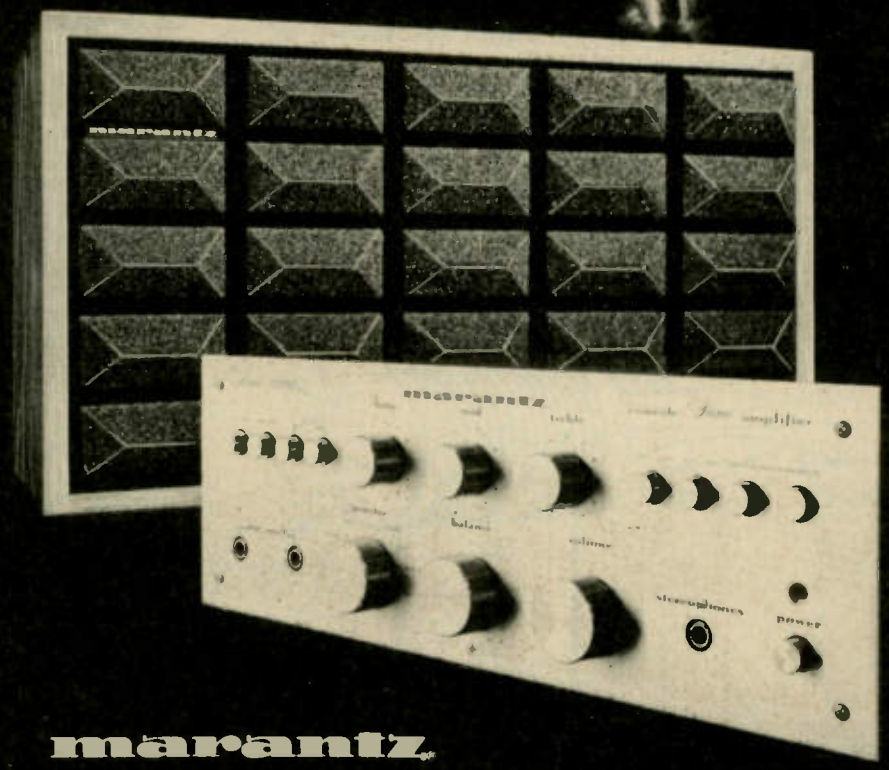
The designers have achieved what they set out to do and until such time as digital recording with dynamic ranges of the order of 80 decibels or greater become a feature of the high fidelity scene, the dbx 117 must be one of the most effective means available for improving the dynamic range and signal-to-noise characteristics of a high fidelity system. ●



The Marantz model 1060 has a combination of features that make this model very desirable. In fact, we would say "un quely desirable". For one thing it has earned the reputation as the standard by which other medium powered amplifiers are judged. Not only in Australia, but in every country where Marantz s sold. What is more, reviewers, critics and owners world-wide acclaim the 1060 as superior. There's unanimous agreement. It simply sounds better. After all "we sound better" is Marantz's pledge. And Marantz's name is your guarantee that you're buying the very best. For brochure and list of stockists write to: Auriema (A'asia) Pty Ltd, 15 Orchard Road, Brookvale, NSW 2100. Phone 939 1900.

Features: Power output 50 watts total continuous (typically 90). Distortion less than 0.5% IM or THD at any frequency and ary power level within rating (typically 0.1%). Stepped tone control for bass, treble ard midrange. Two tape inputs. Hi and low filters. Front panel microphone inputs. Speaker switching. Headphone jack. Pre-out/main-in amplifier jumper plugs. Three year warranty for parts, labour and specifications.

very desirable



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PART 14

Simple power supplies.

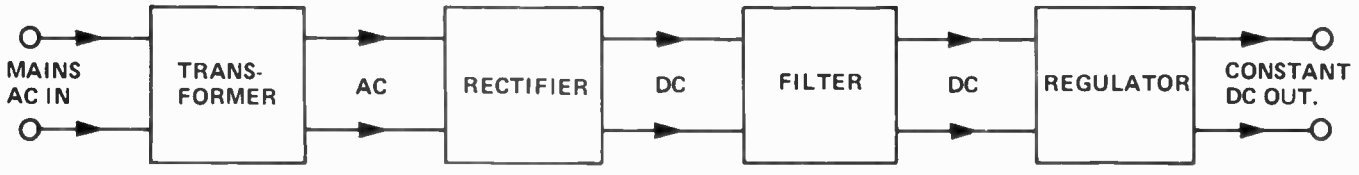


Fig. 1. The various sections required in the process of converting the ac mains supply into a source of dc power.

AN AC SUPPLY provides a sinewave current that changes direction at the supply frequency. Firstly, the ac voltage has to be transformed to the appropriate voltage level. To obtain dc a switch (the rectifier) is needed to reverse polarity of alternative half cycles. This done, all that remains to be added is a method of smoothing out (filtering) the half-sinusoids to obtain a steady current. We will look at each of these steps in turn.

TRANSFORMERS

The principles of inductance were briefly introduced in Part 6 of this course. We suggest that the section be read again.

If two inductors A & B are placed such that the axis of their coils align (as in Fig. 2), and coil A is energised with an ac source a voltage will be generated across coil B.

As we move the coils closer to each other the voltage developed, across coil B, approaches a value which is proportional to that across coil A. The proportion will be equal to the ratio of the number of turns on B, to the number of turns on A.

$$\text{ie } \frac{E_B}{E_A} = \frac{N_B}{N_A}$$

Where E_B = voltage across coil B
E_A = voltage across coil A
N_B = turns in coil B
N_A = turns in coil A

The effect is due to the field of one coil cutting the turns of the other and is known as mutual inductance. If the coils are wound on top of each other, and an iron core is used, the coupling is improved to almost unity and we have a device capable of changing ac voltage from one level to another. Such a device is known as a transformer.

There are losses in the transformer due to the resistance of the wire in the coils — these are known as copper losses, and in the iron of the magnetic core — these are known as iron losses.

A transformer can never *create* power — it can only transfer it and change voltage levels. Small transformers have power efficiencies from 60-90%; 85% is typical.

To reduce the iron losses as much as possible the core material (at frequencies below 20 kHz) is usually a special silicon steel called "transformer iron". The core is built up of thin laminations of this iron individually insulated by a thin coating of lacquer. By this means eddy current (circulating currents within the core) losses are reduced to a minimum.

Note particularly that the transformer is an ac device. It will *only* produce voltage in the secondary winding when there is a current change in the primary. A dc current flowing in the primary will not produce a secondary output.

The iron laminations retain the magnetic field ensuring virtually total magnetic linkage between coils. For high frequencies, up to several megahertz, ferrite powder mouldings are often used. In many high-frequency applications, the ferrous magnetic circuit is omitted altogether. Figure 3 shows a range of transformers for use at various frequencies.

In mains-operated power supplies the relatively low frequency of the mains leads to efficient coupling. Hence the ratio of input/output voltage is as the ratio of input turns/output turns. A transformer is, therefore, selected to provide the correct voltage (stepped down or up) and must be designed with wire in each winding heavy enough to carry the currents needed without overheating. Usually selection of a transformer is made from manufacturers' product lists using the nearest listed, with any difference being on the conservative side — higher voltage or higher current capability when the exact requirement is not available. The power capacity of transformers is stated as the volt-amp

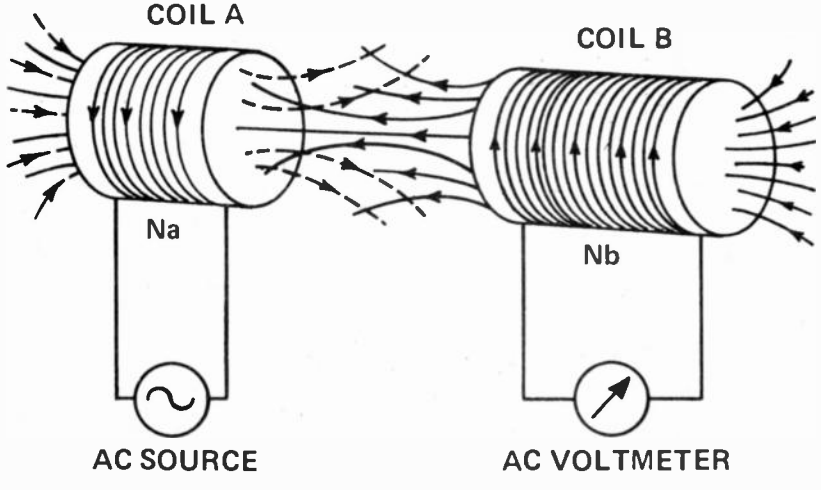
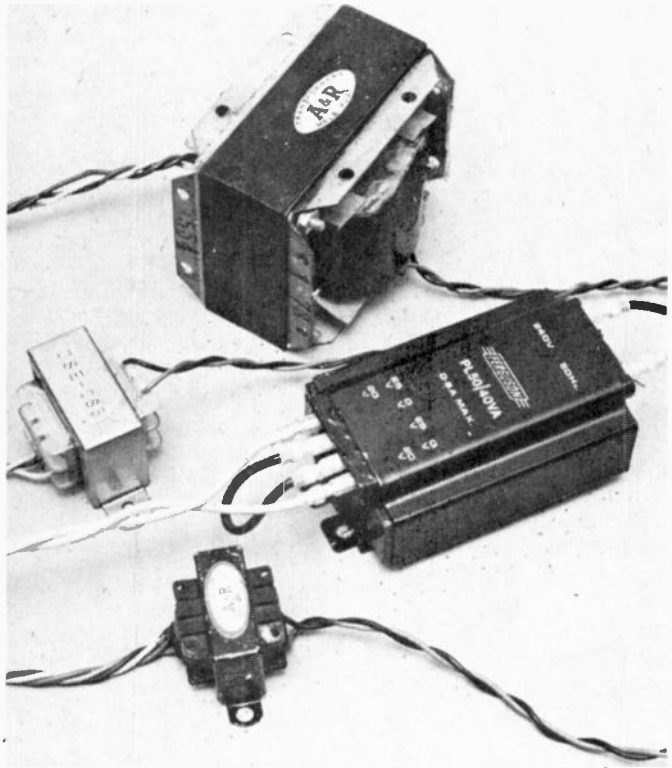
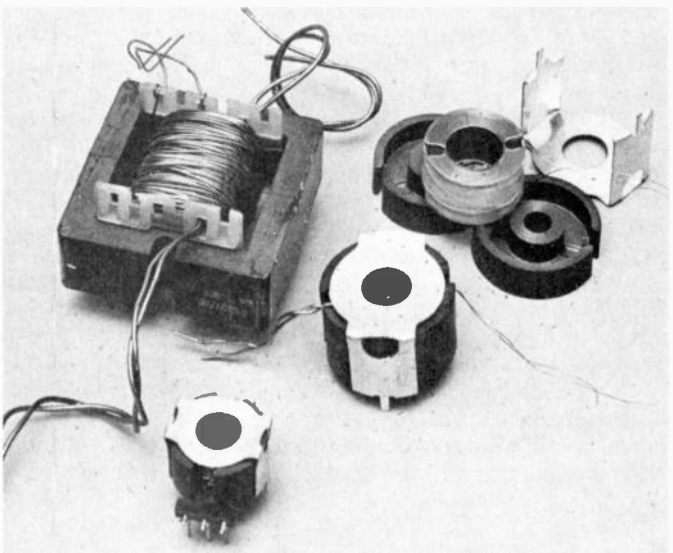


Fig. 2. Transformer relies on the principle that when lines of magnetic force move through a coil, a voltage is induced in the coil which is proportional to the number of turns in the coil.





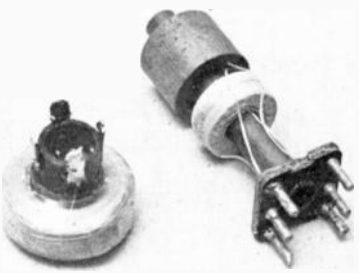


Fig. 3. The design of a transformer depends greatly on the frequency of operation and the amount of power to be handled.
At low frequencies (eg 50 Hz mains) a laminated silicon-steel core is required, (TOP LEFT).
At medium frequencies a ferrite core or slug may well be used to adjust as well as increase inductance (50 kHz to several MHz).
At high frequencies (eg 50 MHz and above) air spaced coils may be all that is necessary, (RIGHT).

Fig. 4. These characteristics of common rectifier arrangements will help you select a transformer to obtain a particular dc output.

COMMON RECTIFIER ARRANGEMENTS

	1 Cycle Output Waveform	Average dc Volts Output	RMS Volts at Output	Peak Volts Output	Peak Reverse Rectifier Voltage	Percent Ripple RMS/dc out
(A) 1 ϕ HALF WAVE		1	1.57	3.14	3.14	121%
(B) 1 ϕ FULL WAVE CCT		1	1.11	1.57	3.14	48%
(C) 1 ϕ FULL WAVE BRIDGE		1	1.11	1.57	1.57	48%
(D) 3 ϕ STAR (WYE)		1	1.02	1.21	2.09	18.3%
(E) 3 ϕ BRIDGE		1	1.00	1.05	1.05	4.2%

product of the total output or input. This can be found as the sum of volts times amps of all of the secondary output circuits plus about 10% for losses.

All transformers have rms rated outputs. In practice this voltage is the *unloaded* output voltage and may vary from transformer to transformer. Additionally, because of the finite winding impedance, the transformer output will drop when loaded. This effect, known as transformer 'regulation', is quoted as the percentage voltage between load and no-load. In prototype designs it is therefore advisable to use a transformer with a number of tappings so that the correct rms output may be selected on test.

RECTIFIER STAGES

Many different rectifier systems may be used, Fig. 4 shows the most commonly encountered. together with their schematic diagrams and relevant conversion factors. Note that the dc output *is not* the same as the ac input. A mistake commonly made by beginners is to assume that the dc output from the rectifier will be the same or less than the rms output from the transformer.

A single rectifier , as in A, gives half wave operation only and clearly, whilst saving a rectifier element, only allows half the sine-wave through with a resultant drop in average dc output. The gain in saving rectifier elements is offset by the need to provide a higher output voltage from the transformer and a more powerful filter to smooth out the pulsating dc current (121% ripple!).

Clearly, fullwave rectification (that is, use of both half cycles) is better but it requires more rectifiers. There are two main methods. One uses four rectifiers to create a 'reversing' switch — the so-called bridge circuit. Output current from the transformer of one polarity passes through to the filter stage using two of the rectifiers; the next direction of current is then allowed through by the second pair which are connected to accept reverse current polarities. An alternative full-wave method uses only two diodes instead of four. It works as two half-wave systems that alternately connect to the common filter terminals with the same polarity. It uses less rectifier elements than in a bridge circuit but requires a centre-tapped transformer. Rectifier diodes for bridge circuits are available ready-packaged as a full 4-element bridge in a common encapsulated unit.

Where a three-phase (the normal industrial high-power mains) supply is available, other rectifier arrangements are possible — as shown. As the number of phase half-cycles used is increased the dc produced becomes smoother, relaxing the degree of filtering needed. Other more sophisticated six-phase systems (using special transformers) are used industrially.

Originally, rectifier elements were either vacuum-tube diodes (two-element tubes) or specially made contacting surfaces of copper oxide or selenium. Although both of these are still in service, they have been more or less superseded by modern solid-state, two-layer semiconductor diodes (in the simplest form) and by the family of multiple-layer semiconductor devices in which the current can be controlled as well as being rectified. (These devices, SCRs and TRIACs, will be covered later.)

Virtually all diodes designed for power rectification are now silicon devices — although germanium still finds some use for low-power, signal-detection diodes. The power handling capability of a diode depends upon the voltage drop across it and the current flowing through it. These determine the heat to be dissipated at the diode junction. Provided the *junction* itself is maintained below its maximum safe value, all is well. Heat sinks are usually used to help liberate this waste heat, thereby raising the current capacity of the rectifier units. When selecting diodes for power use it is necessary to ensure that they can safely withstand the peak reverse voltage of the waveform — this can be as much as three times the quoted ac value (which is usually the rms value). In the manufacturer's data this is shown as the peak inverse voltage (PIV). In a half-wave circuit supplying, say, a 100 Vdc output, the peak inverse voltage rises to 314 V!

Diodes come in all shapes and sizes as Fig. 5 shows. Large power diodes are intended to be mounted on heat sinks and the manufacturers have built them accordingly to ensure good thermal contact. Special heat-sink extrusion is made for this purpose.

