PROJECTS:

CMOS BURGLAR ALARM  •  FLIP-FLOP FLASHER
UNDER $30 DIGITAL CLOCK  •  BEST EVER CDI IGNITION
The best-bred four channel.

4VN550  Integrated 4 channel amplifier. Powerful 50 watts (RMS) output with a high frequency response of 20-50,000 Hz.

4DD5 CD4  Demodulator that is essential to transfer the 4 channel signals separately from a discrete 4 channel record through your 4 channel stereo system.

SRP87  4 channel ready belt drive turntable.

5911  4 channel remote balance control.

SX3  A true revolution in speaker design and construction, with soft dome speaker. Rating 25 watt (RMS).

4MD 20X  Very wide range cartridge (up to 50,000 Hz) with special ‘Shibata’ stylus designed for CD4 records.

Above is just a sample:
For the complete colour catalogue of JVC NIVICO CD-4 four channel systems write to:-

CD-4 ADVISORY SERVICE
Hagemeyer (Australasia) B.V
P.O. Box 49, Kensington, N.S.W. 2033

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COVER: Extract from original painting 'Dreamer and the Fool' by 26-year-old Sydney artist, Jane Le Rossignol.
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Ask for our quotation to send equipment anywhere in Australia at our competitive prices. All new equipment with full manufacturers guarantees that we can back up ourselves.

Want a lead to suit your set to match that accessory? Want any type of plug? Also, complete stocks of spare parts for National, Nivico, Teac, Jorgen, ESS, Marantz, and many others. Largest range of equivalent parts to suit those hard-to-get spare parts for rare models.
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- We are audio experts, so trust us
- We have expanded to give better service, to give you a better purchase
BSR 810 Automatic/Manual Transcription Turntable

The top of the BSR range and suitable for the most sophisticated systems whether professional or for the connoisseur. Operated by a pre-programmed sequential cam system for beautifully smooth operation. A low mass transcription arm floats in a concentric gimbal arm mount, virtually eliminating tracking error. It has precise zero balance adjustment over the full range of cartridge and stylus masses. The die-cast, dynamically balanced 6¾ lb. turntable is driven by a high torque synchronous 4-pole motor. The automatic change is worked on an umbrella type centre spindle to save wear on your records. The 810 also features variable pitch control, dual range anti-skate, stylus position gauge, stylus brush, automatic tone arm lock, slide-in cartridge carrier and viscous damped cue and pause with exclusive friction clutch. The unit is complete with an ADC K5E magnetic cartridge with elliptical diamond stylus and is now mounted in a specially selected quarter cut teak veneer plinth with a smoke tinted perspex cover. $271.18*

BSR HT70 Three Speed Single Play Turntable.

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 a smoke tinted dust cover. $137.45*

*Recommended retail price at the time of going to press.
For years we've been one of the major component suppliers to the industry. That component being changers. We've been gathering experience and along the way we have picked up a lot of inside knowledge about what the hi-fi buff wants. And what he needs. Now we've made some changes. A new range of BSR turntables is available to you. Automatic, transcription and priced to suit any system.

**SOME CHANGERS**

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*

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*
Twin power!

**ROTEL RA 1210 is here.**

The integrated Stereo Amplifier which was reviewed by the authoritative American magazine, "Stereo Review" as follows:

"Each channel has its own individual power supply with separate power transformer."

"With 4 ohm loads, maximum output was 84 watts per channel."

"1000 Hz harmonic distortion was between 0.02% and 0.05% at power outputs from 1.5 watts to slightly more than 60 watts."

"The RA 1210 has an unusually flexible tape recording and monitoring system."

"Distortion was under 0.05% from 20 to 8,000 Hz at full power."

"The highest dynamic range we have yet measured on an amplifier."

"A 'quality' feel that complements its excellent electrical characteristics."

We'd just like to add that the RA 1210 (below) has advanced direct coupled circuitry, ensuring an excellent frequency response (3-100,000 Hz + 0dB — 3dB) superb signal/noise ratio and extended dynamic range.

---

**Available from:**

**N.S.W.** M & G Hoskins Pty Ltd, 37 Castle St, Blakehurst 2221

Telephone: 546 1484

**Q’L.D.** Stereo Supplies, 95 Turbot St, Brisbane 4000

Telephone: 21 3623

**S.A.** Challenge Hi-Fi Stereo, 96 Pirie St, Adelaide 5000

Telephone: 223 3599

**TAS.** Audio Services, 44 Wilson St, Burnie 7320

Telephone: 31 2390

**VIC.** Encel Electronics Pty Ltd, 431 Bridge Rd, Richmond 3121

Telephone: 42 3782

**W.A.** Albert TV & Hi-Fi, 282 Hay St, Perth 6000

Telephone: 21 5034

**A.C.T.** Duratone Hi-Fi, Cnr Botany St & Altreet Crt, Phillip 2606

Telephone: 82 1388

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ELECTRONICS TODAY INTERNATIONAL — JANUARY 1975
Celestion Ditton 25... they're back!

Hen's teeth have been plentiful by comparison — until now! We've had an assurance from the manufacturer that these superb speakers will be coming from England in regular shipments, so start looking for them at any of the addresses below. If you know Celestion Ditton 25, make new acquaintance with this superb speaker system. If you don't — then prepare to hear the speakers which 'Electronics Australia' classified as "one of the finest loudspeakers ever introduced to the Australian market".

(Complete review available.)

Celestion Ditton 25 reproduces all frequencies with the utmost realism from 20 Hz to 40 kHz. The design utilises the highly successful Auxiliary Bass Radiator so that even organ pedal notes are reproduced with superb realism. The ultra-wide bandwidth and smooth response ensures the truest reproduction of all types of orchestral and vocal sounds.
Size: 32" x 14" x 11".
Overall frequency response: 20 Hz to 40 kHz.
Power handling capacity: 25 watts RMS, 50 watts peak.
Impedance 4-8 ohms.
Drive units: 12" Auxiliary Bass Radiator, 12" long throw bass speaker, 2 pressure type mid and high frequency units.

... and so are DITTON 66 MONITORS, DITTON 15's and DITTON 44's.

Available from:

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Telephone: 5461484

Q'LD. Stereo Supplies, 95 Turbot St, Brisbane 4003
Telephone: 213823

S.A. Challenge Hi-Fi Stereo, 96 Pirie St, Adelaide 5000
Telephone: 2233599

TAS. Audio Services, 44 Wilson St, Burnie 7320
Telephone: 312390

VIC. Encel Electronics Pty Ltd, 431 Bridge Rd, Richmond 3121
Telephone: 423762

W.A. Albert TV & Hi-Fi, 282 Hay St, Perth 6000
Telephone: 215004

A.C.T. Duratone Hi-Fi, Cnr Botany St & Alltree Crt, Phillip 2606
Telephone: 821388

ELECTRONICS TODAY INTERNATIONAL — JANUARY 1975
for the sweetest sounds of all...
TDK's "total performers"

There's no doubt about it. TDK's
great new Dynamic-series cassettes
offer serious home recordists sound
reproduction unequalled by any
other cassette sold today. And the
reason is very simple. They deliver
total performance!

Total performance means more than
just full-range frequency response
and high-end sensitivity. It also
means having the proper balance of
all the other characteristics essen-
tial to reproducing "real-life" sound.
Like high MOL (maximum output
level), Broad dynamic range. Wide
bias tolerance. High signal-to-noise
ratio. TDK's Dynamic-series cas-
settes have them all!

You'll quickly discover this fact when
you record your favorite music on
one of TDK's Dynamic-series cas-
settes. You capture all the highs and
lows, all the harmonics and over-
tones, all the emotion and feeling
that gave the original performance
its richness, fullness and warmth.

Look for TDK's "total performers" at
quality sound shops everywhere. Ex-
tra Dynamic (ED) cassettes offer the
discriminating audiophile an entirely
new dimension in recording fidelity.
Super Dynamic (SD), the tape that
turned the cassette into a true high-
fidelity medium, still has better-
balanced total performance charac-
teristics than any other brand made
...and is also available in open reel.
And Dynamic (D) is an entirely new
hi-fi cassette that provides budget-
minded recordists with excellent
quality at moderate prices. All pro-
vide optimum performance on any
cassette recorder, without need for
special bias.

For sound you feel as well as hear,
discover the dynamic new world of
TDK's total performers!

DYNAMIC-series cassettes are:
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for those who want the very best. 45,
60 and 90 minutes.
Super Dynamic (SD): first true hi-fi
cassette started a revolution in the
tape industry. 45, 60, 90 & 120-min.
Dynamic (D): characteristics supe-
rior to most "premium" cassettes. 45,
60, 90, 120 and world's only 180-min.

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DOUGLAS HI-FI

Here are just some of the typical savings from Douglas Hi-Fi in Melbourne, Sydney, Perth and Canberra.

LINEAR DESIGN 169 HI-FI SYSTEM, features Garrard automatic turntable, Shure magnetic cartridge, diamond stylus, connection for tape recording/ playback, 24 watts RMS power, heavy duty twin cone 8" speakers. In acoustically-correct cabinet:
$199 complete, with 2 year warranty.

LINEAR DESIGN 2500 SYSTEM, a DGT-II transcription turntable with Shure 555 cartridge, hydraulic lift, magnetic anti-skate, gold bearing, dynamic balance. Amplifier has 50 watts RMS power output, complete range inputs and auxiliary circuits, tape dubbing facilities a 15" bass speakers, 3½" tweeters. Douglas Hi-Fi price $390 complete.

AKAI GXC 46-D, THE GREATEST VALUE IN HI-FI CASSETTE STEREO TAPE RECORDERS TODAY! Famous Dolby system, chrome tape switch, glass crystal ferrite head, automatic distortion reduction system. DOUGLAS HI-FI PRICE WITH 12 MONTHS WARRANTY $299.

JENSEN SPEAKERS MODEL 15. The finest speaker system. Jensen has ever made. 13" woofer with 11 lb. Binton 6 ceramic magnet structure, 8" mid-range driver, 5½" rear damped tweeter, two 1" drivers, Jensen's 'Bonodome' ultra-tweeters, 100 watt power rating. Special Douglas Hi-Fi price.

JENSEN MODEL 6, features 15" woofer for thundering no-strain bass, 8" and 5½" Floralor drivers for crisp clean mono. Special Douglas Hi-Fi price. 5-Year Parts and labour warranty on all Jensen Speakers.

AKAI 4000DS PROFESSIONAL 3-HEAD TAPE DECK. Exclusive one-micron gap head extends frequency response fast to 25,000 Hz, auto-stop for editing, tape selector switch, sound mixing, 4 track stereo and mono operation with up to 7 speed. $299 with 12 month warranty.

LINEAR DESIGN 2500 AMP. 100 watts RMS power, every possible control including 2 tape monitors. A 6 & 8 speaker switching, microphone mixing, plugs for pre-amplifier amp connection. $198.

LINEAR DESIGN 1988 AMP. 32 watts RMS power, both channels driven at 0.3% distortion, magnetically shielded inputs, stereo headphone output, bass/treble controls, loudness filter and tape monitor circuit, $89.

LINEAR DESIGN 2500 AMP. 50 watts RMS power, 0.3% distortion, complete range inputs and auxiliary circuits: rumbles, scratch and loudness filters, twin tape monitors, switching for 2 pairs of speakers. $89.

ALL LINEAR DESIGN UNITS ARE COVERED BY AN EXCLUSIVE NO-FUSS 2-YEAR WARRANTY.

MAIL ORDERS A SPECIALTY! ALL ORDERS SENT FREIGHT-FREE (and insurance-free) ANYWHERE IN YOUR STATE.

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AUSTRALIA'S ORGANISATION NOW SYDNEY AND
All the great

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Melbourne, 3000. Phone 63 9321.
Drive-In Service Centre,
202 Pelham St., Carlton.
Phone 347 8412.

Call in now and see the gear and prices that make us Australia's HI-FI sales leaders. Douglas HI-FI is the only showroom in Melbourne where you can see more than 30 of the world's leading brands together. And compare any combination of turntable, tape deck, amplifier and speaker instantaneously—in Australia's most sophisticated demonstration rooms.

If you want expert advice, you can trust our consultants, they are all HI-FI enthusiasts—not just salesmen.

Huge nation wide bulk buying power enables Douglas to bring you all these top brands at SPECIAL LOW PRICES. Douglas sells sound for less!
Great news for N.S.W. Douglas Hi-Fi have opened exciting new showrooms in Sydney. Here you can see all the world’s leading gear – at Special low prices.

We’re the biggest Hi-Fi organisation in Australia, so we buy at better prices than anyone else. We do our own importing – in bulk. Often by the container load. And we pass the savings on to you.

See, hear and compare all the great brands together, in a single showroom. More than 30 top brands, from 4 continents. Hundreds of different models, the most comprehensive range in Australia.

All fully guaranteed, and backed by Australia’s fastest, best equipped drive-in service centre.

Douglas sells sound for less!
If you're not impressed by Australia's biggest Hi-Fi showrooms, you'll certainly be impressed by the range and quality of our equipment—and our low prices.

More than 30 top brands, from 4 continents, displayed in a single showroom. There are hundreds of different models to choose from. And to make it easy for you to make the right selection, custom-built electronic comparators enable you to compare any combination of record player, tape deck, amplifier and speakers instantaneously. Because we buy bigger than anyone else, we buy cheaper. And we pass the savings on to you. Call in and prove to yourself that Douglas sells sound for less!

BUY FOR CASH, LAY-BY OR EASY TERMS ARRANGED!
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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Monarch 8000  110 watts RMS
Monarch 800   80 watts RMS
Monarch 88    48 watts RMS
Monarch 80    24 watts RMS

You know you're getting Monarch quality. Without paying more.

Monarch Amplifiers remain "kings" on a power-to-performance-to-cost rating.

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Monarch 8000  110 watts RMS
Monarch 800   80 watts RMS
Monarch 88    48 watts RMS
Monarch 80    24 watts RMS

Available from reputable dealers everywhere.

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AVAILABLE FROM REPUTABLE DEALERS EVERYWHERE
NEW ELECTRON MICROSCOPE TO BE INSTALLED IN SYDNEY

The MR 60, 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 SUS395,000 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, multicolored filters, spectrometers and photographic 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 is 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 when the switching unit is in a normal state. Faults are indicated by a luminescent diode glow on the front panel of the faulty 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 MICROPROCESSOR

A 16-bit single-chip microprocessor (called PACES) 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 unmistakable.

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 12½” W x 9½” D

Speaker Systems are priced from $250 pr.

*ALTEC LANSING equipment is used by:

WALT DISNEY PRODUCTIONS  UNITED ARTISTS
PARAMOUNT STUDIOS  MUSIC CITY STUDIOS
AND MANY OTHER STUDIO LOCATIONS ACROSS THE WORLD

A new limited shipment of Altec Lansing equipment has just arrived at:

KENT HI-FI

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**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 range 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 Shinhau 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.

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**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, navails 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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ADVENT  AND MANY OTHERS

20
US STAFF RETRENCED
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 laid off 4500 of its previous 30,000 workforce. Texas have now dropped nearly 8000 of its 73,800 previous staff whilst Signetics have laid 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 SUS600.

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 . . .
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.

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

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**The turntable voted No.1 by an independent consumer organisation**
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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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PIONEER
High fidelity stereo. That's how perfection sounds.
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.
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 respectability.

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 habitations. 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 essential 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
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 Kosciusko 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!

<table>
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<th>PROPOSED HABITATS</th>
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<td><strong>Unit</strong></td>
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Dates quoted are earliest possible assuming work started almost immediately. Population is for double units as shown in our main drawing.
The Trade Practices Act, 1974, came into force on October 1, 1974. There are important new provisions in this Federal Act of Parliament which contain strict regulations on advertising.

All advertisers and advertising agents are advised to study those provisions very carefully as heavy penalties are imposed.

It can be an offence for anyone to engage, in trade or commerce, in conduct "misleading or deceptive." In particular Section 53 contains prohibitions from doing any of the following in connection with the supply of goods or services or in connection with the promotion, by any means, of the supply or use of goods or services.

FALSELY represent that goods or services are of a particular standard, quality or grade, or that goods are of a particular style or model.

FALSELY represents that goods are new.

REPRESENT that goods or services have sponsorship, approval, performance characteristics, accessories, uses or benefits they do not have.

REPRESENT that he or it has a sponsorship, approval or affiliation he or it does not have.

MAKE false or misleading statements concerning the existence of, or amounts of, price reductions.

MAKE false or misleading statements concerning the need for any goods, services, replacements or repairs.

MAKE false or misleading statements concerning the existence or effect of any warranty or guarantee.

Penalty for an individual is $10,000, or 6 months imprisonment; for a corporation, $50,000.

It is not possible for this company to ensure that advertisements which are published in this paper comply with the Act and the responsibility must therefore be on the person, company or advertising agency submitting the advertisement for publication.

In cases of doubt, consult your lawyer.
- 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 — 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.

On Sale Now—All Newsagents
* Recommended retail price

$2.50

ELECTRONICS TODAY INTERNATIONAL — JANUARY 1975
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.

---

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 deflection either vertically or horizontally with less than 0.20 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"
- 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 300 plays out of the diamond instead of 1000. But a stylus loaded with insufficient weight will bounce around in heavily modulated
grooves, banging against the walls and damaging them.
That's not good.
So in general, when a range of \( \frac{3}{4} \) to 1\( \frac{1}{2} \) grams is given, assume that the \( \frac{3}{4} \) 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 \( \frac{3}{4} \) 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 \( \frac{3}{4} \) to 1\( \frac{1}{2} \) grams; changer manufacturer's top model will perform at 1\( \frac{1}{2} \) 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 \( \frac{3}{4} \) - 1\( \frac{1}{2} \) 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 stylis 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

<table>
<thead>
<tr>
<th>AUDIO DYNAMICS</th>
<th>TURNTABLES and TONE ARMS</th>
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<tbody>
<tr>
<td>Audio-Technica Company has been gathering data on available turntables and tone arms, but no firm recommendations were available by press time.</td>
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### B & O

- **MMC-6000**

### MMC-4000


### SP-14


### SP-12


### DECCA

- **Export Mk.-5**: **B & O**: All models. **BSR**: All models. **Connoisseur**: All models. **Decca**: International. **Empire**: All models. **Garrard**: Zero 100, 401. **JVC**: All models. **Lenco**: All models. **Linnsonder**: LP-12. **Philips**: All models. **Racal**: SL-8E. **K.O.K.**: CV-12. **Sansui**: All models. **Shok**: All models. **Sme**: 3009 S2. **Sony**: All models. **Stax**: UA-7. **Technics**: SP-1200, SP-1100A. **Thorens**: TD-160C, TD-125AB.