Individual diodes in a bridge circuit must be insulated from one another — nevertheless it is often convenient to mount them on a common heat-sink. Mica washers are often used for this purpose as they provide good electrical

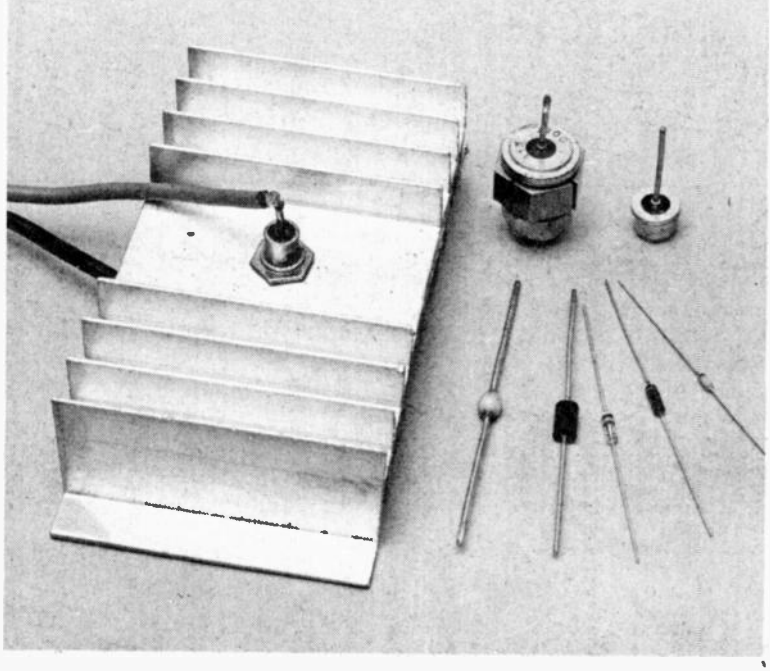
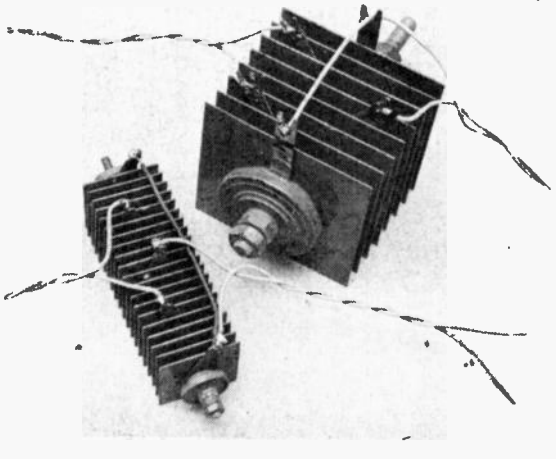


Fig.5a, A selection of commonly used solid state rectifiers. High-power diodes are sometimes mounted on a heatsink to help radiate the heat generated due to internal losses.

Fig.5b, Selenium rectifiers were quite bulky but were extensively used in valve radio days.



insulation whilst allowing heat to be pass through.

The current rating needed of the diodes depends upon the rectifier circuit. If half-wave it must be able to handle the full current expected. For full-wave bridge or centre-tapped single-phase arrangements, the diodes only switch on alternate half cycles and, therefore, can be rated for half the output load current. Special care must be used when silicon diodes are used. The initial onrush of current to the uncharged filter capacitors can exceed the safe maximum of the diodes unless adequate limiting resistance exists in the transformer winding or input leads. Typically, the peak current may be as much as 10 times the average dc current.

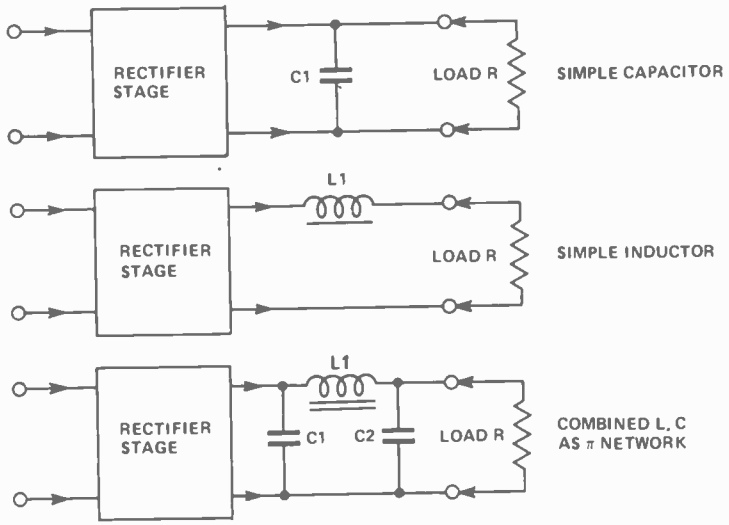


Fig.6. Various types of filter may be used to smooth the pulsating dc from the rectifier. (a) a simple capacitor (b) a simple inductor. (c) a combination of capacitance and inductance (pye filter).

FILTERING

The output of any rectifier system consists of a train of half-sinusoid waveshapes. We know that all waveshapes can be constructed by adding a number of pure sinusoidal signals. Thus the rectifier output is a complex waveshape containing a basic dc level plus many other frequencies. To smooth the signal, therefore, a low pass filter is needed that rejects all frequencies above dc (frequency of zero).

Several alternative methods of filtering are available. The commonest, shown in Fig. 6, is to use a large value shunt capacitor across the output terminals. At each new half-cycle the diodes pass a burst of current into the capacitor to recharge it, making up for charge drawn by the circuit load on the supply. By appropriate choice of capacitor size for a given load and adequately low bridge resistance (this decides how quickly the charge will enter the capacitor), the supply can be made to hold a voltage up near the peak value of the waveform. However care must be taken to ensure that the peak current rating of the diodes is not exceeded.

In applications where a relatively large power level is involved it may be more economical to use another method. The shunt capacitor method, above, provides a short-circuit path to high frequency signals (capacitive reactance falls with increasing frequency) thereby shunting them away. Only dc is unattenuated. The same effect may be achieved if an inductor is used, as shown in Fig. 6 — but this time in series with load. The inductor provides lowest impedance to lowest frequency so dc passes virtually without loss (provided the dc resistance of the winding is low — hence the high cost of effective filter inductors) but provides increasing impedance as the signal frequency rises.

These two basic methods can be taken further again using both together to increase the frequency rejection. We will not pursue the design of sophisticated power supply filters for they tend to be rather specialised. Note, however, that the filtering effect depends largely upon the magnitude of the load current drawn. This can be seen by regarding the filter component reactance and the load impedance as a series or parallel network (see Fig. 7) in which the supply voltage is the output produced across the load impedance.

An increasing load current occurs due to a reduction in load impedance (usually regarded as a resistive load). The series inductive method provides less ripple (the name given to the ac component-present) as the load increases. On the other hand, with the capacitive shunt method the ripple increases as load increases. Hence the two methods complement each other and (as neither is ideal) the two are combined in more advanced filtering methods.

It should now be clear that the rectifier stage design will largely determine the specification of the transformer and that the filter method

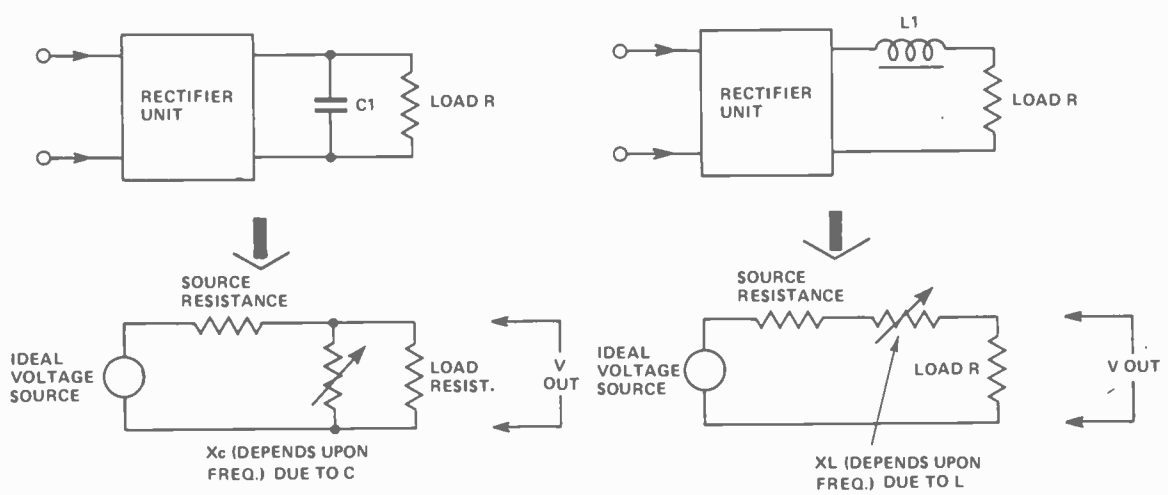


Fig. 7. The performance of a simple filter may be evaluated by replacing the capacitor (etc) by its equivalent resistance at the ripple frequency. Thus we have a voltage divider due to this and the source impedance. We may also from such equivalent circuits calculate the degree of regulation for any given load.

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must also be considered in the overall design.

Power supply design is not as straightforward as might at first be thought. Each stage determines the requirements of the other stages so a certain degree of skill and experience is needed to reach a satisfactory design. Furthermore, as we will see later, the design must also make allowances for the way the supply is to be used and for the method of stabilisation employed.

POWER SUPPLY TERMS

The two forms of power supply – voltage or current – as we have seen earlier, can be represented as black boxes which consist simply of a source (voltage or current) and an equivalent resistance value. A voltage source ideally maintains the required voltage regardless of load current. A current source, the reverse situation, provides the required current regardless of output voltage. Practical supplies have a finite resistance value (the ideal of zero output impedance is unobtainable) but it is possible to produce a circuit that is close enough to the ideal for practical purposes.

Let us now see what happens to a voltage supply as the load current increases. We see from Fig. 7 that the voltage appearing across the load is that produced by a perfect generator driving a divider chain. Hence, provided the source resistance is much smaller (at least ten times smaller) than the minimum load resistance, the change in voltage across the load as the load current varies will be negligible. The aim, therefore, in good voltage supply design is to produce a unit with low internal resistance. Factors of one thousandth are typically obtained.

Constant voltage supply is by far the most common requirement, but there are also many applications for constant current supplies. In addition there are other supplies available with special characteristics.

Because of finite internal power-supply resistance the voltage output of basic supplies (caused in reality by the resistance of the diodes, transformer losses and filter resistances) drops as the load current increases. All these effects produce voltage drops that subtract from the original voltage source. The ratio of, no load voltage (less full load voltage) to the no load voltage is called the regulation of the supply. This is expressed as a percentage.

IMPROVING REGULATION

In some instances, battery supplies for example, the internal resistance is adequately low and the output remains reasonably constant with time and changing load. A lead-acid storage battery for example will provide voltage constant to about 0.1% for quite a long time as long as the load is fairly low.

Mains derived supplies, however, exhibit poor regulation, unless (costly) stabilising circuits are added. Apart from this their output is also proportional to changes in mains voltage – which can fluctuate by as much as ±10%.

In many electronic systems the voltage must remain constant regardless of changes of mains input and load and changes in component values with time. Consequently, basic sources of dc power are often followed by a unit known as a regulator. Its role is to maintain the output constant to a chosen degree (0.1% changes in output due to load or input changes is typical). The degree of stability obtained relates to cost. Techniques cover a wide range – from a single special diode and a resistor, to multiple transistor circuits and special purpose IC's.

Power systems such as these will be covered in the next part of this series.

Further Reading:

"D.C. Power Supply Handbook" – Hewlett Packard, 1973.
Power Supplies" – B. Doherty, Pt. 1. E.T.I. September, 1971. Pt. 2 E.T.I. October, 1971.
"Battery Revolution" – E.T.I. September, 1971.
"Power Supply Handbook" – Kepco Inc. (1966) Flushing, N.Y. 11352, U.S.

ELECTRONICS – in practice

THIS month's project will provide more experience in the use of operational amplifiers. The circuit uses two amplifiers, illustrates a number of new points and provides a very useful piece of equipment.

A MIXER-PREAMPLIFIER CIRCUIT USING OP-AMPS

The signal provided by a sensor operating at audio frequencies, eg a microphone, a guitar-string vibration sensor, a record-player cartridge – needs boosting before the signal is used to drive a main amplifier or recording unit. The preamplifier shown here accepts signals of around 2 mV level, has an input impedance of

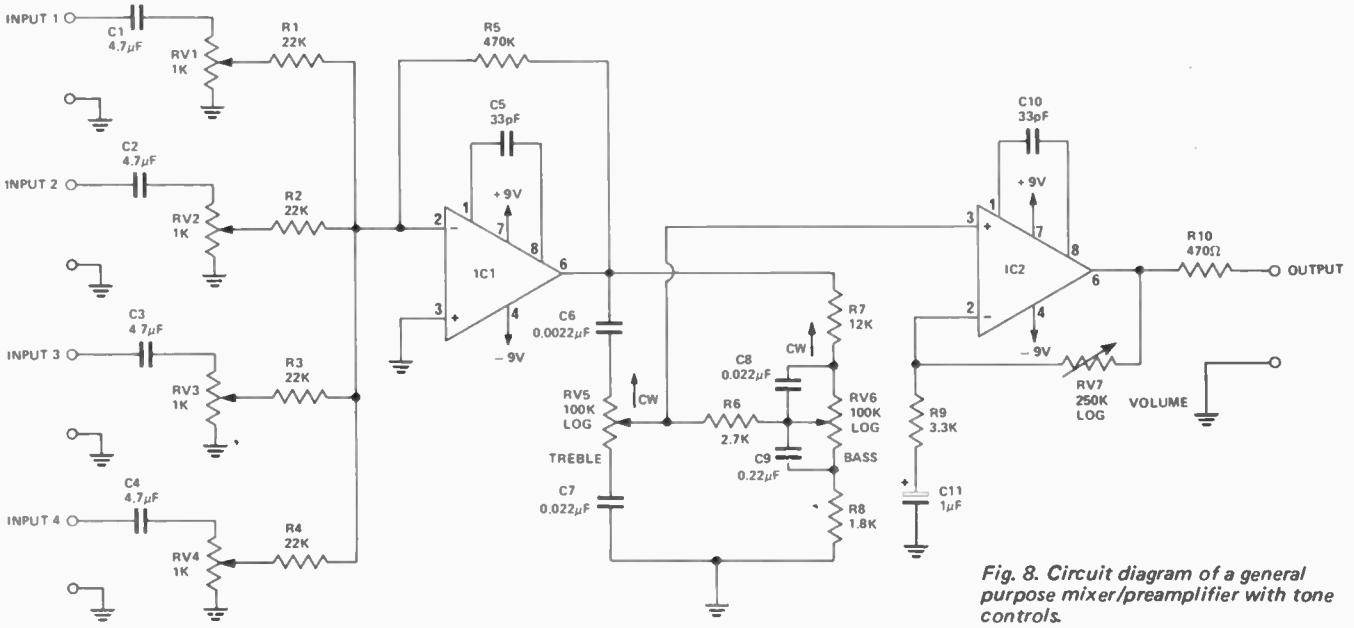


Fig. 8. Circuit diagram of a general purpose mixer/preamplifier with tone controls.

1 k, provides a gain of approx. 1600, and has an output swing of up to 3.2 V for 2 mV input. It introduces comparatively little distortion and is designed to accept four inputs, each having a level control. A special tone control network is incorporated that enables bass and treble signal frequencies to be varied over ±10 dB (at 100 Hz and 10 kHz respectively). Although primarily intended for mixing audio signals in entertainment applications, the circuit can also be used as a single-input, variable-gain unit in any application where gain and frequency adjustment are needed.

OPERATION OF THE MIXER-PREAMPLIFIER

Each input of the circuit given in Fig. 8 is ac coupled and has an attenuating potentiometer that allows the gain of each input channel to be independently adjusted as required. Four such inputs are summed by an inexpensive IC op-amp, connected as a summation circuit, having a maximum stage voltage gain of around 20 (25 dB).

The output of this stage feeds the next stage via a conventional tone control network which either attenuates or boosts bass and treble frequencies according to the settings of each potentiometer. Note that the second stage op-amp is connected as a non-inverting (the output signal has the same polarity as the input) single-input amplifier stage having a maximum gain of about 80 (37 dB). The feedback resistor, in this case, is a potentiometer allowing the overall gain of the unit to be varied. Thus this potentiometer acts as a master gain control.

In the circuit diagram (Fig. 8) the power supply connections are not shown. This is usual in op-amp circuitry to avoid over complicating the diagram. The connections are – positive to pin 7 and negative to pin 4. These connections are, of course, made on the printed circuit board.

A simple power supply (Fig. 9) may be used if batteries are unsuitable. This provides the positive and negative

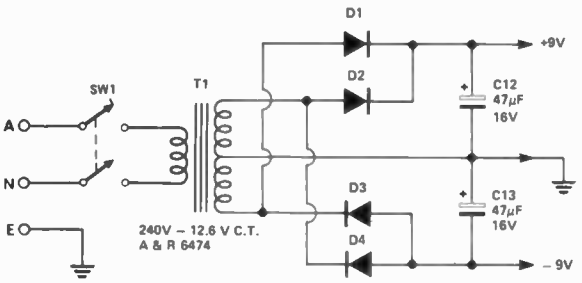


Fig. 9. Circuit diagram of an unregulated power supply suitable for use with the preamplifier of Fig. 8.

supplies necessary for the op-amp. At first glance the circuit appears to be that of a full-wave bridge. In reality it is two separate supplies, driven from different sides of a centre tapped transformer, each being connected in the opposite way to provide opposite polarities.