### London Mk.-5:

- **B & O**: Same as Export Model.

### ELAC


*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

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**PHONO CARTRIDGES**

|-------------|---------------------------------------------|

**TURNTABLE and TONE ARMS**

|-------------|---------------------------------------------|

**ELECTRONICS TODAY INTERNATIONAL — JANUARY 1975**
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

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**PHONO CARTRIDGES**

| PHONOCARTRIDGES | TURNTABLE and TONE ARMS
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<tr>
<td>F3E +</td>
<td>Same as Model FTR + 1</td>
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<tr>
<td>F-2 +</td>
<td>Same as Model FTR + 1</td>
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<tr>
<td>F-1 +</td>
<td>Same as Model FTR + 1</td>
</tr>
<tr>
<td>JVC 4MD-20X</td>
<td>JVC: VL-8, VL-5</td>
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**MICRO-ACOUSTICS**

**QDC-1 Series**

- **ORTOFON**
  - F-15E: Same as Model M-15E.

- **PANASONIC**
  - EPC-660C: 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: Same as Model 1200E, except also compatible with *Philips*: GA-407.
  - 750E: Same as Model 1200E, except also compatible with *Philips*: GA-407.
  - 400E: Same as Model 1200E, except also compatible with *Philips*: GA-407.
  - 200E: Same as Model 1200E, except also compatible with *Philips*: GA-407.
  - 150: Same as Model 1200E, except also compatible with *Philips*: GA-407.
  - 140E: Same as Model 1200E, except also compatible with *Philips*: GA-407.
  - 100: Same as Model 1200E, except also compatible with *Philips*: GA-407.

- **RADIO SHACK**
  - Realistic/Shure Series: R-700E: Same as Model 400E, except also compatible with *Philips*: GA-407.
  - R-7E: Same as Model 400E, except also compatible with *Philips*: GA-407.
  - R-7EB: Same as Model 400E, except also compatible with *Philips*: GA-407.
  - R-7C: Same as Model 400E, except also compatible with *Philips*: GA-407.
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**

**REK-O-KUT**

- **F-3**

**SHURE**

- **V-15 Type III**

**M91ED**

**M75ED Type 2**

**M75EJ Type 2**

**M75EC**

**M75CS**

**STANTON**

- **780/4DQ 681EEE**

- **681EEE**

- **681A**

**ACOUSTIC RESEARCH**


- **Same as Model 681EEE, except not compatible with PIONEER models shown.**

**600EE**

- **600E**

- **600AA**

**ACOUSTIC RESEARCH**


**600E**

- **600**

- **600AA**

**ACOUSTIC RESEARCH**


**TOSHIBA**

- **C401S/SZ200**

**ACOUSTIC RESEARCH**


**JOIN**

- **JVC: VL-5**
Unlike conventional turntables, the Technics SL1200 has no mechanical speed reduction system such as fluting idler wheels or vibrating belts which help cause annoying wow and flutter.

Instead the Technics SL1200 turntable has 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, practicality and value for money.
**Look Here!**
Thom DCR 1 Dolby Cassette Deck $236

The best deck value anywhere featuring limiter to prevent overload on important Dolby Noise Reduction circuit, Bass switch, Blend microphone control, Separate LBX controls for low and mid, Large Peak meter lights, Output level control. Multiples filter for FM repair. Memory switch, The switch can go on or off, and control "lock" switch. 3 1/2"x2 1/2"x2; 2 lbs. $165 in Dollar 56 65; Teriffic value for the enthusiast at $199.95 IP & F. Freight extra.

Speaker Specials
The speaker selection feature our center speaker (first plastic) 22 from 22 to 470 Ovver 50 dollar value and value locked 33 ohm. 186 etc. In our 's you COM led from the enthusiast at $190.00 IP & F. P. M. & P. F. Motions, on.

**ZIPPI X BOXES**
Here's the boxes for projector lamps which are a huge advantage for both home and movie theatres. As you are only going to lose it in the future a pack of projectors is better than a pack of projectors. Pack one to two size and hard use. Save you $22 per 889.90 IP & F. Freight extra.

**CAPACITOR PACKS**
Here are our first computer digital pack of single ended coupling, 42 top for each computer under (that is the value number). Check your weight at 14.8. 6 X 100 0f 4 x 220 P 2 4 10 4 2 470 4 220 5 3 3 4 100 2 120 3 30 T. We say it's not a random pack but based on computer usage. PAP pass 42 electrolytes for only $7.99. Nominal value is around $12.50.

**DIGIPACKS**
These have been produced for our customers' requirements. This instruction sheet covers the operation of the left and right side of the meter. Checking and testing are described. Both packs can be used in any equipment. TTL "A" block has a Delorean 703.ory with 7,92300obi and 3367 decoder and circuit the basis of the above mentioned $0.90 pack. TTL "B" block also has the same components. Both are available for $7.99 and 7.92. They both display the total during counting. Only $7.99.

**US RADIO AMATEUR CALLBOOK**
This is the only book of its kind. 684 listings of CB users overseas $8.95 IP & P. F. 751.

**FOREIGN RADIO AMATEUR**
CALLBOOK—This is the only book containing listing over $1,786 amateur stations overseas. A must for CB and CB users overseas. $14.95 IP & F. P. F. 751.

**630 Battery Saver** A fully approved double isolated pack for extra safety. Will supply up to 300mA and is suitable for 4V, 6V, 12V and 6V and 12V applications. Saves a fortune on batteries with this reel little thing, Ready to plug in at only $15.80 IP & F. P. F.

**Valupacks**
RESISTOR PACKS
Definitely not the usual suspect pack. 20 of 4.7 value $33.15 $16 in packs of 10's. $1.95 per lb. We have values from 220 pF to 410. Over 50 different values and 260,000 5% carbon resistors. Nominal value of $8.00. You get over 260 resistors for only $8.00.

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**LICKS**
ETI Push button dimmer (NOV 74) New feature on ETI dimmer. Push button to increase to dimmer. Redesigned ETI dimmer is available for a huge push on image for 1000VA Inevitable or house. Details 2 seconds will stop on go to frame to the ETI dimmer and will hold for up to 24 hours. On all electronic parts this hard judge switch with P. P. P. F. $18.50.

**METER BEATER KIT (NOV 74)**
Based on 555 timer provides a signal after 1% hour. 2 or 3 hours to have time to open times before pushing up a function. Soon pass for radio. Electronic parts only $17.99.

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ET: 420 colour organ $3.60
ET: 313 car alarm $1.20
E: Computer complete set in 10sory only $32.90
**NEW PRICE**
MUSICAL 54.00
PCBs
ET: 321 light dimmer $1.90
ET: 420 colour organ $3.60
ET: 313 car alarm $1.20
E: Computer complete set in 10sory only $32.90
**NEW PRICE**
MUSICAL 54.00

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Tel: 439 3311
Banksstown
381 Hume Highway, Banksstown (N., Chapel Rd)
Tel: 709 8600

**MITSUI SIGNAL INJECTOR**
This unit is suitable for all AM or FM, in radios, tape recorders, etc. Saves time and effort and a great price for only $8.74 IP & P. F. 751.

**DICK breaks the TIME=PROME barrier!**
**DIGITAL CLOCK**
$29.95

**SEE THIS ISSUE**
No, not the usual $5.00 but a complete kit for only $9.95 IP & F. P. F. M. for those who are not yet into semiconductors. Even the basic beginner can build a kit of this type following full simple manuals. Full money back guarantee. 31 or 5 oz Tools; 3 catalog, 2 $10 a week at home for 7 days and 1 not at a speed of reducing the kit and we will refund your money.

Check these terrific features:
- **Operates on 240V mains 50 or 60 cycle.
- 3 12 to 24 hour display.
- Large 0.7" Red LED solid state display.
- Full circuit board supplied.
- Easy to understand instructions.
- Second curve line easily added.
- Power supply included — no extras.
- Uses brand new National L12 semi-conductors. Spares are available.

**$39.95**

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**$39.95**
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 never 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.

So Australian Distributors

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A page of the MS Components catalog.

- **AMEREX STEREO HEADPHONES.** A very high grade pair of Stereo Headphones at a very moderate price. An ideal gift for Xmas. Frequency Range: 40 Hz - 16,000 Hz. Impedance: 4 ohms. Power rating: 0.2W. Each earphone contains a volume control. Comes complete with Curly Cord and Stereo Jack plug. M.S.C. Price. Only $3.50 each plus $0.50 P & P.

- **McMURDO SLIMLINE CONNECTORS.** Slimline connectors are a handy and practical innovation for making up Male and Female wiring connections for printed circuit and VERO Board. The removable pins are soldered direct into the application Board and the mating wires direct to your Female Strip connector, which also has a fixed polarising pin to avoid accidental reversing of terminals. Comes assorted to 6 or 12 way in 1", 1 1/2", 2", and 2 1/2" pitch. $2.50 per 20 P & P.

- **ACOS DUST JOCKEY RECORD CLEANER.** The most attractive and best presented Record Cleaner we have seen, well engineered and comes a free bottle of anti-static fluid. ONLY $3.50 P & P 50c.

- **EXTENDING AERIALS.** Transistor or Television type. Solidly made and finished in heavy chrome, extends from 6" to 36". Totally directional dual band aerial with integral swivel base. Only $1.50 P & P each. Can be bought at the fantastic price of $1.50 each or 2 for $3.00 P & P 50c.

- **RODAN DIGITAL INDICATOR TUBE.** Type GR-211. Electronic 100-filled Cold Cathode display device. In-line 90° Side viewing. Anode supply voltage 250V. Diameter of glass tube 30mm. Height of digits 35mm. Colors of display 4. Socket is potted. Nickel connector adaptor is also supplied that converts the Unit into an ordinary High class stereo guarantees. Definitive. N.O.T. A GIMMICK and is fully warranted. Must be heard to be believed. ONLY $2.60 each plus P & P.
FLUKE MODEL
8000A MULTIMETER

"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, 0.1 µA 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. Undoubtedly 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

Recommended retail prices:

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<tr>
<td>Low ohms</td>
<td>$ 50</td>
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<tr>
<td>High AMP</td>
<td>$ 20</td>
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<tr>
<td>BCD</td>
<td>$ 70</td>
</tr>
<tr>
<td>Basic unit</td>
<td>$260</td>
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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
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 ± 19.9 V, ± 1199 V
Accuracy ± (0.1% of reading + 1 digit)
(1 year, 15°C to 35°C)
Temperature Coefficient: ± (0.01% reading/°C + 0.005% F.S./°C)
(-10°C to 15°C and 35°C to 55°C)
Input Impedance 10 MΩ, all ranges
Normal Mode Rejection Greater than 80 dB at 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, 19.9 V, 1199 V
Accuracy 45 Hz to 10 kHz ± (0.5% of reading + 2 digits)
(1 year, 15°C to 35°C)
10 kHz to 20 kHz ± (1% of reading + 2 digits)
10° to 10 kHz ± (0.01% reading/°C + 0.005% F.S./°C)
(-10°C to 15°C and 35°C to 55°C)
Input Impedance 10 MΩ in parallel with 100 pf
Normal Mode Rejection Greater than 60 dB @ 50 Hz, 60 Hz
Common Mode Rejection (1 kΩ unbalance) 3 seconds, worst case
Response Time 1200 V rms, not to exceed 10° volt/second product on 20,200, 1200 V ranges.
Maximum Input Voltage 500 V rms on 200 mV and 2 V ranges.

DC CURRENT
Ranges  ± 199.9 µA, ± 1.999 mA, ± 19.99 mA ± 19.9 mA, ± 1999 mA
Accuracy ± (0.3% of reading + 1 digit)
(1 year, 15°C to 35°C)
Temperature Coefficient: ± (0.015% reading/°C + 0.005% F.S./°C)
(-10°C to 15°C and 35°C to 55°C)
Voltage Burden 0.22V maximum up to 200 mA; 0.45 V at 2 amps
Response Time ½ 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 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: ± (0.015% reading/°C + 0.005% F.S./°C)
(-10°C to 15°C and 35°C to 55°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 ± (0.2% of reading + 1 digit) all ranges except: ± (0.5% of reading + 1 digit)
(1 year, 15°C to 35°C)
on 20 MΩ
Temperature Coefficient: ± (0.015% reading/°C + 0.005% F.S/°C)
(-10°C to 15°C and 35°C to 55°C)
10 Meg ± (0.02% reading/°C + 0.005% F.S./°C)
Response Time ¼ second, all ranges except: 4 seconds on 20 MΩ range
Current through Unknown 200Ω/2 range, 1 mA
2 kΩ/2 range, 1 mA
20 kΩ range, 100 µA
200 kΩ range, 1 µA
2000 kΩ range, 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 8 ½” wide x 2 ½” high x 10” deep
(22 cm x 5 cm x 25 cm)
Weight 2% pounds (1.2 kilograms) without batteries
Power Battery Option (-01)
4 pounds (1.8 kilograms) with batteries
100-115-230V ac, 50 to 400 Hz, 2 watts
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 setting 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!
Quality at low prices. Order now while stocks last!
Both models come complete with base, cover and magnetic cartridge AT NO EXTRA COST.

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EXPO MODEL DX-1212
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EXPO --
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10 WATT RMS
STEREO KIT

with Sanken S1010Y


Our newest amplifier kit with full 10 watts rms per channel output, modern extruded aluminium cabinet 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 Superphon 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-emp, 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. $15.50

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- Self-powered.
- Rear level speaker control.
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CANBERRA. Ph: 47-6179. Electronics Shop, 2 Hackett Place, Hackett. 2602.
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 fulfill 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 are not 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
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, permissible 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 parameter 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 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 cutoff HF crystals. The equivalent series resistance (which determines ‘activity’ — that figure of merit of days of old) is much greater and their permissible 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 μF (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
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.
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.

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.
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.

REFERENCES

(1) 'Radio Transmitters', L. Gray & R. Graham (McGraw-Hill)
(2) 'Electronic Fundamentals & Applications', J. D. Ryder (Pitman)
(3) 'Transistor Crystal Oscillators to Cover Frequency Range from 1 kHz to 100 MHz' by M. Lane, Australian Post Office Research Laboratories, Report No. 6513.
(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.

<table>
<thead>
<tr>
<th>XL</th>
<th>C2</th>
<th>C3</th>
</tr>
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<tbody>
<tr>
<td>65mHz</td>
<td>8.2pF</td>
<td>5.6pF</td>
</tr>
<tr>
<td>43mHz</td>
<td>15pF</td>
<td>10pF</td>
</tr>
<tr>
<td>38mHz</td>
<td>22pF</td>
<td>18pF</td>
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<table>
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<tr>
<th>65mHz Xtal 130 MHz OUTPUT</th>
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<tbody>
<tr>
<td>L1 = NEOSID AZ ASSEMBLY</td>
</tr>
<tr>
<td>(4mm FORMER &amp; F29 SLUG)</td>
</tr>
<tr>
<td>WOUND WITH 12 TURNS OF 4.65 mm ENAMEL WIRE, CLOSE WOUND</td>
</tr>
<tr>
<td>L2/3 = NEOSID, DOUBLE ASSEMBLY</td>
</tr>
<tr>
<td>7300 CAN, TWO 722/1 FORMERS, F29 SLUGS, WOUND WITH 6 TURNS, 0.63mm ENAMEL, CLOSE WOUND</td>
</tr>
<tr>
<td>C1 = 33 OR 39 pF</td>
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<tr>
<th>43mHz Xtal 130 MHz OUTPUT</th>
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<tr>
<td>L1 = 20 TURNS 0.4mm AS ABOVE</td>
</tr>
<tr>
<td>L2/3 = AS ABOVE</td>
</tr>
<tr>
<td>C1 = 56pF</td>
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<tr>
<th>38mHz Xtal 116 MHz OUTPUT</th>
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<tbody>
<tr>
<td>L1 = 24 TURNS 0.4mm AS ABOVE</td>
</tr>
<tr>
<td>L2/3 = 9 TURNS 0.83mm AS ABOVE</td>
</tr>
<tr>
<td>C1 = 68pF OR 100pF</td>
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**Fig.11. VHF oscillator — multiplier.**

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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...
ELECTRONIC IGNITION SYSTEM

Fig. 1. Circuit diagram of the CD1 ignition system incorporating tacho and....
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 1 kHz. The output of the multivibrator clocks the D-type flip-flop IC3/1, the D terminal of this IC is coupled to the Q output and the result is that the output is high. If control voltage is low then all transistors will control off. If the output is high this capacitor will charge to about 450 V using a 12 volt input, however, the charging circuit voltage is measured and if an inverter is stopped when 350 V is reached Transistors Q1 and Q2 form a schmitt-trigger circuit where Q2 goes high when the voltage on C8 goes above 350 volts and returns 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 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 μS to revert to zero. This helps prevent point bounce. With SV1 in the run mode the rising voltage of the points opening is coupled, via C10, to the input of IC4/1. The output of IC1 is normally high (+12 V) and if this voltage at pin 2 goes above two thirds of the supply voltage the output will be triggered low. It will remain low until the voltage at pin 6 falls below 0.3V supply voltage when the output will revert to high. When the output goes low C11 will be discharged via R28 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 resistance. 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 the output of the multivibrator. The voltage on the multivibrator is measured and if an inverter is stopped when 350 V is reached Transistors Q1 and Q2 form a monostable with this capacitor, which switches off the inverter, or at least holds it off, while the SCR is on and therefore prevents the inverter running into a short circuit. This effectively reduces the power drawn from the battery.