Note that the transformer supplies a total of 12.6 volts rms, that is 6.3 volts on either side of the centre tap. This, when rectified and filtered, provides 9 volts dc (capacitor charges to peak of waveforms that is $\sqrt{2} \times 6.3 = 8.9$ volts). Hence the capacitors must be rated for at least 9 volts – a little more is usual, say 12 volts, but not too much higher as the rated capacity of some capacitors falls if not worked at near full design voltage.

The diodes must have a peak-inverse rating of *twice* the peak voltage, 18 volts in this case, because at the time when the diode is non-conducting it has the charged capacitor voltage on one side and the full peak reverse voltage from the transformer on the other. In practice modern silicon power diodes have voltage ratings starting from about 50 volts and the EM401 specified is rated at 100 volts – much more than is required.

BUILDING THE UNIT

A printed circuit-board layout for the pre-amplifier is given in Fig. 10 along with the component overlay that shows where each component is placed. Take particular note of the polarities of the diodes, the ICs and the electrolytic capacitors when fitting them to the board.

The power supply components (watch the mains connections – they must be made safe) and the board may be conveniently housed in a diecast box or one of the plastic (Clipsal) boxes made for electrical use. Mark each control clearly for ease of operation. ●

Parts List for mixer/preamplifier

R1	22 k	½ watt	5%
R2	22 k	½ watt	5%
R3	22 k	½ watt	5%
R4	22 k	½ watt	5%
R5	470 k	½ watt	5%
R6	2.7 k	½ watt	5%
R7	12 k	½ watt	5%
R8	1.8 k	½ watt	5%
R9	3.3 k	½ watt	5%
R10	470 k	½ watt	5%
RV1	potentiometer		1 k log.
RV2	"		1 k "
RV3	"		1 k "
RV4	"		1 k "
RV5	"		100 k "
RV6	"		100 k "
RV7	"		250 k "
C1	4.7µF	10V	
C2	4.7µF	10V	
C3	4.7µF	10V	
C4	4.7µF	10V	
C5	33 pF ceramic		
C6	0.0022µF polyester		
C7	0.022µF	"	
C8	0.022µF	"	
C9	0.22µF	"	
C10	33 pF ceramic		
C11	1µF 25 V tag tantalum		
C12	47µF 16 V electro. P.C. mount		
C13	47µF 16 V electro. P.C. mount		
IC1	LM301A		
IC2	LM301A		
PC Board	ETI 419		
SI	DPDT toggle switch, 400 V, 1 AMP		
T1	transformer A + R 6474 or similar		
D1	4 EM 401 or similar		

Constructional kits for project ETI 419 are suitable.

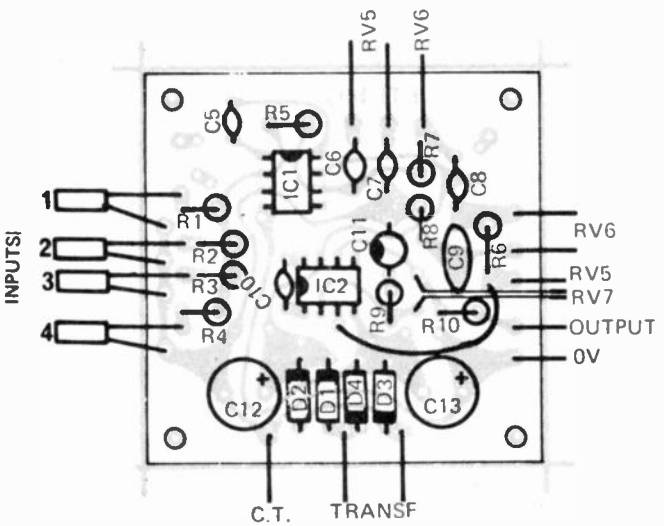


Fig. 10a. Printed circuit board for the mixer preamplifier. (b) Component overlay for the preamplifier incorporating the components for the ac power supply (except the transformer).

HAM RADIO SUPPLIES

MAIL ORDER SPECIALISTS

67-7329 323 Elizabeth Street, Melbourne (2 doors from Little Lonsdale Street) 67-4286

SOLID STATE 19 TRANSISTOR MULTI-BAND RADIO – 9 RANGES

$79

AM, SW, FM, VHF, AIR, PB
BATTERY/ELECTRIC
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 and AC cord. $79.00 p.p. $1.40

SPECIAL NOTICE TO PURCHASERS OF RADIO RECEIVING AND TRANSMITTING EQUIPMENT.

The words "PMG approved type" in our advertisements do not mean that this equipment is covered by a PMG licence. But the equipment is of a type approved for licence application. Individual purchases of radio receiving and transmitting equipment must obtain a licence to operate from the PMG radio branch in their particular state. Some equipment sold by us cannot be licensed and therefore can only be operated by licenced amateurs. K.J. MILLBOURN

AM/FM/AIR-PB-WB SOLID STATE VHF MONITOR

$39.00

battery electric

SPECIFICATIONS

Transistor: 12 Transistor, & 8 Diode; Frequency: FM 88-108 MHz, AM 540-1600 kHz, AIR-PB108-174 MHz; Power Output: Maximum 500 mW, Undistorted 280 mW; Speaker: 3" 8 ohms; Earphone: Magnetic 8 ohms; Power Source: DC 6V UM-2 x 4 pcs. or AC 230 Volt; Antenna: Ferrite bar for AM, Rod antenna for FM/AIR-PB-WB; Controls: Volume (w/on³off switch); Selector (AM/FM/AIR-PB-WB); Accessories: Earphone & batteries; Dimensions: 3 3/8" x 6¼" x 9¾"; Weight: Approx. 3 lb.

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 Citz. Band
Transmitter Frequency Tolerance: ±0.005%
RF Input Power: 1 Watt
Tone Call Frequency: 2000 Hz
Receiver type: Superheterodyne
Receiver Sensitivity: 0.7μV at 10 dB S/N
Selectivity: 45 dB at ±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.
Price $49.50 per unit or $99.00 pair

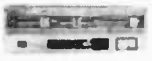
PROJECT KITS

Popular Gakken and Scienceland Electronic Kits, ideal for beginners, Completely safe, no soldering, learn electronics with each project.

Crystal Set Kit	$5.50
10 Project Kit	$10.90
15 Project Kit	$11.50
50 Project Kit	$23.50
100 Project Kit	$27.95
150 Project Kit	$35.00

P & P extra

CASSETTE CAR STEREO WITH 4 IC'S



Australia's best value in cassette players. Check these features:
Mini sized modern styled slide controls • Easily fitted under dash with no protrusions • Full variable tone, balance, volume and fast forward controls • New sideways cassette loading • Latest solid state and IC circuitry.

12 VOLT NEGATIVE EARTH
PRICE $65 WITH SPEAKERS

$79.00 a pair
Single units $39.95, each.

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 — 2¼" PM type (built-in) function as microphone on transmit.

SCOOP PURCHASE!

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.

SPECIAL INTRODUCTORY PRICE $59

SPECIFICATIONS

CIRCUIT: 16 transistors, 15 diodes, 1 varistor and 2 rectifiers. FREQUENCY RANGE: AM 535-1605 KHz, FM 88-108 MHz, TV1 56-108 MHz, TV2 174-217 MHz, AIR/PB2 110-174 MHz and WB 162.5 MHz. POWER SOURCE: DC 6 Volts/240V. AC. POWER OUTPUT: 350 mW (Maximum) 250 mW (Undistorted). DIMENSION: 9 3/8" x 3 3/4" x 8". WEIGHT: 4 1/4 Lbs. (approx). SUPPLIED ACCESSORIES: Earphone, Batteries (4 size D).

MULTIMETERS

AS-100D/P $34.50

High 100,000 Ω/Volt sensitivity on D.C. Mirror scale. Protected movement.
AC/V: 6V, 30V, 120V, 300V, 600V, 1200V (10,000Ω/V).
DC/V: 3V, 12V, 60V, 120V, 300V, 600V, 1200V (100,000Ω/V)
DC/A: 12μA, 6mA, 60mA, 300mA, 12A.
OHM: 2kΩ, 200kΩ, 20MΩ, 200MΩ
db: -20 to +63db.
Audio Output: 6V, 30V, 120V, 300V, 600V, 1200V AC
Battery: Internal
Approx. size: 7½" x 5½" x 2¾"

THIS MONTHS SPECIAL

Magnavox 8-30 speakers $14.95

MODEL OL-64D/P MULTIMETER $21.95

20,000 ohms per volt. DC volts: 0.025, 1, 10, 50, 250, 500, 1000 (at 20K o.p.v.), 5000 (at 10K o.p.v.). AV volts: 0-10, 50, 250, 1000 (at 8K o.p.v.). DC current: 50uA, 1mA, 50 mA, 500 mA, 10 amps. Resistance: 0-4K, 400K, 4M, 40 megohms. DB scale 20 to plus 36 dB. Capacitance: 250pF to 0.02uF. Inductance: 0-5000 H. Size: 5¾ x 4-1/6 x 1¾ in.

CT-500/I. $19.95

Popular, medium-size, mirror scale. Overload-Protected.
AC/V: 10V, 50V, 250V, 500V, 1000V, (10,000Ω/V)
DC/V: 2.5V, 10V, 50V, 250V, 500V, 5000V (20,000Ω/V)
DC/A: 50μA, 5mA, 50mA, 500mA.
OHM: 12kΩ, 120kΩ, 1.2MΩ, 12MΩ
db: —20db to +62db.
Approx. size: 5½" x 3-5/8" x 1¾". p.p. 50c

A-10/P $55 p.p. $1

Giant 6½" Meter, inbuilt signal injector. Overload Protected.
AC/V: 2.5V, 10V, 50V, 250V, 500V, 1000V, (10,000Ω/V).
DC/V: 0.5V, 2.5V, 10V, 50V, 250V, 500V, 1000V at (30,000Ω/V) 5000V (10,000Ω/V).
DC/A: 50μA, 1mA, 50mA, 250mA, 1A, 10A.
OHMS: 10kΩ, 100kΩ, 1MΩ, 100MΩ
db: —20 to + 62dB
Signal Injector: Blocking oscillator circuit with a 2SA102 transistor.
Approx. size: 6-2/5" x 7-1/5" x 3-3/5".

H10K1 MODEL L 55 FET MULTITESTER

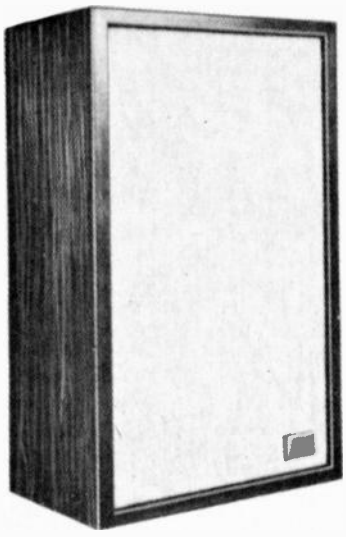
This amazing instrument features a 20 Meg ohm input impedance, 36 ranges from 300 mV full scale to 1200 volts and can measure as low as .2 ohm! Comes complete with probes and carry case.
$42.95 p.p. 75c.

MODEL C1000 $8.95 p.p. 50c

Is the ideal low cost pocket meter.
AC volts: 10V, 50V, 250V, 1000V (1000Ω/V).
DC volts: 10V, 50V, 250V, 1000V, (1000Ω/V)
DC current: 1mA, 100mA
OHMS: 150kΩ
Decibels: -10db to +22dB.
Dimensions: 4¾" x 3-1/8" x 1-1/8" 4¾" 3-1/8" x 1-1/8"

200-H. $13.50 p.p. 75c.

90° quadrant meter. Pocket size.
AC/V: 10V, 50V, 100V, 500V, 1000V (10,000Ω/V).
DC/V: 5V, 25V, 50V 250V, 500V, 2500V (20,000Ω/V).
DC/A: 50μA, 2.5mA, 250mA
OHM: 60kΩ, 6MΩ
Capacitance: 100pF to .01-μF, .001μF to .1μF.
db: -20db to + 22dB.
Audio Output: 10V, 50V, 120V, 1000V Ac.
Approx. size: 4½" x 3¼" x 1-1/8"



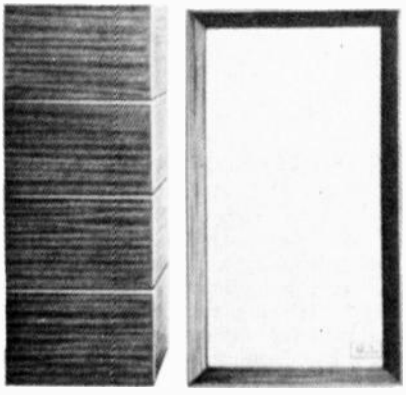
AR-7

a new standard of excellence in a speaker of small size

The AR-7 is the smallest speaker system Acoustic Research has ever designed. It is purposely small.

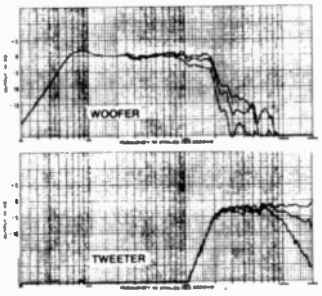
Recognizing the space demands imposed by four channel stereo music systems, AR decided to develop a small speaker to permit installation in areas where our larger speakers are not appropriate. At the same time, this speaker must offer the extended range usually associated with speakers of much larger dimensions.

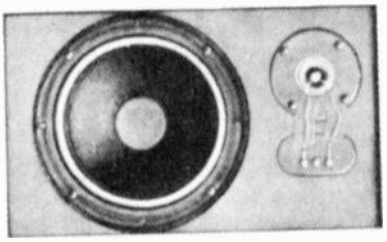
That the AR-7 has achieved both design objectives is clearly evident.



The size (9¾ x 15¾ x 6¼) is such that 4 AR-7's occupy less cubic volume than a single AR-3a.

The accuracy of the sound is such that we show these power response curves and guarantee each AR-7 speaker to match the curves within ± 2dB. Such accurate, full frequency range performance from an enclosure of this size did not come easily. It required years of development and state-of-the-art technology.





The woofer of the AR-7 uses such advanced design and manufacturing techniques that its low frequency response extends substantially below that of competitive speakers of far greater size.

The tweeter of the AR-7 is similar to the tweeter used in the highly acclaimed AR-6. It produces smooth, wide dispersion sound. Both the woofer and the tweeter use high temperature voice coils, permitting higher power handling capability.

Though the AR-7 was designed primarily with four channel stereo installations in mind, its accurate wide frequency response makes it a wise choice for high quality two channel stereo systems.

AR-7, priced at $199 a pair*. Compare the superb sound of the modestly priced AR-7, AR 4xa and the AR-6. Even to the most critical ear, the difference is subtle.

*Recommended retail price

2559

CONTROL NEWS

SINGLE-CHIP MODEM

A 0-600 bps digital modem, the MC6860L, has been introduced by Motorola. This N-MOS device, a subsystem on a chip, provides modulation, demodulation and supervisory control functions necessary to implement a serial data communications link. Employing frequency shift keying (FSK) modulation, data, at rates up to 600 bps, can be transferred by means of a standard, voice-grade telephone channel.

The MC6860L is compatible with the M6800 microcomputer family and interfaces directly with the MC6850 Asynchronous Communications Interface Adapter (ACIA). Modes of operation for the MC6860L include full duplex, half duplex, simplex, automatic answering, automatic disconnect, originate only, answer only and answer/originate. The Modem operates from a single voltage supply and is TTL compatible. Functionally, the device is compatible with the 100 Series Data Sets and 1001 A/B Data Couplers (CBS, CBT).

Housed in a 24 pin, ceramic DIP, the MC6860L operates over the temperature range from 0°C to +70°C.

The Modem can be used in a wide variety of data handling systems, such as I/O interfaces for minicomputers, remote communications terminals, stand alone modems, data storage devices, etc.

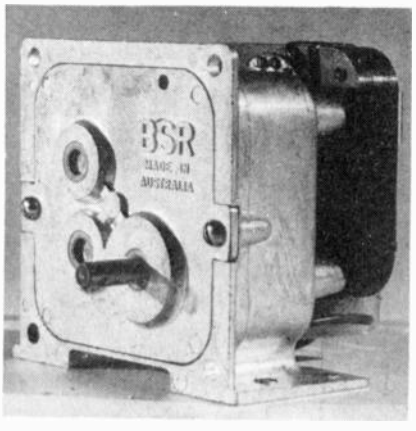
BSR VPS100 GEARED MOTORS

The original VPS100 geared motor range which could be supplied at output speeds from 0.9 to 812 rpm with 44 ratios between these speeds, has been extended by the addition of tandem and reversing motors, giving greatly increased torque output and flexibility.

In addition, friction clutch drives which can be set to break out at a predetermined load, and positive stop rotor braking are now offered as optional extras.

This increased versatility means that very few applications requiring compact power cannot be filled from existing designs, e.g. up to 105 lb/in of torque output is now available.

Further details: BSR (A'asia) Pty Ltd., Anne St., St. Marys, NSW, 2760.



MINIATURE PLUGBOARD SYSTEM

ACME Engineering Company Pty. Ltd., Victoria have recently introduced a range of versatile cordless miniature plugboard systems.

The design consists of a cordless multiple pole, multiple throw switching device in the form of an X-Y matrix made of two vertically stacked planes of contact strips running at 90° to each other.

The design ensures a high-pressure contact giving a long life and low contact resistance over a wide range of electrical loading. Each contact on the strip is individually flexible and unaffected by operation of adjacent contacts. Contacts are finished in gold plated phosphour bronze.

Each 4 mm grid Sealectroboard has a maximum working voltage of 300 Vdc at 2 amps and is fitted with terminations which can be either soldered or wirewrapped. Contact decks at each intersection may be interconnected in a variety of ways through the use of shorting and component holding (diode) pins, completely eliminating patchcords and expensive multipoint switches.

The applications for Sealectroboard 4 mm grid plugboards are virtually limitless. They include missile launching control, computer testing, telemetry systems, audio signal distribution, instrument calibration, distribution networks, test equipment programming, telephone network test systems, digital coding, diode matrices, lighting systems and process control systems of all kinds.

Further details: ACME Engineering, Kilsyth, Victoria.

CERTIFICATED REFERENCE DIODES

Compensated reference diodes, manufactured by Semitron Ltd (UK), are each supplied with a certificate of performance, and have a voltage stability down to five parts per million (ppm).

Each diode – the CR05 Zener – is tested for over 1000 hours under laboratory controlled conditions, with room ambient temperature controlled to plus or minus 1°C, oil bath temperature maintained at 35°C, plus or minus 0.01°C, and the test current at 7.5 A plus or minus 100 nano-amps.

During tests, the Zener voltage is measured to seven digits by a potentiometric method with 1 microvolt resolution after 168 hours running at the test current. Measurements are subsequently repeated at 168 hour intervals over a total of 1176 hours.

After successfully completing its tests, each diode is packaged individually together with a certificate providing diode type details, test voltage reading and maximum voltage drift.

The diodes are suitable for replacing standard cells in many applications where they offer the combined advantages of high stability and improved temperature coefficients.

Apart from the highly accurate type described, other versions are available giving a voltage stability of up to 50 ppm for less exacting applications. Zener voltage for all types is 6.3 V plus or minus 5 per cent at a Zener test current of 7.5 milli-amps d.c.

The diodes may, however, be operated up to 100 milliwatts at 100°C ambient while maintaining their stability.

Diodes may be mounted in any position using mechanical or solder methods for connecting the leads, which are available in gold or tin finish.

Further details: General Electronic Services P/L., 99 Alexander Street, Crows Nest, NSW 2065.

LOW COST TRANSFORMERS

A new range of specially imported transformers has been introduced by Dick Smith Electronics Pty. Ltd. They have been specially designed for Australian conditions to exceed dielectric test requirements as follows:–

Insulation resistance at 500 Vdc is claimed to be better than 100 Megohm between primary, secondary and core. Dielectric strength exceeds 4000 Vac from primary to secondary and core and 1500 Vac from secondary to core, according to the distributors.

Three types are available, all having 240 Vac primaries.

DSE2851 has a 12.6 V ct secondary rated at 150 mA. Termination is by flying leads which are colour coded.

DSE2155 has a tapped secondary giving 6.3, 7.5, 8.5, 9.5, 12.6 and 15 V at 1 A, terminated with tags.

DSE6672 has a tapped secondary giving 15, 17.5, 20, 24, 27.5 and 30 V at 1 A terminated with tags.

All three are very competitively priced. They are approximately half the cost of currently available equivalent transformers. They are available from several component stockists in addition to the Dick Smith Electronics Centres.

Trade enquiries are also invited.

Further details: Dick Smith Electronics Pty. Ltd., 160-162 Pacific Highway, Gore Hill, 2065.

PROXIMITY SWITCHES

The RSM02 series proximity switches have been designed to fulfil many functions hitherto performed by micro-switches in industrial machine control and limit switching applications.

The great advantage of these switches is that limit and proximity switching functions may be performed in control systems without the use of any moving parts.

The switch contacts are completely encapsulated protecting them from environmental erosion.

The switches are normally used with a permanent magnet and the RSM03 has been designed as a matching actuator with fixing

holes for ease of mounting.

Typical applications for the RSM02 include pulse generation, limit switching, proximity detection and alarm circuits.

Further details: NS Electronics Pty Ltd., Cnr Stud Rd., & Mountain Highway, Bayswater, Vic. 3153.

LOW PRICED MOSAIC PRINTER

Philips' ELCOMA Division announces the extension of their present range of mosaic printers with the addition of a new low priced model – the A4.

This fully conversational type printer is ideally suited for use as a mini computer or with a keyboard as a transmitter/receiver telexprinter or in data logging equipment. The design of the print-head permits printing at 100 characters/second and 50 lines/minute at 80 characters/line. The head may be removed replaced and printing started without further adjustment in less than sixty seconds.

Standard features include:

Character by character or continuous printing, immediate visibility of last character printed, visual indication of print head position, and paper width variable from A5 to A4 standard sizes.

MINIATURE ROCKER DIP SWITCHES

The new Grayhill Series 76 single pole/single throw rocker actuated dual in-line switches are now available in Australia.

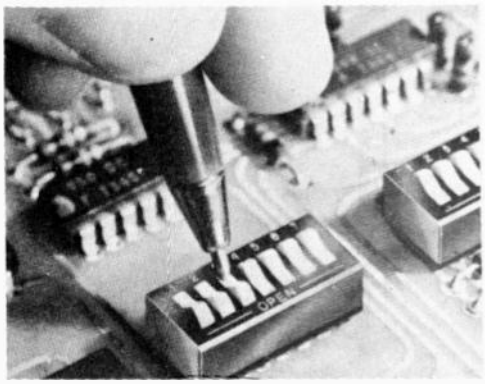
Series 76 switches are particularly suited for PC board mounting in data processing, communications, and other back panel and logic applications where manual programming will be utilised.

This new series from Grayhill features a spring-loaded sliding ball contact system providing positive positioning and high resistance to shock and vibration. Moulded-in terminals protect the Series 76 switch from contact contamination.

Other features include tease-proof reliability and a degree of wiper action.

The Grayhill series 76 is available in nine sizes ranging from two up to 10 positions, and is manufactured from strong moulded thermoplastic polyester.

Further details: ACME Engineering, Canterbury Road, Kilsyth, Vic. ●



AN RF LEVEL CONTROL

Try this interesting new approach, described here by its designer, Laurie Cachia, B.Sc., C. Eng., A.M.I.E.E., A.M.I.E.R.E., M.I.E. Aust.

A COMMON REQUIREMENT in many circuit designs is for an RF level control possessing most or all of the following features.

(a) continuously variable output level,

(b) a degree of output variation in excess of 50 dB

(c) absence of waveform distortion,

(d) good frequency response over two octaves,

(e) control of output level from a remote position,

(f) control effected by means of a variable resistance,

(g) input standing wave ratio approaching 1:1,

(h) simplicity and practicability.

Requirements (e) and (g) immediately eliminate resistance and capacitance potentiometers, whilst conditions (b), (c) and (d) eliminate controls incorporating active devices.

An arrangement that meets all the above requirements is shown below.

Two windings, a primary and a secondary, are wound on two separate toriodal ferrite cores. A tertiary winding in the form of a short circuited turn through both cores, effectively couples primary and secondary windings. A fourth winding, again through both cores, but in the reverse direction to the tertiary winding, is the level control winding.

When an RF voltage is applied to the primary, RF currents are set up in the tertiary (coupling) winding and the resultant magnetic field couples the primary and secondary windings together.

With the level control winding open-circuited, the degree of coupling between primary and secondary is at maximum. With the control winding short circuited the current induced in this winding sets up a magnetic field in opposition to that set up by the coupling winding and coupling between primary and secondary is reduced to a minimum.

A variable resistor connected across the level control winding enables variation of the degree of coupling between primary and secondary and thus, variation of the output level.

The variable resistor may be connected across the control winding through a length of co-axial cable since the shunting capacitance of the cable only reduces the maximum output voltage from the secondary. The minimum output voltage is not affected by cable capacitance because with the variable resistor set at zero the impedance seen at the other end of the cable, which is short in comparison with one wavelength, is also zero.

OTHER VARIATIONS

1) Primary and secondary windings are wound on the same toroidal core in diametrically opposite positions. Two control windings connected in series are wound on the same core between the primary and secondary windings.

When the control windings are open circuited, coupling between primary and secondary windings is at maximum and the device acts as a normal transformer. When the control windings are short circuited, the currents set up in these windings create an electro-magnetic screen between the primary and secondary.

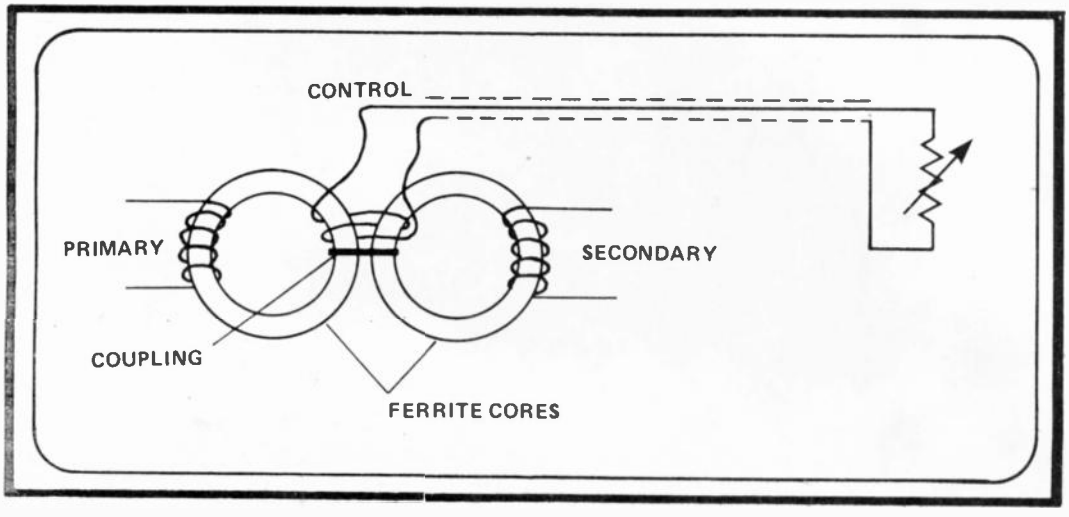
A variable resistor may be used to vary the degree of coupling but it should be connected directly to the control windings, since the capacitance of a coaxial cable would shunt the windings at RF.

2) The transformer is wound as in (1) above. When a current (dc) is passed through the control winding the permeability of the core is reduced and hence the coupling between primary and secondary is also reduced.

As the current is increased further the core goes into saturation and the secondary is isolated from the primary.

3) The primary and secondary windings are wound on separate toroidal cores. Coupling is established by means of a tertiary winding linking the two cores.

When the tertiary winding is short circuited, coupling between primary and secondary is at maximum and when it is open circuited, coupling is at minimum. As in (1) above the controlling variable resistor should be connected directly across the control winding. ●



Note – Commercial organisations are advised that some aspects of this design have been patented by Philips Industries Ltd.

hi-fi REVIEW

AUSTRALIA'S OWN AUDIO MAGAZINE

No 4 80¢*

TEST REPORTS:

- CAMBRIDGE AMPLIFIER
- IMF LOUDSPEAKERS
- TELEPHONIC HEADPHONES
- INFINITY LOUDSPEAKERS

ON SALE NOW!

at ALL LEADING NEWSAGENTS

Published by Modern Magazines (Holdings) Ltd., The Publishers of Electronics Today International.

- PORTRAIT OF MILES DAVIS
- TOP RECORDS FOR CHRISTMAS

SAVE to 50%

electronic agencies

THE MAIL ORDER DISCOUNT HOUSE,
P.O. BOX E5, CONCORD EAST, 2137

Money cheerfully REFUNDED if not fully satisfied.

VU STEREO METERS

1 3/8" Scales.

$6.95

Dual Meters in one case — will "dress-up" any amplifier or tape recorder — for amateur or professional use.

MICRO MINIATURE Plessey 3 pin plug socket set

1—4 85c 5—24 75c 25+ 65c

Picture shows ACTUAL SIZE of plug and socket together. Panel mounting socket suits test gear, industrial and commercial applications etc — gold plated pins, less than ½ normal price.

ROLA 2¼" MINIATURE SPEAKER

☐ $1.00 ea. or 10 for $9.00.

Popular replacement speaker for local and imported transistor radios. Model 225A, 300 Hz to 5kHz.

6 — 12 VOLT Miniature 2 Changeover Cradle Relays

Buy 5, take 10% discount. $3 ea.

NIXIE TUBE SALE

$2.50 ea. 4 for $9.00

Mullard ZM1080.

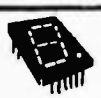
0 to 9, characters 13mm high, 170V operation, 2mA anode current, includes red filter, fitted with 14 pin base, vertical mounting.

Mullard ZM1000

0 to 9, characters 14mm, 170V operation, 2.5mA anode current, decimal point left side, fitted with 14 long wire leads, vertical mounting.

$3.25 4 for $12.00 ☐

LED 7 SEGMENT READOUTS



at rock-bottom prices

each $3.95 or 4 for $14.00

These Hewlett-Packard 7 Segment LED's have common anodes, 0.3 inch display, 0 to 9 with decimal point and TTL compatibility. Last available at these prices.

10A 250V MICROSWITCHES

- Single pole changeover.
- Aust. made.
- Highest quality.
- Buy 5, take 10% discount.

90c limited quantity.

VHF TRANSISTOR T.V. TUNER

$7.50 12 Channels

A high sensitivity transistorized T.V. tuner suit Australian Stations. Operates from 12 V D.C. and output goes to IF section. Suit hobbyists, amateurs, T.V. servicemen etc. $8.50 ea. ☐

5 inch T.V. TUBE

Brand new, sealed in manufacturer's carton

SPECIAL PRICE $11.95.

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Price $11.95. (plus $1.00 registered post)

A limited quantity of yokes is available to suit above T.V. tube. Price $7.50

HEWLETT PACKARD LED DISPLAY

The latest in LED displays — specially imported from USA at rock bottom prices. A 7 segment four by seven dot matrix display with built in decoder/driver and memory, left hand decimal point and 8 pin DIL package — as used by ETI magazine in DIGITAL FREQUENCY METER & DIGITAL STOP WATCH METER projects. Comes complete with full spec sheet. Normally priced at around $16.00 each, we have limited quantity available NOW at only $10.50 or 4 for $39.00. ☐

MINIATURE TUNING CAPACITOR

Most popular type suit imported radios. Size ¾" x ¾", 200pf per gang with inbuild trimmers, ☐ $1.00 ea. or 10 for $8.00.

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IGNITION SUPPRESSOR KIT for car radio $1.95

Easy to instal, 10 piece kit includes 2 suppressor condensers, 1 resistor, various terminals, mounting screws and instructions. Parts alone worth lots more!

DE-LUXE TUNER MODULE 304

A high sensitivity 4 transistor AM tuner with tuned RF amplifier and two IF stages for extra selectivity and sensitivity. The Module is ready assembled and operates from 9V DC at approximately 3MA. A permeability type tuner and push-button On-Off switch are supplied together with circuit and application diagrams. As the module may be used with a ferrite road type aerial OR an external wire type antenna, it is ideally suited to car, portable or home use. Size 5½" long x 1½" wide x 7/8" deep. Ferrite rod aerial $1.25ea. $12.99 ☐

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A limited quantity of these "hard-to-get" heavy-duty paper block capacitors suitable for extra-powerful strobes is now available. Manufactured by Ducon and brand new. Add $1.00 post. Price ea. $5.00.

STEREO 30

30 Watts for $30

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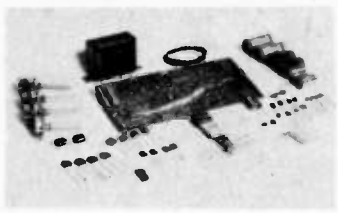
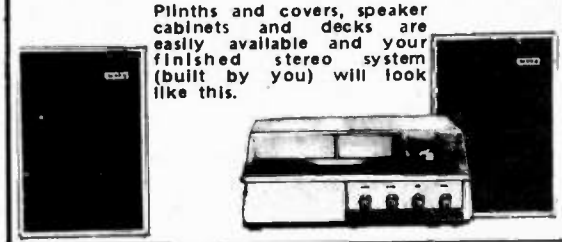


FREE Stereo Headphones

Amazing offer for "hi-fi-ers" — Stereo amplifier kit, giving 15W RMS in 4 ohms, 10W rms in 8 ohms (per channel) with 5mV magnetic cartridge input VOLUME, BALANCE, BASS and TREBLE controls supplied — latest integrated circuit pre-amp and driver stages, complementary "flat-pack" output transistors — all on one P.C. Board for easy assembly. HI-FI performance with 20Hz to 50KHz response, low distortion and low hum level ensure compatibility with the best turntables and speakers.

Plinths and covers, speaker cabinets and decks are easily available and your finished stereo system (built by you) will look like this.