This multivibrator allows the transistor to fully saturate by limiting the peak current enough 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 charging circuit voltage is measured and if the inverter is stopped when 350 V is reached Transistors Q1 and Q2 form a schmitt-trigger circuit where Q2 goes high when the voltage on C8 goes above 350 volts and returns 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.

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ELECTRONIC IGNITION SYSTEM

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

CHOOSEING CAPACITORS FOR CDI

The main discharge capacitor C9 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
1µF 600 V type 3510
(oil filled)
1µF 1000 V type 3510
(must be mounted external to printed circuit board)

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 (e.g., 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 µW 5%
R10,11,12 68 1W 5%
R14,15,16 68 1W 5%
R20,21,22 180 1W 5%
R37 220 µW 5%
R23 270 µW 5%
R9,18,29 560 µW 5%
R12 680 µW 5%
R28,34,36 1k µW 5%
R24 2k2 µW 5%
R35 2k7 µW 5%
R30 3k9 µW 5%
R5,6 10k µW 5%
R3 15k µW 5%
R37,33 47k µW 5%
R4,7,25 100k µW 5%
R31,32 100k µW 5%
R8,26 1M µW 5%
RV1,Potentiometer 50k Trim
RV2 100k Trim
C13 Capacitor 0.0022 µF polyester
C5 0.0033 µF polyester
C7 Capacitor 0.01 µF polyester
C10,15,16 Capacitor 0.01 µF polyester
C7 Capacitor 0.01 µF polyester
C9 0.047 µF Polyester
C3,4 0.068 µF Polyester
C2 0.1 µF Polyester
C6 10 µF 25V electrolytic
electrolytic
C12 10 µF 16V dc mounting
C1 Capacitor 470 µF 25V pc
mounting electrolytic
C1,11,14 See Text.
Q1 Transistor BC558, BC178 or smaller
Q2 Transistor BC548, BC108 or smaller
Q3,6 BD135, BD137, BD139
or similar
Q4,5,7 2N3055
Q7 2N3643 PN3643 or similar

SOANAR
D1 Diode 1N4001, IN4005 or similar
D2,7,8,10 Diode IN4148 or similar
D3,4,5,6 Diode BYX55/600
ZD1 Zener Diode 6.8V 5W
SCR1 Thyristor 1A 600V 1C14D, 25F206 etc.
J1 Transformer See Text.
L1 Inductor See Text.
PC Board ETI 312
DPDT slide switch or toggle switch.
D.C. input 130 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 2N3055
Wire etc.
If the car does not have an internal ballast resistor a 112 30 watt.
M1 1 mA FSD meter scaled to RPM
required Renier CS-260-T or similar
(if you already have a tachometer it will work well as 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 1**

<table>
<thead>
<tr>
<th>TACHO Value of C11</th>
<th>Full scale</th>
<th>8 cyl</th>
<th>6 cyl</th>
<th>4 cyl</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5000</td>
<td>0.027 μF</td>
<td>0.039 μF</td>
<td>0.056 μF</td>
</tr>
<tr>
<td></td>
<td>6000</td>
<td>0.022 μF</td>
<td>0.033 μF</td>
<td>0.047 μF</td>
</tr>
<tr>
<td></td>
<td>7000</td>
<td>0.022 μF</td>
<td>0.027 μF</td>
<td>0.039 μF</td>
</tr>
<tr>
<td></td>
<td>8000</td>
<td>0.015 μF</td>
<td>0.022 μF</td>
<td>0.033 μF</td>
</tr>
<tr>
<td></td>
<td>10 000</td>
<td>0.012 μF</td>
<td>0.018 μF</td>
<td>0.027 μF</td>
</tr>
</tbody>
</table>

**REV LIMIT Value of C15**

<table>
<thead>
<tr>
<th></th>
<th>8 cyl</th>
<th>6 cyl</th>
<th>4 cyl</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000</td>
<td>0.039 μF</td>
<td>0.047 μF</td>
<td>0.082 μF</td>
</tr>
<tr>
<td>5000</td>
<td>0.027 μF</td>
<td>0.033 μF</td>
<td>0.047 μF</td>
</tr>
<tr>
<td>6000</td>
<td>0.022 μF</td>
<td>0.033 μF</td>
<td>0.039 μF</td>
</tr>
<tr>
<td>7000</td>
<td>0.022 μF</td>
<td>0.027 μF</td>
<td>0.033 μF</td>
</tr>
<tr>
<td>8000</td>
<td>0.015 μF</td>
<td>0.022 μF</td>
<td>0.033 μF</td>
</tr>
</tbody>
</table>

---

**TABLE 2**

**Transformer Winding Details**

<table>
<thead>
<tr>
<th>WINDING</th>
<th>TURNS</th>
<th>WIRE SIZE</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary</td>
<td>600</td>
<td>0.315mm (28 B&amp;S)</td>
<td>layer wind and use 0.05 mm insulation every 150 turns</td>
</tr>
<tr>
<td>interwinding insulation 0.25mm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WINDING</th>
<th>TURNS</th>
<th>WIRE SIZE</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary 1</td>
<td>15</td>
<td>1mm (18 B&amp;S)</td>
<td>Bifilar wound (i.e. wind both primaries together as a pair)</td>
</tr>
<tr>
<td>Primary 2</td>
<td>15</td>
<td>1mm (18 B&amp;S)</td>
<td></td>
</tr>
</tbody>
</table>

**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**

Philip E core 4322-020-34720 2 required

**FORMER**

Philip 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**

Bobbins 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 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.

- **NOTE IF STANDARD SYSTEM DOES NOT USE A BALLAST RESISTOR LINK PIN 1 AND 3 NOT PIN 2 AND 3.**

---

**Fig. 6.** Standard ignition system.

- **Fig. 7.** Method of connecting octal plug into existing ignition system.
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- Tone arm height and stylus pressure finger adjustments
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- Largest turntable bearing in the industry
- Exclusive Uni-Planar Mechanism... results in smoother, quieter turntables by putting most moving parts on a single plane

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RTR Industries of California, to promote its products, use a phrase that has more meaning with each passing year..."total capability". If "High Fidelity" in reproduction is to be an end, "total capability" must be the means. In loudspeaker design, that demands a fundamental understanding of each speaker component. What better way is there to understand than to build. And this is exactly what RTR does, from the smallest tweeter and electrostatic panels, right up to the massive Magnum 25.

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| 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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65 Parramatta Rd., Five Dock 2046 NSW, Ph. 799-3156
BY CROWN INTERNATIONAL

If diamonds are the epitomy of value and quality in the realm of gems, then the Amcron IC150 control unit and D150 power amplifier is its equal in the sphere of electronics.

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Unlike the price of diamonds, Amcron equipment is not sold by the carat (or watt), and the IC150/D150 amplifier combination is a reasonably priced superlative product.

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SPECIFICATIONS:

IC150

Frequency Response— HI-LEVEL 20.6 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 .005% at rated output. PHono Input—Sensitivity 1MV at 1kHz for 2.5V out; Overload 30-330 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° at 20kHz to 20kHz. Tone Controls—± 15 db at 30 Hz to 12 kHz, Filters—(High and low filters).

D150

Frequency Response—± 0.1 db 20-20 kHz at 1 watt into 8 ohms, ± 0.5 db 4-100 kHz, Power Output—100 watt RMS into 6 ohm, both channels operating. Power Bandwidth—± 1 db, 5-20 kHz at 75 watt RMS into 8 ohms. Distortion—THD typically 0.002%. (At 0.5 to 75 watts) IM typically .005%. Damping Factor—Greater than 200 from zero to 1 kHz 8 ohms. Weight—25 lbs.

Audio Magazine said:— "IC150— With all the high price, low noise levels of approximately .93 db below 2.5 volts output, and phase 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 .3 db at our lowest limit of 5 Hz and 1 db at 225 kHz. The RIAA equalization was so accurate (± .25 db) that we may have been checking the residual errors in our setup."

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65 Parramatta Rd., Five Dock, NSW 2046. Ph. 799-3156

ELECTRONICS TODAY INTERNATIONAL — JANUARY 1975
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. 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.
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 1/4 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 1/4 watt
- C3, C4: Capacitors electrolytic 470 µF 16 volt.
- Q3, Q4: PNP transistors TIP32A or equivalent.
- Other parts as above.
Slowly but surely, sales of Electronic Today International are increasing.

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Name: ...................................................

Address: .............................................

Post Code: ...........................................
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 susceptible 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
INTRUDER ALARM

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

Fig. 2. Printed circuit board layout for the alarm. Full size 90 x 70 mm.

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.

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 applied 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.

![Fig. 4. Wiring diagram showing connections from printed circuit board to switches and connector strip.](image)
INTRUDER ALARM

Fig. 5. Front panel artwork.

Fig. 6. Rear panel artwork.