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22	mfd	63V	15c	Can.		
22	mfd	100V	18c	20/75	400/75V	80c
33	mfd	10V	10c	32/32	350V	60c
47	mfd	10V	10c	50/30	150V	60c
100	mfd	10V	10c	64	350V	70c
100	mfd	160V	40c	80	400V	80c
200	mfd	6V	10c	90 —	300V	60c
200	mfd	70V	30c	200/100	300V	80c
330	mfd	10V	15c	1000	60V	$1.00
470	mfd	6V	20c	5000	20V	$1.00
470	mfd	16V	25c	6500	80V	$2.00
1000	mfd	6V	25c	(tx comp)		
1000	mfd	10V	35c	12000	30V	$2.00
1000	mfd	16V	45c	(ex comp)		

BUY 25 ASSORTED, TAKE 10% DISCOUNT.

LATEST Transistorised TV CAMERA Scoop!

Ideal for closed-circuit television, amateur T.V. transmission, video recording etc. Operates direct into any standard T.V. receiver, mains powered, features 1" vidicon for bright, sharp image. This well-known Japanese import is normally priced out around $299. — only 20 available so be early.

Full Price $175

BONANZA JACKPOT!

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EQUIPMENT NEWS

NEW SIGNAL GENERATOR COVERS 0.5 to 1024 MHz

The familiar Hewlett-Packard 8640 am-fm signal generators are now optionally available with an internal extension band, 512 to 1024 MHz, (with over-range of 1100 MHz). When the high band (512-1024 MHz) is included, the generators are designated HP 8640A Option 002 (dial readout of frequency) or HP 8640B Option 002 (digital frequency readout). The digital readout version features a built-in 550 MHz frequency counter plus internal synchronization to phase lock the carrier frequency to a crystal reference.

Output in the 512-1024 MHz extended range is +13 dBm to -145 dBm into 50 ohms and is levelled to ±1.5 dB. Most of the desirable precision modulation and operating features of the standard HP 8640A and 8640B are preserved. Amplitude modulation is possible to 100% and to 50 kHz, with low distortion. Frequency modulation is provided with calibrated peak deviation to 5.12 MHz and rates to 250 kHz. Externally pulsed outputs exhibit less than 1 microsecond rise and fall times and a 60 dB on-off ratio.

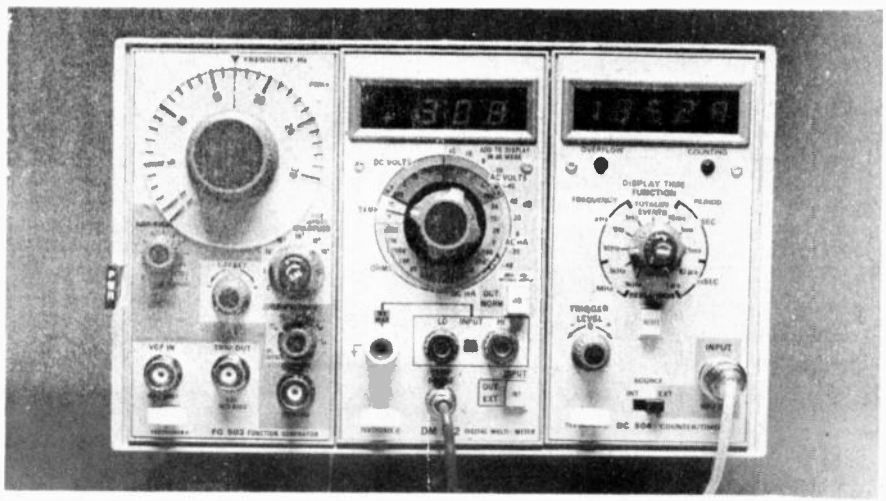
The high band coverage is achieved through use of a frequency doubler followed by a wide-band low-noise output amplifier. This approach retains the signal purity and stability of the basic oscillator. The oscillator is cavity-tuned and optimized so that single-sideband phase noise is down 124 dB/Hz at kHz offset. This solid-state performance is only rivalled by the best tube-type generators. Stability is such that the carrier frequency can be set to 100 Hz using the digital readout, very useful for receivers with narrow channel spacing.

Further details: Hewlett-Packard Australia Pty Ltd, 31-41 Joseph St, Blackburn, Vic. 3130.

TEKTRONIX ANNOUNCES LOW-COST TM 500 INSTRUMENTATION

Versatile general-purpose instrumentation of high quality is now available with Tektronix' new Low-Cost Package of TM 500 modular instruments.

The Low-Cost Package features: an FG 503 Function Generator, producing "clean" sine, square, and triangle waveforms over a broad frequency range; a DM 502 Digital Multimeter, offering an up-to-date mix of ranges, including dB and temperature measurements; and a DC 504 Digital Counter/Timer, featuring an 80 MHz five-digit display that gives RPM, totalizes, and measures periods with a high resolution.



Units are enclosed in a TM 503 Mainframe which supplements the front panel input-output connectors of the three plug-in instruments with 30 interconnecting lines through its common interface circuit board.

An oscilloscope or other instrument from the TM 500 line can replace suggested instruments to increase the versatility of application. This flexibility is, in fact, an outstanding feature of the TM 500 modular instruments. The line includes digital counters, digital multimeters, power supplies, pulse generators, signal generators, mainframes, signal processors, amplifiers, a crt monitor, an oscilloscope, a time mark generator, and others.

Further details: Tektronix Australia Pty Ltd., 80 Waterloo Rd., North Ryde, 2113.

BANDPASS FILTER/AMPLIFIER

Tektronix have announced the AF 501 Bandpass Filter/Amplifier, the first of their popular TM 500 Modular Test and Measurement Instrumentation line to be directed toward mechanical measurement. Combining the functions of an active tunable bandpass filter, ac-coupled amplifier and sinewave generator in a single module, the AF 501 brings new versatility and convenience to the investigation of low-frequency phenomena.

In combination with other TM 500 Series modules, the AF 501 lends itself to a wide range of applications, including isolation of frequency components in complex sound and vibration signals, retrieval of low-amplitude signals buried in noise, accurate measurement of RPM in high speed machinery, and measurement of amplitude and phase in dynamic balancing.

Government noise regulations and the trend toward higher speeds in all rotating machinery have created a need for inexpensive analytical tools for the investigation of sound and vibration. Real-time spectrum analyzers and specially developed digital processing equipment are often too expensive for serious consideration by smaller industrial establishments. An AF 501, used in conjunction with an oscilloscope, and a little time spent in hand-plotting, will often supply the information required to identify sources of noise and vibration like gear chatter, spalled bearings, structural resonance, etc., in rotating machinery.

Many mechanical measurements are hindered by the presence of electrical noise or extraneous frequencies on the transducer signal under investigation. The AF 501 can be used as a signal processor in these cases, filtering out all but the desired signal, and amplifying it for display where necessary.

In conventional electronic applications the AF 501 can be used to measure harmonic distortion, analyze complex signals, and filter out noise and interference. It will prove particularly valuable in adjusting tone signals to specified frequency, as required in the telephone industry. Oscillators in many tape recorders can be quickly calibrated

with this versatile new TM 500 module.

The AF 501 can also be used as a training aid in the classroom or laboratory. For instance, a squarewave input signal will be broken down into sinewaves at the fundamental and odd harmonic frequencies, illustrating the process performed mathematically by Fourier analysis.

As with other TM 500 modules, the AF 501 can be connected through rear panel fixtures to other modules, such as DMM's, counters, or oscilloscopes, for measurement and processing of the output signal. In some cases, these measurements can be transmitted in digital form to external digital processing equipment.

When used as a bandpass filter, this multi-purpose module has a tuning range from 3 Hz to 35 kHz with selectivities of Q=5 and Q=15. Maximum filter attenuation is greater than 70 dB and phase shift less than 10° at the tuned frequency. Gain ranges from 1 to 500 are provided in a 1, 2, 5 sequence.

The same frequency range applies when the AF 501 is used as a sinewave generator. Waveform distortion is less than 3%. Output amplitudes of 1, 2, or 5 volts can be selected by adjusting the gain control. Output impedance is less than 1 ohm with a 10 mA current limit.

As an ac-coupled amplifier the AF 501 offers selectable gains of 1 to 500 in a 1, 2, 5 sequence. Bandwidth extends from less than 0.5 Hz to more than 50 kHz.

A trigger pulse of 10 V is generated each time the signal in the amplifier or the filter goes from positive through zero. This pulse is available at the front panel for triggering a strobe or oscilloscope.

The primary areas of application for the AF 501 are (1) the analysis of vibration and sound signals, where it can be used as a manually-tuned, low-cost spectrum analyzer, (2) dynamic balancing and (3) the measurement and calibration of tone signals in the communications industry. Other important applications exist in audio and hi-fi research and service, engine and turbine maintenance, calibration of sonar and other hydrosonic devices, and in education as a training aid in physics, mechanical engineering and related subjects.

The AF 501 offers versatility and economy to manufacturers and users of rotating machinery, schools and colleges, the communications industry, and a wide range of users in the electronics and industrial service industries.

Further details: Tektronix Aust. Pty. Ltd., 80 Waterloo Road, North Ryde, N.S.W. 2112.

NEW DIGITAL MULTIMETER KITS

A 'build-it-yourself' digital multimeter kit from ESE Corporation of California is now available in Australia.

The ES210K is an extremely sensitive and accurate bipolar multimeter with automatic polarity indicator. It displays ohms, volts or amps in five ranges. Voltage from 100 microvolts to 500 volts. Resistance from 100 milliohms to 1 megohm. Current from 100 nanoamps to 1 amp.

The ES210K is priced well below comparable assembled units. Each kit has easy-to-follow illustrated instructions, a complete parts list and a circuit diagram. The only tools needed for assembly are a soldering iron, a screwdriver and wire stripper. Everything else, including solder, comes with the kit.

Further details: Tecnico Electronics, Premier St., Marrickville, N.S.W. 2204.

SPECTRUM ANALYSERS FOR HIGH-ACCURACY AMPLITUDE MEASUREMENTS

Two new spectrum analysers, one manually operated, the other fully automatic and programmable, are designed for fast, accurate production testing of consumer electronics, for quality control, and for laboratory applications. Amplitude is measured to 0.01 dB resolution and displayed in decibels on a digital display. Accuracy of amplitude measurements is not limited by CRT accuracy as on conventional analysers. Operator error is significantly reduced.

Hewlett-Packard Model 3044A is manually operated and can be used with either of two synthesisers, depending upon the frequency resolution requirement.

The Model 3045A is an automatic, programmable version using a high-resolution synthesiser with a choice of three different programmable desktop calculators. Control and computational capabilities of the calculators and their peripherals make the system fully automatic. Software for several general types of measurements, and programming instructions for more specific measurements are supplied.

While both analyser systems are designed for spectral analysis, they are also ideal for distortion analysis and wave analysis. Discrete frequency components are located using the numerical frequency entry on the synthesiser. Cranking a tuning knob is not necessary.

With a plotter, the Model 3045A can rapidly generate a constant bandwidth plot which is essentially a plot of gain versus frequency for a constant power output for audio amplifiers.

Total harmonic distortion or intermodulation distortion can be automatically plotted versus frequency. Power output versus frequency for a constant percent total harmonic distortion can also be easily plotted.

Other applications include signal to noise plots, frequency modulation deviation plots and as general purpose automatic check-out systems.

Further details: Hewlett-Packard Aust. Pty. Ltd., 31-41 Joseph St., Blackburn, Vic. 3130.

EQUIPMENT NEWS

SIMPLE AUDIO-VISUAL SYSTEM

Electrosonic, the multi-vision division of Convoy International Pty. Ltd. announce the introduction of an audio visual hardware package that allows the production of sophisticated single screen presentations to be produced by almost anyone.

The package is made up of only four units: a simple to operate yet electronically sophisticated dissolve and programme unit with a hand slide control, a cassette recorder and two carousel projectors. All units can be stowed away in three compact carry cases for easy portability.

"The availability of such a package was made possible by the development of Electrosonic's new ES69 control unit named the Q-slide," said Mr. Eric Gidney, Manager of Convoy's Electrosonic Division. "The aim of putting such a simple-to-operate package together was to offer advertising agencies an economical means of client presentation and for companies to use at exhibitions and on site customer presentations.

There are seven steps to be taken to produce an audio visual programme using the "Q-slide" package.

1. Clearly define objectives for presentation.
2. Prepare script.
3. Prepare photographic or illustrative slides.
4. Assemble slides to match with script.
5. Record the commentary and musical effects if required, using the condensor microphone on the cassette player.
6. Practice runs by dissolving and superimposing the slides from one projector to the other in time with the commentary which is monitored through earphones.
7. When satisfied with the results achieved simply switch the cassette player into record and repeat as per the practice run.

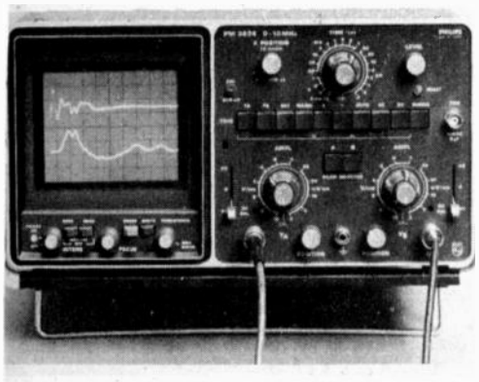
"It's as simple as that" said Eric Gidney, "the whole programme is now on one cassette, the voice, music and pulse instructions to the projectors telling them to dissolve, superimpose etc. All you do to watch the presentation is pop the cassette into the recorder, switch to play and sit back."

Further details: Convoy International, 4 Dowling St., Woolloomooloo, NSW, 2011.

STORAGE COMBINED WITH TRUE DUAL BEAM TECHNIQUE IN NEW OSCILLOSCOPE

Philips have recently introduced a new 10 MHz 2 mV storage oscilloscope featuring true dual beam operation. This technique was developed by Philips in order to eliminate the need for chopped or alternate mode displays. Its technique ensures that the phase relationship of the signals is always correct and allows the complete waveform to be displayed. In the new oscilloscope, designated the PM 3234, this technique is combined with that of half tone storage and the result is a very versatile specification of particular value for obtaining true displays and records of single shot phenomena.

When the storage facility is not required, the PM 3234 operates in the normal manner



but with the added benefit of having continuous control of the persistence from 0.3 seconds to 1.5 minutes. This allows the optimum display of difficult-to-see signals like low frequency signals with flicker and high frequency, fast rise time pulses with low repetition rates. When storage is employed, it can be switched from high to low intensity viewing positions giving either minimum brightness for 15 minutes or maximum brightness for 3 minutes.

Addition to 10 MHz family

The PM 3234 oscilloscope is an addition to the Philips 10 MHz range of true dual beam instruments and shares many of the features. The screen, for example, is 8 x 10 div (of 9 mm each) with full coverage for each beam. The acceleration potential is a high 8.5 kV.

Easy triggering is a common feature. In the automatic position the time base is free running (in the absence of a signal) for quick zero line reference at all sweep speeds. In the automatic mode the triggering level is derived from the signal, so again, there is no problem in finding a stable display. The scopes also have dc as well as ac trigger coupling. A useful service feature of the instruments is the fact that they can operate from a 24 Vdc supply, as well as the conventional ac mains.

FM STEREO RECEIVER ALIGNMENT GENERATOR

The SOUND TECHNOLOGY MODEL 1000A FM alignment generator is designed specifically to permit fast, accurate adjustment of monaural and stereo FM systems. The unit uses "dual sweep", a refinement of conventional sweep alignment techniques to provide a unique visual display of receiver performance.

An operator connects the 1000A's RF output (variable in frequency from 88 to 108 MHz and adjustable in level from 0.5 μV to 30 000 μV) to the receiver antenna terminals and feeds the receiver audio output to the 1000A's built-in filter. Distortion and tuning characteristics will then be displayed on any oscilloscope – without probing inside the receiver.

The instrument has switchable left and right tones plus 19 kHz pilot tone test, phase test, and composite output for

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*Apan BFU 121** fully automatic belt-drive turntable features

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- Wow and flutter less than 0.16% wrms
- Signal to noise ratio better than —52dB
- 12" diecast aluminium platter weight 1.3 kg
- Integrated oil damped lifter
- Static balance "S" type tone arm with anti-skate device
- Removeable headshell and revolving counterweight with graduated scale from 1-3 grams
- Complete with magnetic cartridge Frequency response 20-20,000Hz Output 4.5 MV

* Comes complete with "high tension" four-channel leads and is 4-channel ready.

APAN BFU·121 Four·Channel

*Apan BFU 121** fully automatic belt-drive turntable features

- 4-pole synchronous motor
- Wow and flutter less than 0.16% wrms
- Signal to noise ratio better than 52dB
- 12" diecast aluminium platter weight 1.3 kg
- Integrated oil damped lifter
- Static balance "S" type tone arm with anti-skate device
- Removeable headshell and revolving counterweight with graduated scale from 1-3 grams
- Complete with magnetic cartridge Frequency response 20-20,000Hz Output 4.5 MV

* Complete with Jelco 4C1X CD4 cartridge Frequency response 10-50,000 Hz. Output 2.5 mV using revolutionary Ichikawa styles.