ETI 258 INTRUDER ALARM PARTS LIST

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

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

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AUDIO TRADER, MODERN MAGAZINES (HOLDINGS) LTD, 15 BOUNDARY ST, RUSHCUTTERS BAY, N.S.W.
Mr. Hi-Fi, Sells and recommends Lenco

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 g 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 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 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°.

JACK STEIN AUDIO 275 Clarence St., Sydney (Town Hall end) Tel: 29-6315
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
2. x NSN71R displays
3. x 2N4403 transistors
4. x 100 ohm 1/4 W resistors
5. x pc board
6. x single momentary contact push button switches
7. x power transformer (DSE 2851 or similar)
8. x mains connecting wire
9. x mains cord and plug
10. x Hook up wire, tinned copper wire etc.

Extra parts for six digit operation

1. x MM5314 MOS Clock IC
2. x NSN71R displays
3. x 2N4403 transistors
4. x 100 ohm 1/4 W resistors

**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 pumps. 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.

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 a MOS (Metal Oxide Semiconductor) device housed in a 24-pin pack. The device contains 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 2N4403 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.
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.

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 phantoscope of Professor Plateau (1832); the thaumatrope 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!

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UNDERSTANDING COLOUR TV

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 \( \theta \) 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 = \( \cos \theta \)

\[ \because \text{demod product} = S \cos \theta \times \cos \theta \]

\[ \begin{array}{c|c}
\text{IF REFERENCE OSCILLATION IS} & \text{DEMULATED SIGNAL IS} \\
\hline
\cos \theta & S \text{ (correct demodulation)} \\
\cos \theta \times 180^\circ & S \text{ (incorrect polarity)} \\
\cos \theta \times -90^\circ & \text{zero} \\
\end{array} \]

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.
Suppose it were out of phase by a phase oscillator, i.e., generating carrier (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_V) 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

But as cos 90° = zero

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_V 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_V) and (E_B - E_V) 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_V) and (E_B - E_V) but this ratio also defines a particular hue in the colour triangle described in Part 1.
UNDERSTANDING COLOUR TV

Further, the length (amplitude) of the chroma vector can only be large if one or both \(E_R - E_V\) or \(E_B - E_V\) 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 \((E_R - E_V)\) and \((E_B - E_V)\) 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 respective 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. 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 \((E_R - E_V)\) demodulator; the \((E_B - E_V)\) demodulator works similarly.](image-url)

![Fig. 18. Typical chroma vectors (thin arrow) produced by various values of \((E_R - E_V)\) and \((E_B - E_V)\) modulated as in Fig.16.](image-url)
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 re-inverted 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. 19. Phases and amplitudes of primary colour vectors using practical modulation signals "V" and "U".**

**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 not 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 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 )(( and ( 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.
**XL250 BURGLAR/INTRUDER/FIRE ALARM**

- Complete kit ready to install
- Additional sensors, alarm accessories may be added any time to meet future needs
- Fully automatic operation, simple to operate
- Protects the family against burglars, intruders and fires (with optional sensors)
- Do-It-Yourself Installers Handbook included

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.

**ALARM ACCESSORIES**

- **SD-10** Magnetic switch (for doors/windows) $1.80
- **SD-20** Emergency tamper push button $1.50
- **SD-40** Ultra Thin Pressure mat: 55 cm x 85 cm (for under carpets, rugs, etc.) $11.25
- **SD-50** Foil Tape/Terminal kit (for protecting plate glass) $4.25
- **Hu-30** Fire Detector (ceiling mounted) $8.75
- **AS-60** 5 Watt reflex horn loudspeaker (for external siren etc.) $11.25
- **CA-20** Flashing Red Light Module (very effective with car alarm system) $8.75
- **XL250** Home alarm module only (complete with instructions) $18.75

PHONE ENQUIRIES: (02) 476-4758
OFFICE HOURS: 9-5 Mon-Fri, 9-12 Sat.

**RB200 CAR BURGLAR ALARM**

- Complete kit ready to install
- Operates on patented “current sensor” principle (not the unreliable vibrator type)
- Only 3 wires to connect, no special switches required.

The CARGARD RB200 is the latest development of the popular 100HR system. The RB200 module includes the same patented current sensing circuit which senses any disturbance in the vehicle’s electrical system and eliminates the need to fit special switches to doors etc. An automatic exit/entry delay is built in which eliminates the need for fitting an external key switch in the car’s bodywork. The output of the alarm is a pulsating horn blast (1 second on/1 second off) which automatically resets after 3 minutes. An optional RED LIGHT module (CA-20) is available and when mounted on the vehicle’s dashboard becomes a powerful burglar deterrent.

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.

12 months manufacturer’s warranty: $37.50 incl. post and packaging.

**PLEASE PRINT CLEARLY**

NAME ___________________________ ADDRESS ___________________________

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PLEASE SEND ME: XL250 HOME ALARM FOR $66.00 RB200 CAR ALARM FOR $37.50 ACCESSORIES: ___________________________

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.

ELECTRONICS TODAY INTERNATIONAL — JANUARY 1975
dbx 117 dynamic range enhancer

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 (rms2) 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
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).

MEASUR ED PERFORMANCE OF dbx 117 DECILINEAR

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Response</td>
<td>20 Hz to 20 kHz ± 1 dB</td>
</tr>
<tr>
<td>Compression Expansion Ratio</td>
<td>Continuous from 1.4 compression slope (14 dB output change for a 20 dB input change)</td>
</tr>
<tr>
<td></td>
<td>2.0 expansion slope (20 dB output change for a 10 dB input change)</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>Greater than 115 dB</td>
</tr>
<tr>
<td>Signal to Noise Ratio: re 1 volt</td>
<td>110 dB</td>
</tr>
<tr>
<td>Maximum Output Level:</td>
<td>10 volts rms (open circuit)</td>
</tr>
<tr>
<td>Distortion: (T.H.D.)</td>
<td>Frequency (1.0 expansion ratio) 100 Hz 0.2% 1 kHz 0.1% 1.3 kHz 0.12%</td>
</tr>
<tr>
<td></td>
<td>(gain set for 1 volt output) 100 Hz 0.1% 1 kHz 0.9% 6.3 kHz 0.13%</td>
</tr>
<tr>
<td></td>
<td>Two:one expansion ratio (gain set for 1 volt output) 100 Hz 0.1% 1 kHz 0.9% 6.3 kHz 0.11%</td>
</tr>
<tr>
<td></td>
<td>Compression ratio 1.1 (gain set for 1 volt output) 100 Hz 0.27% 1 kHz 0.9% 6.3 kHz 0.11%</td>
</tr>
<tr>
<td>Release Decay Time</td>
<td>Constant rate of 140 dB/second in normal position or 50 dB/second in the slow position at 1.4 expansion ratio. (See photos)</td>
</tr>
<tr>
<td>Dimensions:</td>
<td>145 mm x 96 mm x 230 mm</td>
</tr>
<tr>
<td>Weight:</td>
<td>2 kg.</td>
</tr>
</tbody>
</table>
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 rms? 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 LP35 class, and was not Dolbyprocessed 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 misused, particularly in the expansion mode. If the expansion ratio is taken much above 1.4 – 1.5, 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 "unquely 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 is 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 any power level within rating (typically 0.1%). Stepped tone control for bass, treble and 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.
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.

\[ \frac{E_B}{E_A} = \frac{N_B}{N_A} \]

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. 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**

<table>
<thead>
<tr>
<th>1 Cycle Output Waveform</th>
<th>1 Cycle Output Waveform</th>
<th>Average dc Volts Output</th>
<th>RMS Volts at Output</th>
<th>Peak Volts Output</th>
<th>Peak Reverse Rectifier Voltage</th>
<th>Percent Ripple RMS/dc out</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) 1 Φ HALF WAVE</td>
<td></td>
<td>1</td>
<td>1.57</td>
<td>3.14</td>
<td>3.14</td>
<td>121%</td>
</tr>
<tr>
<td>(B) 1 Φ FULL WAVE CCT</td>
<td></td>
<td>1</td>
<td>1.11</td>
<td>1.57</td>
<td>3.14</td>
<td>48%</td>
</tr>
<tr>
<td>(C) 1 Φ FULL WAVE BRIDGE</td>
<td></td>
<td>1</td>
<td>1.11</td>
<td>1.57</td>
<td>1.57</td>
<td>48%</td>
</tr>
<tr>
<td>(D) 3 Φ STAR (WYE)</td>
<td></td>
<td>1</td>
<td>1.02</td>
<td>1.21</td>
<td>2.09</td>
<td>18.3%</td>
</tr>
<tr>
<td>(E) 3 Φ BRIDGE</td>
<td></td>
<td>1</td>
<td>1.00</td>
<td>1.05</td>
<td>1.05</td>
<td>4.2%</td>
</tr>
</tbody>
</table>
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 as be much as 10 times the average dc current.

FILTERING

The output of any rectifier system consists of a train of half-sinusoid waveforms. We know that all wave shapes can be constructed by adding a number of pure sinusoidal signals. Thus the rectifier output is a complex waveform 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

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**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).

**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.
ELECTRONICS - it's easy!

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 unattainable) 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 applications 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:

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. 1,600, 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 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 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 √2 x 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**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>22 k</td>
<td>5%</td>
</tr>
<tr>
<td>R2</td>
<td>22 k</td>
<td>5%</td>
</tr>
<tr>
<td>R3</td>
<td>22 k</td>
<td>5%</td>
</tr>
<tr>
<td>R4</td>
<td>22 k</td>
<td>5%</td>
</tr>
<tr>
<td>R5</td>
<td>470 k</td>
<td>5%</td>
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<td>R6</td>
<td>2.7 k</td>
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<tr>
<td>R7</td>
<td>12 k</td>
<td>5%</td>
</tr>
<tr>
<td>R8</td>
<td>1.8 k</td>
<td>5%</td>
</tr>
<tr>
<td>R9</td>
<td>3.3 k</td>
<td>5%</td>
</tr>
<tr>
<td>R10</td>
<td>470 k</td>
<td>5%</td>
</tr>
<tr>
<td>RV1</td>
<td>potentiometer</td>
<td>1 k - 10 k</td>
</tr>
<tr>
<td>RV2</td>
<td>&quot;</td>
<td>1 k</td>
</tr>
<tr>
<td>RV3</td>
<td>&quot;</td>
<td>1 k</td>
</tr>
<tr>
<td>RV4</td>
<td>&quot;</td>
<td>1 k</td>
</tr>
<tr>
<td>RV5</td>
<td>&quot;</td>
<td>1 k</td>
</tr>
<tr>
<td>RV6</td>
<td>&quot;</td>
<td>1 k</td>
</tr>
<tr>
<td>RV7</td>
<td>&quot;</td>
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<tr>
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<td>&quot;</td>
<td>250 k</td>
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<tr>
<td>C1</td>
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</tr>
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<td>C3</td>
<td>4.7 µF</td>
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<td>C4</td>
<td>4.7 µF</td>
<td>10 V</td>
</tr>
<tr>
<td>C5</td>
<td>33 pF ceramic</td>
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</tr>
<tr>
<td>C6</td>
<td>0.0022µF polyester</td>
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<td>C7</td>
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<td>33 pF ceramic</td>
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<tr>
<td>C11</td>
<td>1 µF 25 V tantalum</td>
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</tr>
<tr>
<td>C12</td>
<td>47 µF 16 V electro. P.C. mount</td>
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<td>C13</td>
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<td>IC2</td>
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<td>ETI 419</td>
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<tr>
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<td>C12</td>
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*NOTE: For project ETI 419 are suitable.*

---

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

**Fig. 10a. Printed circuit board for the mixer preamplifier.**

*1 Component overlay for the preamplifier incorporating the components for the ac power supply (except the transformer).*
SOLID STATE
19 TRANSISTOR MULTI-BAND RADIO – 9 RANGES
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P & P extra

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WITH 4 ICs

AUSTRIA'S BEST VALUE IN CASSETTE PLAYERS. CHECK THESE FEATURES:

• EASILY FITTED UNDER DASH WITH NO PROTRUSIONS
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12 VOLT NEGATIVE EARTH
PRICE $85 WITH SPEAKERS

1 watt 2 channel transceiver with call system, 27,240 MHz. 12 transistors. Price $19.45

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 45 KHz IF. Built-in 60° telescopic whip antenna. Audio output: 0.5 volt DC (battery cells). Loudspeaker - 6.35mm jack plug type (built-in function as microphone on transmit.)

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LATEST MILITARY DESIGN MULTI-BAND RADIO. 30 TRANSISTORS, 15 DIODES. WITH EXCLUSIVE (LED) LIGHT EMISSION TUNING INDICATOR FOR POSITIVE STATION SELECTION. BATTERY AND ELECTRIC COVER ALL AM AND FM BANDS.

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A5-1000 $34.59

A HIGH 100,000 VOLTS/Ohms sensitivity on D.C. Mirror scale, no moving parts. Miniature. DC: 200V, 600V, 1000V, 1500V. AC: 200V, 600V.

Model OL-640/P
$21.95

2000 ohms per volt. DC volts: 0.025, 10. 50, 250, 500, 1000 at 20K ohms p.d.v.. AC volts: 0-10, 50, 250, 1000 at 8K ohms p.d.v.. DC current: 50A, 1mA, 50mA, 100mA, 500mA, 10amps. Resistance: 0-14K, 400V, 4M, 40megohms. DB scale to 20 plus 36 dB. Capacitance: 250pF to 0.002uf inductance: 0-5000 H. Size: 5/4 x 4-1/6 x 1/4 in.

CONNECTIONS

AM/FM AIR-PB-WB

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$39.00

VHF MONITOR ELECTRIC BATTERY

SPECIFICATIONS:

MODEL NC-310 DE LUXE

1 WATT 3 CHANNEL C.B. TRANSCEIVER

• WITH MODERN FM
• EXTERNAL AERIAL CONNECTION

SPECIFICATIONS, NC-310

Transmitters: 13 Channel Number: 3, 27.24 OMHz Clitz. Band Transmitter Frequency Tolerance: ±50ppm RF Input Power: 1 Watt Tone Call Frequency: 2000 Hz Receiver Type: Superheterodyne Receiver Sensitivity: 0.7 uV at 10 dB Selective: 45 db at ±1kHz IF Frequency: 455 kHz Audio Output: 500 mW to External Speaker. Power Supply: 8 UM-3 (penlite) battery. Current Drain: Transmitter: 120-220mA. Price: 203-210-130mA. Price: $49.50 per unit or $99.00 pair

THESE MONTHS SPECIAL

MAGNOVOX 8-30 SPEAKERS
$14.95

THIS MONTH SPECIAL
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 AR-7 is priced at $199 a pair.

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.

AUSTRALIAN DISTRIBUTORS
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Telephone: 642 3993 642 2595
Showroom demonstration by appointment

The size (9¼ x 15¼ 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.

*Recommended retail price
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.

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 cardless 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 phosphor 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 wirewapped. 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 secondaries 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 Centre.

Trade enquiries are also invited.


PROXIMITY SWITCHES
The RSM02 series proximity switches have been designed to fulfill 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' ELOCA 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 teleprinter 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 dip 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 ease-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.

Colour TV is the exciting breakthrough for the electronics service industry. It offers a great future for the service man who's gained the knowledge necessary to do the job.

Stott's introduce a brand new course designed to take you, step by step, all the way from basic electronic theory through to colour television receiver servicing techniques.

If you're a beginner, it can teach you everything you need to know about television principles and receiver circuity.

If you are already working in the field or have already successfully completed some studies in electronics, you may be eligible to commence the course at an advanced stage.

Divided into three sections, the Stott's course covers:
Part 1 — Introduction to Electronics (theory and practice)
Part 2 — Monochrome Television Receivers
Part 3 — Colour Television including fundamentals, colour processing, servicing techniques and faults.

Like all Stott's courses, you will work with your own instructor, an expert in this exciting field, at your own pace, in your own home.

Whether you intend to enter the television service industry, or whether you wish to gain a thorough understanding of television theory and servicing as an aid to sales experience, this is the course to help you make it.

Other electronic courses offered by Stott's include:
Radio for Amateurs — Amateur Operator's Certificate

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66 King William St, Kent Town 5067
89 St. George's Tce, Perth, 6006
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AN RF LEVEL CONTROL


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 toroidal 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.
A precision switch for those who can't afford a failure.

This is a precision switch for those who can't afford a failure.

We wanted a switch which met the highest industry standards of reliability, a switch that was perhaps extravagant in its structure, in the raw materials employed and in its mechanical and electrical life expectancy.

It would be machined out of a single piece of brass, finished in nickel plating, be insulated with Hostaform C and with contacts of rolled gold on silver.

It would be a miniature illuminated type with interchangeable lens caps of varying colours.

It would be at home in the most sophisticated professional or conventional equipment, but essentially where dependability was a foremost requirement.

It would probably be Swiss made.

Only Sloan met all our requirements.

This quality switch is now available from Plessey.

Plessey Australia Pty Limited Components Division Box 2 PO Villawood NSW 2163 Telephone 72 0133 Telex 20384

THE MAIL ORDER DISCOUNT HOUSE, P.O. BOX 5, CONCORD EAST, 2137

STereo 30 WATTS for $30 Quality Sound Budget Price PLUS...

FREE Stereo Headphones

Amazing offer for "Hi-Fi"ers - Stereo amplifier kit, 15W RMS, in distorted RMS 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-back" 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 bookends are easily available and your dealers system (built by you) will look like this.

CLEARANCE SALE ELECTROLYTIC CAPACITORS

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LATEST Transistorised TV CAMERA Scoop!

Ideal for closed-circuit television, amateur TV, transmission, video recording etc. Operates directly into any standard TV receiver, mains powered, features "1" videocon for bright, sharp image. This well-known Japanese Import is normally priced at $299.00, now only 20 available so be early.

BONANZA JACKPOT!

$25 Value for only $5.

For experimenters and constructors, a large assortment of new, highest quality electronic components, Transistors, Diodes, samples, special, and - of - line supplies. Inc. Everything you need.

This is real anti-inflationary VALUE FOR YOUR MONEY!

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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 rivaled 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 sine-wave 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 in 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 millihms to 1 megohm. Current from 1 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 measurements to within 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.