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KITSETS

KIT'S KOLUMN

There's an awful lot of waffle written by retailers about how their prices are lowest and how nobody can beat their prices. Everybody seems to say it, just like used car places keep saying that hoary old phrase "first to see will buy." Well, at the risk of sounding trite, I'd like to lay some interesting news about Kitsets prices on you.

You know how prices have been going up lately. OK. And you recall how we brought out our Kitsets catalogue around May '74. Well, except for a few unavoidable increases on transformers and a few other items **those prices still hold good.** Most other suppliers have jacked up their prices since May.

Catalogues are as scarce as hen's teeth, but you can check one at any Kitsets branch. And, if you're like my friend, Alfred E. Neuman of Gore Hill, we'll even read it to you when you come in.

(We've got a whole load of new stuff in for '75 in components, including circuit boards for all your E.A. and E.T. projects.)

Talking about projects, I'd like to thank the boys at OTC's Paddington IMC for all the nice things they've been saying about me. Yes, I like parties, but I'll have to turn down your offer of a lift to Terrey Hills. It's been so long since I've been in a Kombi I wouldn't know how to defend myself. Some other time maybe. Hey — here's something you might be interested in . . .

We've just landed these Kikisui Oscilliscopes. They operate up to 5MHz with a TV time base and are a really professional unit. Ask for number 537. P&P $5. $216.

A very happy New Year from all of me to all of you. Until January . . .
Keep your iron hot.

Kit

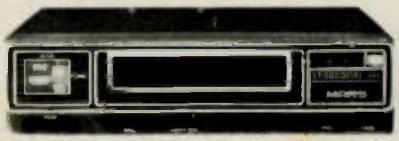
JM0080FP

BRILLIANT SANYO CASSETTE DECK $215

This is the incredible RD4250. Check our price and see what you're saving! All the goodies, including ferrite heads, CRO_2 switch, separate Dolby switch, separate on/off switch, slide controls, and tape counter. Response CRO_2: 30-16KHz; S/N ratio with Dolby: 58 dB; 48 semi-conductors including 2 FETS; Auto stop. Customary ins and outs. Usual hilarious manual . . . but understandable. (They build a lot better deck than they write English.) 423 mm x 242 mm x 120 mm. Approx. 4.4 kg. P&P $4. FREE! Something to frighten our accountant. Get yourself this beaut stereo deck at Kitsets anytime up to end of January, and we'll give you a C90 Gamma cassette. (Deck comes with pre-recorded music demo cassette as well.)

DOLBY SYSTEM

CAR RADIO/ CARTRIDGE PLAYER BARGAIN AT $59-50



A really beaut unit. Sorry, but we've only 100 so it's first come, first served. We'll refund any mail orders which arrive too late. Hooks to 12V DC negative earth, has 21 semi-conductors, puts out 2 x 4 watts max power. Response 50-8,000 Hz; S/N ratio 40dB or better; wow & flutter less than 0.3% WRMS. Takes 8 track stereo cartridge. Radio range 535-1605 KHz. Wrinkle black and chrome-type finish. Approx. 210 mm x 200 mm x 50 mm. Packed wt. in carton with fittings and manual approx. 3.18 kg. P&P $2.

DIRTY BOOK DEPT.

Now that we have your attention, cop this: at Kitsets you can get a whole range of books and magazines on almost any electronic or related subject. This month, we're running 2 specials:

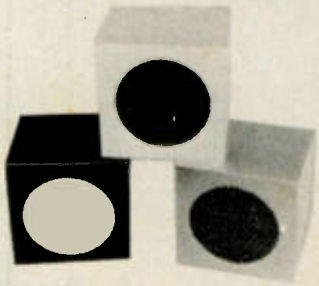
A: Radio Valve and Transistor Data
The famous Iliffe manual that has sold over 400,000 copies. A mass of information covering over 232 pages, only 4 of which are ads. An absolute must if you're really into detail. 210 mm x 275 mm x 15 mm. Better to call in for this as the P&P is heavy at $1.40. Good buying at $2.60.

B: 20 Solid State Projects. Mainly things around the home, like light operated switch; lamp dimmer; intercom; telephone amplifier; sound-operated switch. Exceptionally clear descriptions and diagrams as only the Poms can do. P&P 50c. $4.25.

CASSETTES GALORE!

Glad to announce we've managed to get supplies of Certron (blank) cassettes. Genuine screw type — not welded. Pro C60: $1.25. Pro C90: $1.50. Gamma C60: $1.75. Gamma C90: $2.25. P&P on each is 50c which is a bit steep, but we don't run the Post Office. To save, buy any 4 cassettes and pay 60c P&P, or any 10 and pay $1 P&P.

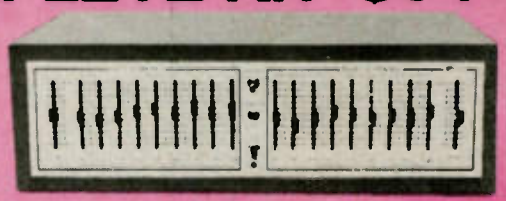
SPEAKERS



Unit needs speakers 4-8 ohms per channel. If you don't have your own, we suggest our weenie wonder whoppers as shown. Get 2. P&P each $1.50. Each $14.95. Or buy without cube enclosure for each — P&P $1. $7.50.

BUILD THE NEW ETI GRAPHIC EQUALISER: COMPLETE KIT - $94

ETI 427 (October 1974). Nobody has a perfect room and so even the greatest Hi-Fi system can sound a bit off. Usually, a unit like this would cost you a leg and a half, but now you can get into the big league without getting poor. Broadly, your Graphic Equaliser will compensate for speaker and room deficiencies, and show you pretty dramatically that you don't have to put up with resonances and dips. The ETI 427 has nine filters spaced at octave intervals in each of two channels. Construction is relatively easy, but if you're a beginner, you'll need someone to hold your hand. Complete kit includes prewound coils, veneered cabin. , screws, nuts, and so on. P&P: $3.50.



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TYPE	min.Watts		SUPPLY	Printed Bd.
	4 Ω	8 Ω	volts	numbers
TA3C	3	–	13·2	370105
TA5B	8	5	25	339250
TA10B	13	10	32	339250
TA15B	18	15	38	339250
TA20C	30	20	±22	339771
TA25C	35	25	±24	339771
Preamp	–	–	–	339251

Semiconductor Division

STC-CANNON COMPONENTS PTY. LIMITED

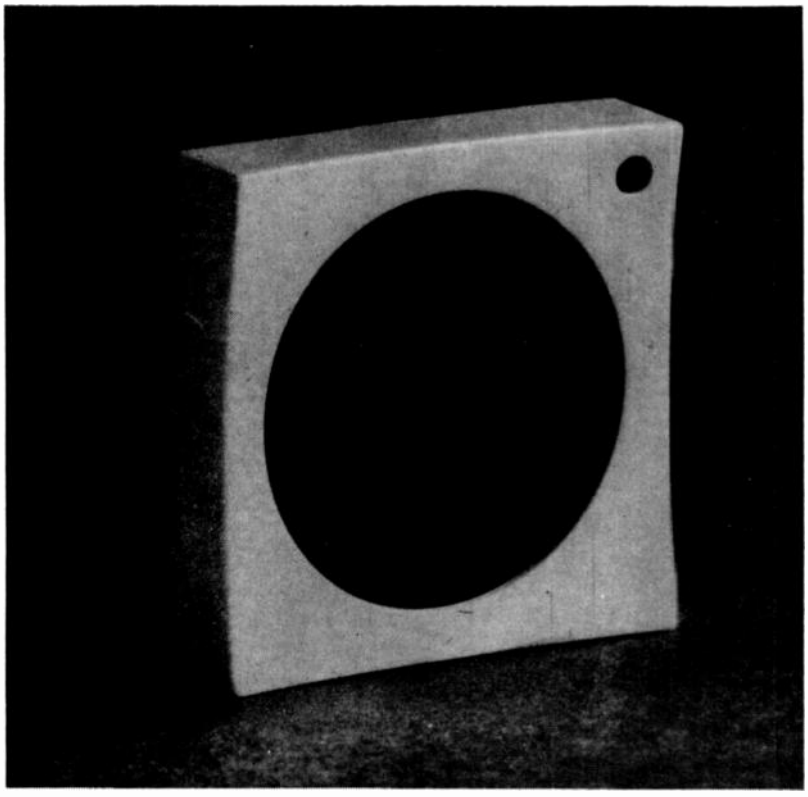
Moorebank ave.Liverpool NSW 2170

6020333 SYDNEY

951566 MELB.

Wild Rover

the tender touch



Touch a 'Wild Rover' switch and things happen with the greatest of ease. Office machines, elevators, vending machines, appliances, numerical control equipment, mini-computers, intercoms, material handling equipment, 'panic buttons', etc., are all unfailingly activated at a touch.

The Wild Rover Corp. (U.S.A.) has achieved world-wide acceptance of 'Touch-activated' switches by their unique, patented 'Electrical Grating' contact design. The range embraces three series which cater for consumer oriented control functions, heavy duty use and mini sized applications where space is at a premium.

These switches provide ample touch area, are virtually maintenance-free, shock-proof and are resistant to dust, oil and water. A variety of colours and styles is available. LED or incandescent illuminated styles are optional and are subject to special order.

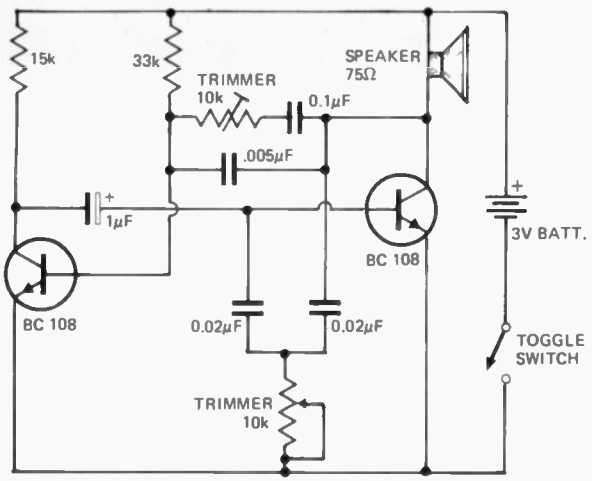
PLESSEY

Plessey Australia Pty. Limited Components Division
Box 2, P.O. Villawood, N.S.W. 2163. Tel 72 0133. Telex 20384
MELB.: Zephyr Products Pty. Ltd. 56 7231. ADEL.: K. D. Fisher & Co. 223 6294. PERTH: H. J. McQuillan Pty. Ltd. 68 7111. N.Z.: Henderson (N.Z.) 6 4189.

AC117

IDEAS FOR EXPERIMENTERS

TRANSISTORIZED FISHCALLER

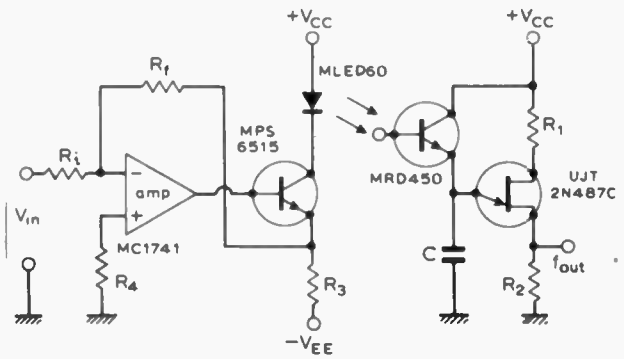


A lot of controversy exists among amateur fishermen as to the effectiveness of "fish-callers". Some swear by them, others just shake their heads.

Here's an inexpensive way of finding out. The two-transistor circuit drives the speaker. Varying the two potentiometers produces a wide variety of sounds. You may be lucky and hit on one that will bring in the big ones.

An inexpensive waterproof housing is a *thick-walled* polythene bag with a few lead sinkers inside. An on-off toggle switch can be manipulated without opening the bag when switching power on and off. The bag opening is sealed with good quality electrical tape to make system waterproof. Tape seal should be renewed after each use.

LIGHT-COUPLED VOLTAGE-TO- FREQUENCY CONVERTER



It is often necessary to convey information from two electrically isolated points. The circuit shown here was developed in the applications department of Motorola Semiconductors and allows information represented by voltage to be transferred to a remote point via a light beam.

The output takes the form of a signal, the frequency of which is proportional to the applied voltage.

The functioning of the circuit is more or less self-evident. An operational amplifier drives a l.e.d. to provide a light output proportional to the applied input. The operational amplifier's scaling resistors are chosen to suit the application. At the receiving end the impedance of the photo-transistor alters the time constant in a conventional UJT relaxation oscillator circuit in sympathy with the level of incoming light beam to alter the output frequency.

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 provide 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.

ELECTRONIC SWITCH

The switch in this circuit uses an N channel FET to present either a high or low impedance path to ground for any incoming signal.

The main advantage of such a switch is that the actual switching of an audio or RF signal can be done in-situ on the board rather than bringing the signal along a cable to and from a mechanical switch.

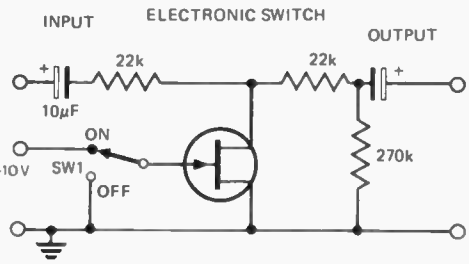
This eliminates hum pick up and other stray problems.

The mechanical switch simply switches dc to the FET gate.

Another feature of the circuit is that one mechanical switch is sufficient to key a number of FET switches with no crosstalk between channels.

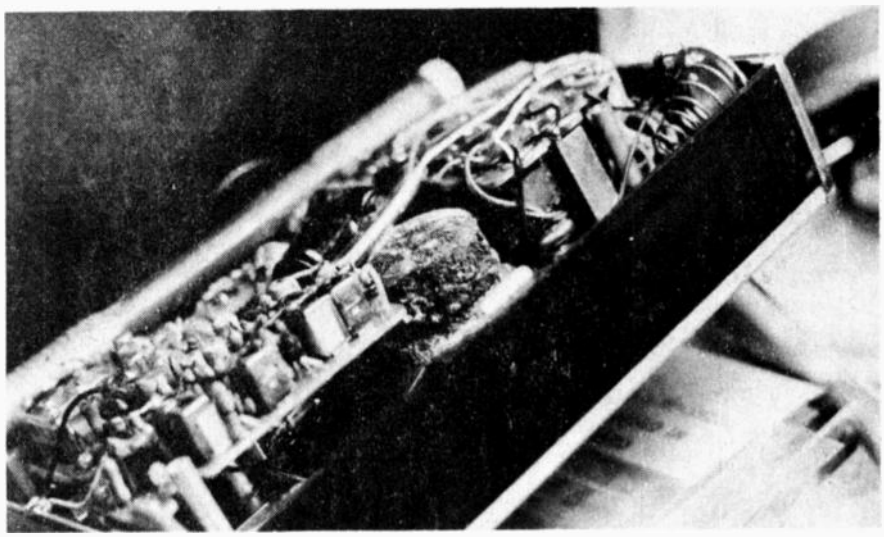
The operation is that when the switch is in the "off" state the FET is biased hard on. Any incoming signal is effectively shorted to ground. In the "on" position the FET is biased to the non-conducting region thus presenting a high impedance to ground. This allows the incoming signal to appear at the output terminals unattenuated.

The output impedance of the circuit is high and the following stage impedance should be in excess of 50 k if excessive loading is to be avoided.



IDEAS FOR EXPERIMENTERS

ASSAULT BY BATTERY



MOST PEOPLE are aware of what happens when they leave exhausted batteries in a hand-torch: the chemical content of the cells eats its way through the casing and starts to attack the body of the torch itself.

If left for a prolonged period, the damage and corrosion becomes so extensive that it is impossible to which consequently has to be scrapped.

The situation becomes much worse and considerably more expensive when battery corrosion affects electronic equipment. Transistorised tape recorders and radios are the most common victims, having been set aside and forgotten for a while, during which time corrosion can cause considerable damage.

The owner of apparatus so damaged is usually caught out completely, and quickly takes it to a servicing organisation in the hope that things can be rectified easily. Unfortunately, the devastation caused by corrosion can be so severe that some equipment has to be written off. This certainly applies to small transistor radios, where the economics of repair would be out of proportion to the value of the apparatus.

In the case of more expensive equipment, a rigorous approach can save it on many occasions.

The battery compartment will have suffered most; if it is a separate item it should be replaced in its entirety. Fortunately this compartment often serves to contain the bulk of the corrosion, and provided the caustic fluid has not escaped into the remainder of the equipment, there is a good chance that the repair will be 100 per cent effective.

If fluid has penetrated into the remainder of the equipment the situation will inevitably be much more serious. Printed panels, switches, coils and transformers are particularly vulnerable, and a preliminary examination should be carried out to see to what extent these components have been affected. Note that the fluid can penetrate underneath larger components and seep through, causing damage at a later date. It is essential that all traces of corrosive material be removed, even if to do so involves the removal of components from a printed panel.

If a panel has been badly saturated, but not extensively eaten away by corrosive fluid, it is best to remove all inductive components and switches, then wash it off thoroughly in fairly hot water. A small toothbrush is useful for scrubbing, and a hair-dryer can be used for drying off afterwards. Healthy components will survive this treatment unscathed; sick looking ones may well be damaged and should be replaced.

Switches affected should always be replaced, and this also applies to RF and IF coils, ferrite rod windings and transformers, all of which may cause trouble at a later date even though they may appear to have survived superficially.

Repairs such as these usually take up a large amount of time, and often some expensive components, so the economics of any one repair should be assessed early on, so that work is not commenced precipitately on a job which will ultimately be uneconomic.

Fortunately, assessment is not too difficult when one bears in mind the foregoing points. It is relatively easy for an experienced engineer to say that possibly three hours work will be required, plus a switch bank, battery box, several IF transformers and a loudspeaker. A quick mental totting-up will yield a figure which can then be compared with the value of the repaired apparatus.

Do remember though that this sort of repair can never be guaranteed. It is possible for 'green spot' corrosion to occur in coils after a period of time, even if they appear to have escaped initial damage, and a customer should be made aware of this.

Spares availability plays a major part in the success or otherwise of a repair. This is true to the extent that a relatively cheap transistor radio of obscure origin, may need to be written off if there is any possibility of damage beyond the area of the battery compartment.

Standard battery compartments, of Japanese origin, are now easily available and can be used as standard replacements.

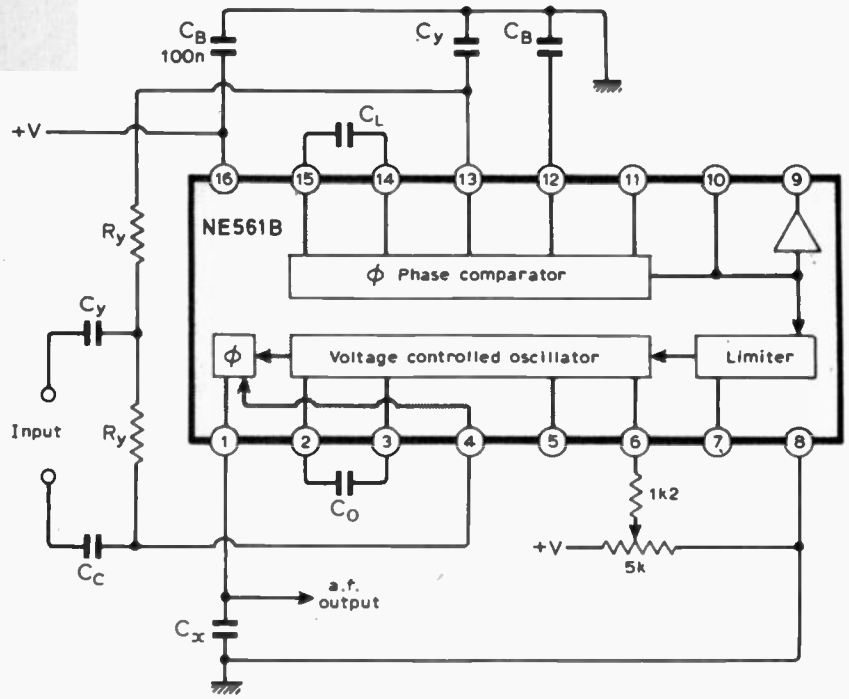
Portable tape recorders, when affected by battery corrosion, can present further problems in addition to those mentioned above. The mechanical side of the machine can be adversely affected, and in particular castings can be eaten away. The effects on ball-races, flywheels, and motors (let alone rubber drive belts!) must be seen to be believed. In any event, a complete stripping down operation is often the only sure approach, a process which is obviously time-consuming and expensive.

If ever the point should be made that prevention is better than cure, it applies in the case of damage by battery corrosion. Whenever equipment is being put away for a period, the batteries should be removed as a precaution. If it is obvious that the batteries are flat, they should be removed *straight away*. Do not wait until you have purchased new ones; you could slip up and break your leg on the way home, and by the time you are discharged from hospital, your pocket calculator could be a write-off!

SIMPLE AM RECEIVER EMPLOYS A PHASE-LOCKED-LOOP

Here is a simple am receiver using a single off-the-shelf phase-locked-loop integrated circuit, together with a few external components. A major advantage of this approach is that no tuning coils are needed. Sensitivity can be improved with the addition of a wide-band rf amplifier front end, but it is important that the input of the phase-locked-loop should not exceed 0.5 Vrms.

The phase-locked-loop is locked to



the incoming amplitude modulated carrier and the voltage controlled oscillator provides the local oscillator signal. The amplitude of the demodulated signal at the output is a function of the phase relationship between the carrier and the local oscillator, being a minimum when the two are in quadrature and a maximum when either an in-phase or 180° degree out-of-phase condition exists. As the phase-locked-loop will always lock onto the input signal with a constant 90° phase error, it is necessary to add a 90° phase shift to compensate (Cy Ry).

For a receiver intended for use in the medium wave band from 550 kHz to 1.6 MHz, the 90° phase shift is set to be correct at the geometric mean of the frequency limits (= 0.94 MHz). Assuming a value of 3 kΩ for Ry, Cy is then:

$$Cy = \frac{1.3 \times 10^{-4}}{0.94 \times 10^{6}} = 135 \text{ pF}$$

The low-pass filter for the loop, C_L, is non-critical since no information is being derived from the loop error. It is only necessary to ensure loop stability. A value of 10 nF was found to be perfectly satisfactory for this component.

Tuning is accomplished by setting the voltage controlled oscillator frequency to the frequency to be received. Ignoring the tuning potentiometer for a moment, the voltage controlled oscillator frequency is set by C_o and is determined by the formula:

$$C_o = \frac{300 \text{ pF}}{f_o}$$

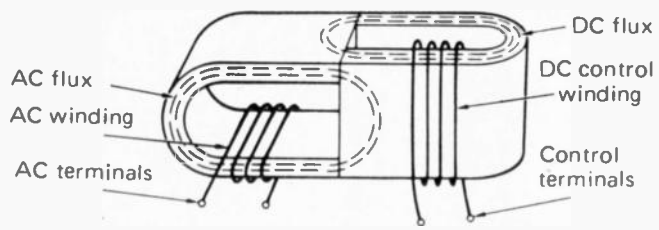
where f_o is in MHz.

Fine tuning can be achieved by varying the amount of current flowing into or out of pin 6. When this current is zero — corresponding to the potentiometer being set in the centre of its travel — the voltage controlled oscillator frequency is determined by C_o. A value of 330 pF will set the frequency close to 0.94 MHz, which is the centre of the required tuning range. The resistor in series with the potentiometer wiper is selected to provide the desired tuning range — about 1.2 kΩ when an 18 V power supply is employed.

Capacitor Cx is intended to roll-off the audio output to provide the desired bandwidth and should be calculated on the basis of an output resistance of 8 kΩ. Obviously the load resistance must also be taken into account for this calculation.

The receiver requires a good earth and, as mentioned earlier, sensitivity is improved by a wide-band rf amplifier.

REGULATOR COMPENSATES FOR LINE AND LOAD VARIATIONS



To assure constant voltage supply to electronic equipment in spite of line variations due to brownouts or other causes, Tele-Dynamics/Wanlass, Div. of Ambac, Ft. Washington, Pa., developed a new line called Varax line regulators. The regulator is based on the same principle as the Paraformer, a passive power conversion device introduced by the company several years ago.

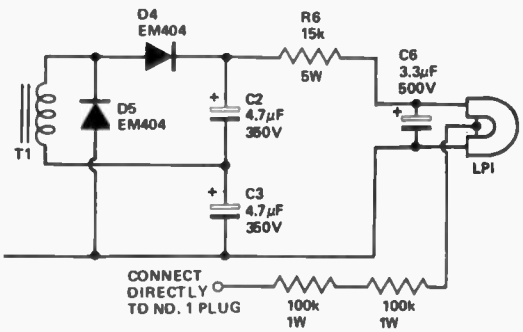
The varax units are intended for use in 115 or 230 volt applications. Since it is insensitive to frequency, the unit can be used on multiple frequency lines without modifications. The unit maintains constant voltage with ± 0.5 percent regulation for power line variations of 30-40%.

The operation is different from a saturable reactor core and is based on the principle that a small dc control current, proportional to voltage, controls the ac winding inductance in series with the load, thus permitting increase of decrease of the output ac voltage. The basic core consists of two C-cores each containing a winding, as shown. Due to this physical configuration the ac power is highly decoupled from the dc control circuit. The dc control winding contains a large number of turns resulting in low current requirement. Thus, 95 per cent regulator efficiency is said to be standard.

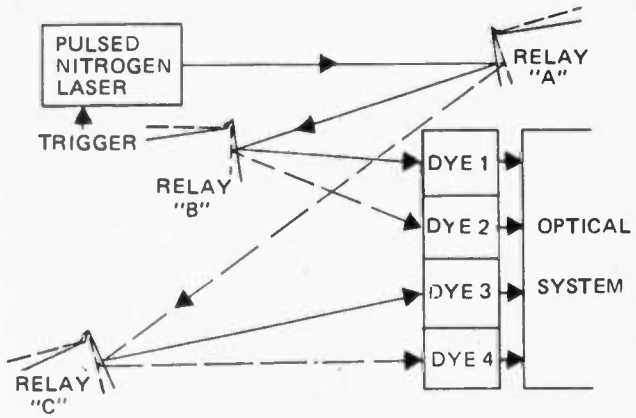
SIMPLER TRIGGERING
For ETI 310 Timing Light

This simplified triggering circuit may be used for the simple timing light where the energy from the spark coil triggers the flash tube directly.

The two 100 k 1W resistors limit the current in case of arcing. Note that the lead from the spark plug to the unit MUST be high tension cable. ●



IDEAS FOR EXPERIMENTERS



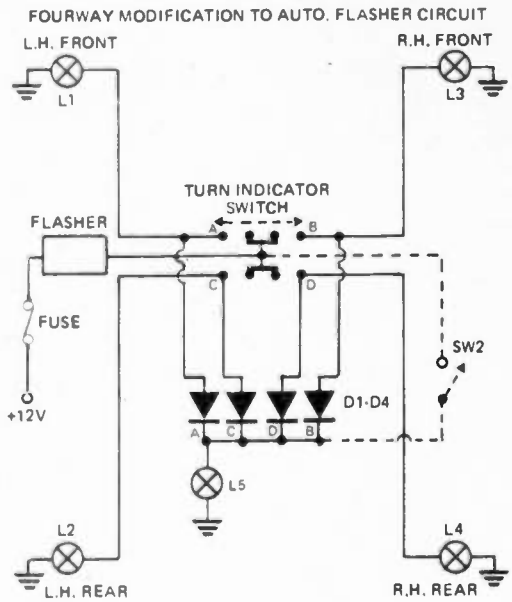
LIGHT DEFLECTION BY RELAYS

Relays not only trigger but actually *deflect* a laser beam in this extraordinary application. Following delays of 0, 30, 10, and 70 mS after control command, four dye cells are illuminated by a pulsed nitrogen laser according to a sequence programmed by control logic.

Deflection of the laser is done as shown in Fig. 1 using relays with polished and coated armatures which act as front surface mirrors. Relays are also adjusted for the required delays.

Struthers-Dunn Inc. N.J. USA

FOUR-WAY FLASHER ADAPTOR UNIT



Many current model cars now incorporate a turn indicator switch position which causes all four indicator lights to flash simultaneously. This is a valuable safety device if stalled on the road — especially at night.

Older model cars fitted with normal winking indicators can be converted to include this facility with the aid of a few diodes, a switch and a heavy duty flasher unit.

Since in the "four" position the flasher must switch twice its normal load it is advisable to substitute the normal flasher unit with a heavy duty one as supplied for use with caravans and trailers.

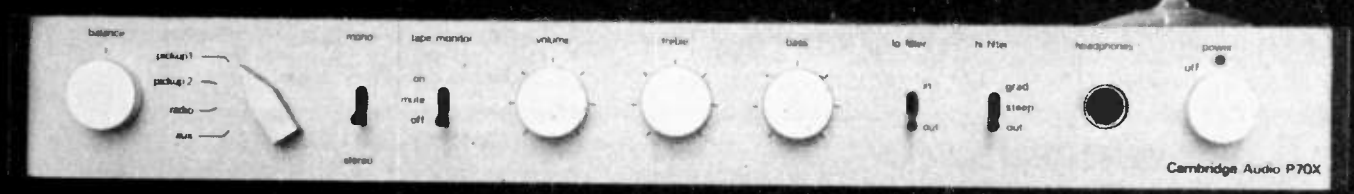
Diodes D1-D4 are any rectifier types capable of handling about 3 A. Switch 2 is fitted in on the dashboard and L5 is a optional indicator also located to the dashboard.

The circuit as shown will work with both 6 and 12 volt negative earth systems. If the wiring is positive earth, reverse the direction of the diodes. ●

Sleek, sheer soundpower. Cambridge Audio Integrated Amplifier. No fat, no frills. Just 5½ cms deep – but inside a massive toroidal mains transformer. Rated 35W it exceeds 45W effortlessly. All virtually distortion-free. In fact less than 0.05% at 1 Khz at all powers to full power – and crossover distortion almost non-existent. The sound? Incredible low frequency response at high levels. Hugely forgiving for boisterous speakers. Separate outlet uniquely sensitive for tape volume.

Computer-safe
Overload is impossible. Fail safe protection computes three ways – pre-amp analog on gain control; automatic output monitor; intricate double – fusings.

After this, other amps look clumsy.... and sound it.



International experts hail Cambridge Audio equipment as a triumph of intelligent design, and quality without compromise . . . "in the highest rank". For instance the matching Transmission Line Speakers are unique in their use of a long hair lambswool damped tapered labyrinth. The result is so rich and natural it has to be experienced to be believed.
This is truly ultimate sound – by specialists, for enthusiasts. But the most remarkable thing is the cost: literally about half what your ear hears.

Cambridge Audio

For people who listen to music . . . naturally

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MICROPROCESSORS

IEU is making available for the first time anywhere an extremely versatile 16 bit microprocessor kit. The basic kit includes all necessary components to build a 16 bit microprocessor. Optional memory boards are available allowing possible expansion of the basic system to microcomputer or minicomputer proportions.

Basic Kit Includes: PRICE (basic kit) $349.50

A printed circuit boards (compatible with 22 pin edge connectors – not supplied)
B microprocessor chip set
C gates, interface elements, clock drivers, etc.
D transistors, diodes, capacitors
E 75 page data package which includes an introduction to microprocessors, all necessary data sheets and extensive data on the workings and applications of microprocessor chips.