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ELECTRONICS TODAY INTERNATIONAL — JANUARY 1975

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**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 condenser 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.

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**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 STEREOR 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

---

**LAFAYETTE 27 MHz TWO-WAY RADIO**

FOR INDUSTRY, FARM, BOATS, SPORTS – LOW COST

**MICRO 66**
5 WATTS

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- Built-in Speaker plus Push-Button Selected External Speaker-Microphone (Supplied).
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**1 WATT 3 CHANNELS**

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- Full Range of 27MHz Crystals Available.

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**Model HA-310**
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CUSTOM SCIENTIFIC ELECTRONICS PTY LTD., 74-76 Annerley Rd., Woolloomooloo, Qld. 4102.

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APAN BFU-121

- Fully automatic belt-drive turntable features
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- Wow and flutter less than 0.16% w.r.m.s.
- 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-skip device
- Removable headshell and revolving counterweight with graduated scale from 1.3 grams
- Complete with magnetic cartridge
- Frequency response 20-20,000 Hz
- Output 4.5 MV

* Comes complete with "high tension" four-channel leads and is 4-channel ready.

APAN BFU-121 Four-Channel

- Fully automatic belt-drive turntable features
- 4-pole synchronous motor
- Wow and flutter less than 0.16% w.r.m.s.
- Signal to noise ratio better than -52dB
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- Integrated oil damped lifter
- Static balance "S" type tone arm with anti-skip device
- Removable headshell and revolving counterweight with graduated scale from 1.3 grams
- Complete with magnetic cartridge
- Frequency response 20-20,000 Hz
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KIT'S KOLUMN

There's an awful lot of waffle written 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 nobody old phrase "first to see will buy." Well, at the risk of sounding brash, I'd like to lay down some interesting facts about Kit's prices on you.

You know how prices have been going up lately? OK. And you recall how we brought out our Kit's catalogue around May 93? 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 Kit's branch. And, if you're like my friend, Al Fried of Gore Mill, you'll never read it to you when you get it.

We've just landed these Kiklux Oscilloscopes. They operate up to 18MHz with a TV time base and are a really professional unit. Ask for number 537 & P&P $5.216.

BRILLIANT SANYO CASSETTE DECK $215

DOLBY SYSTEM

CAR RADIO/CARTRIDGE PLAYER BARGAIN AT $59-50

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CASSETTES GALORE!

Now that we have your attention, cop this: at Kit's 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 little 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've 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 $3.60.

B: 20 Solid State Projects

Mainly things around the home, like light operated switches; lamp dimmer; intercom; telephone amplifier; sound operated switch. Exceptionally clear descriptions and diagrams as only the Poms can do. P&P $0.50. $4.28.

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 bass and treble 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 not handy, you'll need help. Complete kit includes prewound coils, veneered cabin, screws, nuts, and so on. P&P $3.50.

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107
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Specifications: Chassis - steel plate; Body - 1/8 scale plastic; Drive - sider winder, rear axle gear drive; Clutch - Centrifugal; Brake - belt type nylon; Suspension - coil spring; Flywheel - steel chrome plated; Wheel - die cast; Front tyre - rubber .76 mm diameter, 40 mm. width; Rear Tyre - sponge .56 mm diameter. .56 mm width; Fuel tank for R/C car - vinyl 4oz size; Engine - glob-plug. 3.5 c.c. B.B.R/C; Gear Ratio - 5:1 spare 4:1, 6:1; Max speed - 60 km (scale 480 km/h) with gears 4:1 - 720 km/h.

Price: Car: $75.00 plus $5.00 package & postage; Engine: $29.00 plus $2.00 package & postage or ONE PRICE $99.00 plus $5.00 package & postage.


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<table>
<thead>
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<th>TYPE</th>
<th>min.Watts</th>
<th>SUPPLY</th>
<th>Printed Bd. numbers</th>
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<td>5 25</td>
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<td>18</td>
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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.

---

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Plessey Australia Pty. Limited Components Division

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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.

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 i.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 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 large 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 casting 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 C_x 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 Parafomer, 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%.

T he 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 increased 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 percent 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.

ELECTRONICS TODAY INTERNATIONAL — JANUARY 1975
IDEAS FOR EXPERIMENTERS

LIGHT DEFECTION 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.

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 an 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.

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Here are the latest from this world-famous range:

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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
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sensitive for tape volume.

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computes three ways – pre-amp analog on
gain control; automatic output monitor;
intricate double – fusing.

After this, other amps
look clumsy .... and sound it.

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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.
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what your ear hears.

Cambridge Audio
For people who listen to music ... naturally
INTERNATIONAL ELECTRONICS UNLIMITED

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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 erasable PROMS)

Basic Data Package available separately refundable at purchase of basic kit. $5.00.

TRANSISTORS

<table>
<thead>
<tr>
<th>DEVICE</th>
<th>FUNCTION</th>
<th>CROSS REF</th>
<th>MRF</th>
<th>MCT</th>
<th>VCEO</th>
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RF POWER AMP

| 2N3131 | 53002  | 30 130 | 75 100 | 7.0 2 1.0 10 50 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 2N3132 | 53010  | 40 250 | 50 75  7.0 2 1.0 10 50 |
| 2N3123 | 53013  | 40 250 | 50 75  7.0 2 1.0 10 50 |

POWER DRIVER

| 2N3869 | Audio/RF | 53031 | 40 150 | 75 50  7.0 2 1.0 10 50 |
|--------|---------|-------|--------|--------|--------|--------|--------|--------|

AUDIO DRIVER

| 40594 | MRF      | 3274 | 50 150 | 75 50  7.0 2 1.0 10 50 |
|-------|----------|-----|--------|--------|--------|--------|--------|--------|

GEN PUMP AMP

| 2N2995 | RF        | 3272 | 40 120 | 65 120 | 7.0 1.8 120 12.5 |
|--------|-----------|-----|--------|--------|--------|--------|--------|--------|

HF GEN PUMP

| 2N3333 | VHF UHF | 3039 | 56 250 | 25 20  7.0 1.8 120 12.5 |
|--------|---------|-----|--------|--------|--------|--------|--------|--------|

RESISTORS

<table>
<thead>
<tr>
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<th>Type</th>
<th>Brand</th>
<th>Code</th>
<th>Tolerance</th>
<th>Package</th>
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CAPACITORS

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SWITCHES

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MISC. COMPONENTS

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<tr>
<td>100kohm</td>
<td>Film</td>
<td>100V</td>
<td>1000</td>
<td>±5%</td>
<td>20</td>
</tr>
</tbody>
</table>

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| 8830 | Dual line driver | 2.75 | |
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MV64 | Jumbo Vio. Red (Clear Dome) | 33 |
MAN1 | Red 7 seg. "270" | 2.50 |
MAN2 | Red alpha number "32" | 4.95 |
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| CD4009 | 55 | CD4019 | 1.35 | CD4030 | 95 |
| CD4012 | 55 | CD4022 | 2.75 | CD4035 | 2.85 |

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300 | 75V Reg (super 723) | TO 5 | 79 |
301 | He Perl | mDIP TO 5 | 32 |
302 | Volt follower | TO 5 | 79 |
304 | 9V Reg | TO 5 | 79 |
306 | 9V Reg | TO 5 | 1.55 |
307 | 8V Amp (super 741) | mDIP TO 5 | 35 |
308 | Micro Pwr Op Amp | mDIP TO 5 | 1.10 |
309 | 9V 1A regulator | TO 5 | 1.85 |
310 | Volt Follower Op Amp | TO 5 | mDIP 1.19 |
311 | Hi Perf V Comp | TO 5 | mDIP 1.05 |
312 | Hi Sorted Dual Comp | DIP | 1.20 |
313 | Neg Reg 5.2, 12.15 | TO 5 | 1.35 |
314 | Quad Op Amp | TO 5 | 5.95 |
315 | Quad Comparator | DIP | 1.69 |
316 | 12V Volt Reg | (6V/12V 15V: 18V-24V) | TO 5 | 2.95 |
317 | AGC Span (AMPL) | TO 5 | mDIP 1.15 |
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325 | Lo Noise Dual preamp | 1.75 |
326 | Prec. V Reg | DIP | 79 |
327 | Timer | mDIP | 5.99 |
328 | Phase Locked Loop | DIP | 2.75 |
329 | Phase Locked Loop | DIP | 2.50 |
330 | Phase Locked Loop | DIP | 2.75 |
331 | Function Gen | mDIP TO 5 | 2.50 |
332 | Tone Gen | mDIP TO 5 | 2.50 |
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336 | 9V Reg | DIP | 6.9 |
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338 | Comp Op AMPL | mDIP TO 5 | 2.25 |
339 | Dual 741 Op Amp | mDIP TO 7 | 2.75 |
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347 | Quad Amplifier | DIP | 5.99 |
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351 | Core Mem Sense Amp | DIP | 2.75 |
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356 | (351) Dual Push- Pull Drive | DIP | 3.9 |
357 | Quad Seg Driver for LED DIP | 79 |
358 | Hi Digit Driver | DIP | 8.9 |

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See you soon."