Available Options

1 power supply component pkg.
2 memory board #1 (employs 1101 rams)
3 memory board #2 (employs 1101 rams and 5203 erasible PROMS)

Basic Data Package

available separately
refundable with purchase of basic kit $5.00

TRANSISTORS

DEVICE	FUNCTION	CROSS REF ** SK	HEP	SPECIFICATIONS HFE	VCEO	VCBO	VEBO	IC(A) AMP	IB(A) AMP	TOT DIS (WATTS)	FREQ MHZ	CASE	PRICE
PWR AMP AUDID													
40411	"	3036		35-100	80	90	5.0	30	15	150	1.5	TO-3	$3.75
40636	"	3027	704	20-70	95*	95*	7.0	15	7.0	115		TO-3	1.95
2N3714	"	3036	704	25-90	80	100	7.0	10	4.0	150	4.0	TO-3	2.59
2N3715	"	3036	704	50-150	60	80	7.0	10	4.0	150	4.0	TO-3	2.75
RF PWR AMP													
2N5320	"	3512	53002	30-130	75	100	7.0	2	1.0	10	50	TO-5	1.65
2N5322 (P)	"			30-130	75	100	7.0	2	1.0	10	50	TO-5	1.75
2N5321	"	3512	53010	40-250	50	75	5.0	2	1.0	10	50	TO-5	1.65
2N5323 (P)	"	3513		40-250	50	75	5.0	2	1.0	10	50	TO-5	1.65
PWR DRIVER													
2N5679 (P)	Audio/RF		53031	40-150	100	100	4.0	1.0	0.5	10	30	TO-5	1.70
2N5681				40-150	100	100	4.0	1.0	0.5	10	30	TO-5	1.70
AUDID DRIVER													
40594	"	3024	53002	70-350	95*		4.0	2.0	1	10	1.0	TO-5	1.45
40595 (P)	"	3025	53031	70-350	95*		4.0	2.0	1	10	1.0	TO-5	1.65
2N5781 (P)	"			20-100	65	80	5.0	3.5	1	10	1.0	TO-5	1.75
2N5784	"		53002	20-100	65	80	5.0	3.5	1	10	1.0	TO-5	1.75
2N5864 (P)	RF & Audio			25-500	70	90	5.0	1.5		8.75	50	TO-39	1.35
40348	"	3044	243	30-125	40	60	7.0	1.5	0.5	8.75	1.6	TO-5	1.72
40544	"	3045		35-200	50*	50*	5.0	0.7		7.0	100	TO-5	.79
GEN PURP AMP													
2N2895	RF & Audio	3024		40-120	65	120	7.0	1.0		1.8	120	TO-18	1.25
2N930A	Lo Noise	3039	50	100-300	60	60	6.0	.03		1.8	.45	TO-18	.95
2N2219A	Audio UHF Amp/SW	3024	53001	75-375	40	75	6.0	.8		1.8	300	TO-5	1.05
2N2846	High Speed Sw	3024		30-120	30	60	5.0	.8		3.0	250	TO-5	1.55
HF GEN PURP													
2N3933	VHF UHF Amp	3039	56	60-200	30	40		.002		2	750	TO-72	1.55
40894	VHF UHF RF Amp	3039		50-250	12	20	2.5	.05		.3	1200	TO-72	1.10
40895	VHF UHF Mix, Osc	3039		40-250	12	20	2.5	.05		.3	1200	TO-72	.95
40897	VHF UHF IF Amp	3039		70-250	12	20	2.5	.05		.3	800	TO-72	.90
2N5179	LoNoise, Amp, Osc, Mix, Conv	3039	709	25-250	12	20	2.5	.05		.3	2000	TO-72	1.10
2N918	VHF UHF Amp Mix, Conv	3039	709	20 Min	15	30	3.0	.05		.3	600	TO-72	.95
2N2905A(P)	DC, VHF, Amp Hi Sp Sw	3025	708	100-300	60	60	5.0	.6		3.0	200	TO-5	1.15

**Manufacturers' (SK, RCA, HEP, MOTOROLA) Suggested Cross Reference. *External Res (R_{BE}) = 100 OHMS

TRANSISTORS ARE NEW, FIRST QUALITY, BRANDED DEVICES – ON HAND FOR IMMEDIATE SHIPMENT

RESISTORS

15	ohm	5%	1w Corning	Film	.08
15	ohm	5%	25w Ohmite	WW	.75
28.7	ohm	1%	1w Dale	Film	.25
75	ohm	5%	8w Ohmite	WW	.39
102	ohm	1%	½w Corning	Film	.15
200	ohm	5%	5w Intl. Tect.	WW	.30
220	ohm	10%	½w Stackpole	C Comp	.07
330	ohm	5%	½w Stackpole	C Comp	.10
390	ohm	5%	2w Allen Bradley	C Comp	.25
450	ohm	5%	5w Dale	WW	.30
500	ohm	5%	1w Allen Bradley	C Comp	.19
620	ohm	5%	½w Stackpole	C Comp	.10
681	ohm	1%	¼w Dale	Film	.20
750	ohm	1%	¼ Dale	Film	.20
1	Kohm	1%	½w Corning	Film	.15
1	Kohm	5%	10w Dale	WW	.35
1.2	Kohm	1%	1w Intl. Rect.	C Comp	.25
1.6	Kohm	5%	½w Stackpole	C Comp	.10
2	Kohm	1%	¼w Dale	Film	.20
2	Kohm	5%	5w Intl. Rect.	WW	.30
2.15	Kohm	1%	½w Corning	Film	.15
2.4	Kohm	1%	5w Intl. Rect.	WW	.50
2.5	Kohm	5%	25w Ohmite	WW	.75
2.7	Kohm	5%	5w Dale	WW	.30
3.01	Kohm	1%	½w Electra	Film	.15
4	Kohm	5%	10w Dale	WW	.35
4.7	Kohm	1%	½w Corning	Film	.15
5.6	Kohm	5%	2w A.B.	C Comp	.25
7.5	Kohm	5%	½w Burroughs	C Comp	.10
8.25	Kohm	1%	½w Electra	Film	.15
9.09	Kohm	1%	½w Corning	Film	.15
9.1	Kohm	5%	2w A.B.	C Comp	.25
10	Kohm	1%	½w Corning	Film	.15
15	Kohm	10%	½w Stackpole	C Comp	.07
17.4	Kohm	1%	½w Corning	Film	.15
20	Kohm	5%	1w A.B.	C Comp	.19
23.7	Kohm	2%	¼w Corning	F Im	.15
39	Kohm	1%	½w Corning	F Im	.15
51	Kohm	5%	½w Burroughs	C Comp	.10
75	Kohm	1%	½w Corning	Film	.15
100	Kohm	1%	½w Corning	Film	.15
120	Kohm	5%	½w Burroughs	C Comp	.10
130	Kohm	5%	½w Stackpole	C Comp	10

CAPACITORS

.0033	mfd	100V	5%	Skottie mylar axial	S .10
.0047	mfd	100V	10%	G.E. mylar axial	.09
.0047	mfd	100V	10%	Gen. Inst. mylar axial	.09
.01	mfd	200V	20%	Aerovox paper axial	.05
.02	mfd	100V	1%	Sprague mylar axial	.15
.1	mfd	600V	3%	Aerovox paper axial	.20
.1	mfd	400V		Aerovox paper axial	.20
.1	mfd	200V		CDE paper axial	.15
.1	mfd	200V		Aervox paper axial	.15
.5	mfd	400V	10%	Gen. Inst. mylar axial	.35
1.0	mfd	200V		Aerovox axial	.20
2.0	mfd	200V	20%	Aerovox axial	.20
4.0	mfd	350V		Sprague Elec axial	.45
5.0	mfd	25V		Gen. Inst. Elec axial	.15
10	mfd	150V		Sprague Elec axial	.30
30	mfd	300V		Mallory Elec axial	.35
60	mfd	350V		Mallory Elec axial	.75
1,000	mfd	100V		Sangamo Comp grd can	2.65
1,000	mfd	50V		CDE Elec axial	1.25
2,000	mfd	15V		Mallory Elec can	.85
6,000	mfd	25V		Sangamo Comp grd can	3.75
50	mfd	285V		I.C.C. oil imp bathtub	.60

SWITCHES

SPST	1A Momentary Return P.B.-A.H.&H.	.25
SPST	15A Micto switch Flat leaf	.50
DPST	5A Micro switch Pin plunger	.75
DPST	10A Micro switch-mini Pin plunger	.65
DPST	10A Pin plunger	.65
4P3T	6A Slide Stackpole	.25

MISC. COMPONENTS

1 ohm 25w 5A Memcor wire wound pot.	1.95
100 ohm ½w Bourns EZ trim WW 30 turn pot.	1.50
10 Kohm ½w Bourns EZ trim WW 10 turn pot.	1.50
MDA 962 Motorola fullwave bridge 10A 100V	4.95
AEX 43 1 TEC selenium Rectifier	.05
IN 2990A Motorola 33V 1w zener diode	1.95
LA 2751 Fenwell Thermister 550-100	.75
6113 Elwood Thermal	.75
Panel Light PTT red DPST SW W/ Mount Tec	.95
Panel Light red Neon W/NE 2 Bulb Snap Mount	.45
4 Terminal Chassis Count Terminal Strip	10/.25
Chassis Mount Cable Clamp ½" Nylon	15/.25

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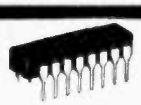

	Ea.		Ea.		Ea.
7400	$ .19	7447	$1.15	74141	$1.23
7401	.19	7448	1.15	74145	1.15
7402	.19	7450	.24	74150	1.09
7403	.19	7451	.27	74151	.89
7404	.22	7453	.27	74153	1.29
7405	.22	7454	.39	74154	1.59
7406	.39	7460	.19	74155	1.19
7407	.39	7464	.39	74156	1.29
7408	.25	7465	.39	74157	1.29
7409	.25	7472	.36	74161	1.39
7410	.19	7473	.43	74163	1.59
7411	.29	7474	.43	74164	1.89
7413	.79	7475	.75	74165	1.89
7415	.39	7476	.47	74166	1.65
7416	.39	7483	1.11	74173	1.65
7417	.39	7485	1.39	74176	1.65
7420	.19	7486	.44	74177	.99
7422	.29	7489	2.75	74180	1.09
7423	.35	7490	.76	74181	3.65
7425	.39	7491	1.29	74182	.89
7426	.29	7492	.79	74184	2.69
7427	.35	7493	.79	74185	2.10
7430	.22	7494	.89	74190	1.59
7432	.29	7495	.89	74191	1.59
7437	.45	7496	.89	74192	1.49
7438	.39	74100	1.65	74193	1.39
7440	.19	74105	.49	74194	1.39
7441	1.09	74107	.49	74195	.99
7442	.99	74121	.57	74196	1.85
7443	.99	74122	.53	74197	.99
7444	1.10	74123	.99	74198	2.19
7445	1.10	74125	.69	74199	2.19
7446	1.15	74126	.79	74200	7.95
LOW POWER TTL					
74L00	.33	74L51	.33	74L90	1.69
74L02	.33	74L55	.33	74L91	1.45
74L03	.33	74L71	.33	74L93	1.69
74L04	.33	74L72	.49	74L95	1.69
74L06	.33	74L73	.69	74L98	2.79
74L10	.33	74L74	.69	74L164	2.79
74L20	.33	74L78	.79	74L165	2.79
74L30	.33	74L85	1.25		
74L42	1.69	74L86	.69		
HIGH SPEED TTL					
74H00	.33	74H21	.33	74H55	.39
74H01	.33	74H22	.33	74H60	.39
74H04	.33	74H30	.33	74H61	.39
74H08	.33	74H40	.33	74H62	.39
74H10	.33	74H50	.33	74H72	.49
74H11	.33	74H52	.33	74H74	.59
74H20	.33	74H53	.39	74H76	.59
8000 SERIES TTL					
8091	.59	8214	1.69	8811	.69
8092	.59	8220	1.69	8812	1.10
8095	1.39	8230	2.59	8822	2.59
8121	.89	8520	1.29	8830	2.59
8123	1.59	8551	1.65	8831	2.59
8130	2.19	8552	2.49	8836	.49
8200	2.59	8554	2.19	8880	1.33
8210	3.49	8810	.79		
9000 SERIES TTL					
9002	.39	9309	.89	9601	.99
9301	1.14	9312	.89	9602	.89

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CMOS

74C00	.39	74C74	1.15	74C162	3.25
74C02	.55	74C76	1.70	74C163	3.25
74C04	.75	74C107	1.50	74C164	3.50
74C08	.75	74C151	2.90	74C173	2.90
74C10	.65	74C154	3.50	74C195	3.00
74C20	.65	74C157	2.19	80C95	1.50
74C42	2.15	74C160	3.25	80C97	1.50
74C73	1.55	74C161	3.25		

JANUARY SPECIALS

7406	Hex inverter DIP	$ .35
7440	Dual 4 input buffer DIP	.17
7454	AND OR INVERT gate DIP	.23
74164	Serial in parallel out 8 bit shift register DIP	1.69
7474	Dual D flip-flop DIP	.29
74125	Tri state quad buffer DIP	.55
74175	Quad D flip-flop w/clear DIP	1.80
8230	Tri state 2-4 line demultiplexer DIP	1.95
8830	Dual line driver	1.75
8836	Quad 2 input receiver	.25
301	Hi perf amplifier mini-dip	$ .19
380	2W audio amp DIP	1.35
3900	Quad amplifier DIP	.39
1103	1024-bit dynamic RAM MOS 18 pin DIP	2.95
5260	1024-bit dynamic RAM MOS low power 16 pin DIP	2.95
5316	6 digit, 50-60 Hz, 12-24 hr., alarm-snooze alarm, presettable sleep timer 40 pin DIP	6.95
MAN66	Red, spaced seg, .6" common anode-LH dec (sep anode) 14 pin DIP	3.95

MEMORIES

1101	256 bit RAM MOS	1.75
1103	1024 bit RAM MOS	4.95
5260	1024 bit RAM Low Power	3.95
7489	64 bit RAM TTL	2.75
8223	Programmable ROM	4.95

CALCULATOR & CLOCK CHIPS w/data

5001	12 DIG 4 funct fix dec	3.95
5002	Same as 5001 exc btry pwr	7.95
5005	12 DIG 4 funct w/mem	8.45
MM5725	8 DIG 4 funct chain & dec	2.79
MM5736	18 pin 6 DIG 4 funct	4.95
MM5738	8 DIG 5 funct K & Mem	7.95
MM5739	9 DIG 4 funct (btry sur)	6.95
MM 5311	28 pin BCD 6 dig mux	9.95
MM 5312	24 pin 1 pps BCD 4 dig mux	6.95
MM 5313	28 pin 1 pps BCD 6 dig mux	7.95
MM 5314	24 pin 6 dig mux	8.95
MM 5316	40 pin alarm 6 dig	8.95

LED & OPTO ISOLATORS

MV10B	Red TO 18	$ .25 ea.
MV50	Axial leads	.20
MV5020	Jumbo Vis. Red (Red Dome)	.33
	Jumbo Vis. Red (Clear Dome)	.33
ME4	Infra red diff. dome	.60
MAN1	Red 7 seg. .270"	2.50
MAN2	Red alpha num .32"	4.95
MAN3A	Red 7 seg. .127"	.79
MAN3M	Red 7 seg. .127" claw	1.15
MAN4	Red 7 seg. .190"	2.15
MAN5	Green 7 seg. .270"	2.95
MAN6	.6" high solid seg	6.95
MAN7	Red 7 seg. .270"	1.35
MAN8	Yellow 7 seg. .270"	3.95
MAN64	.4" high solid seg	4.50
MAN66	.6" high spaced seg	4.65
DL707	Red 7 seg. .3"	2.15
MCD2	Opto-iso diodes	1.09
MCT2	Opto-iso transistor	.69

DTL

930	$ .17	937	$ .17	949	$ .17
932	.17	944	.17	962	.17
936	.17	946	.17	963	.17

4000 SERIES — RCA EQUIVALENT

CD4001	.55	CD4013	1.20	CD4023	.55
CD4009	.85	CD4016	1.25	CD4025	.55
CD4010	.85	CD4017	2.95	CD4027	1.35
CD4011	.55	CD4019	1.35	CD4030	.95
CD4012	.55	CD4022	2.75	CD4035	2.85

LINEAR CIRCUITS

300	Pos V Reg (super 723)	TO-5	.79
301	Hi Perf	mDIP TO-5	.32
302	Volt follower	TO-5	.79
304	Neg V Reg	TO-5	.89
305	Pos V Reg	TO-5	.95
307	Op AMP (super 741)	mDIP TO-5	.35
308	Micro Pwr Op Amp	mDIP TO-5	1.10
309K	5V 1A regulator	TO-3	1.65
310	V Follower Op Amp	TO-5 mDIP	1.19
311	Hi perf V Comp	mDIP TO-5	1.05
319	Hi Speed Dual Comp	DIP	1.29
320	Neg Reg 5.2, 12, 15	TO-3	1.35
324	Quad Op Amp	DIP	1.95
339	Quad Comparator	DIP	1.69
340T	Pos Volt Reg (6V-8V-12V-15V-18V-24V)	TO-220	1.95
370	AGC/Squelch AMPL	TO-5 or DIP	1.15
372	AF IF Strip detector	DIP	.79
373	AM/FM/SSB Strip	DIP	3.25
376	Pos. V Reg	mDIP	.59
377	2w Stereo amp	DIP	2.69
380	2w Audio Amp	DIP	1.49
380-8	.6w Audio amp	mDIP	1.25
381	Lo Noise Dual preamp	DIP	1.79
382	Lo Noise Dual preamp	DIP	1.79
550	Prec V Reg	DIP	.79
555	Timer	mDIP	.99
560	Phase Locked Loop	DIP	2.75
562	Phase Locked Loop	DIP	2.75
565	Phase Locked Loop	DIP TO 5	2.65
566	Function Gen	mDIP TO 5	2.75
567	Tone Gen	mDIP	2.95
709	Operational AMPL	TO 5 or DIP	.29
710	Hi Speed Volt Comp	DIP	.39
711	Dual Difference Compar	DIP	.29
723	V Reg	DIP	.69
739	Dual Hi Perf Op Amp	DIP	1.19
741	Comp Op AMP	mDIP TO 5	.35
747	Dual 741 Op Amp	DIP or TO 5	.79
748	Freq Adj 741	mDIP	.39
1304	FM Mulpx Stereo Demod	DIP	1.19
1307	FM Mulpx Stereo Demod	DIP	.82
1458	Dual Comp Op Amp	mDIP	.69
LH2111	Dual LM 211 V Comp	DIP	1.95
3065	TV FM Sound System	DIP	.69
3075	FM Det LMTR & Audio preamp	DIP	.79
3900	Quad Amplifier	DIP	.59
3905	Precision Timer	DIP	.65
7524	Core Mem Sense AMPL	DIP	1.89
7534	Core Mem Sense Amp	DIP	2.59
8038	Function Gen	DIP	5.95
8864	9 DIG Led Cath Drvr	DIP	2.50
75451	Dual Peripheral Driver	mDIP	.39
75452	Dual Peripheral Driver	mDIP	.39
75453	(351) Dual Periph. Driver	mDIP	.39
75491	Quad Seg Driver for LED	DIP	.79
75492	Hex Digit Driver	DIP	.89

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