electronics TODAY INTERNATIONAL

NOVEMBER 1975
75c*

help prevent pool deaths

SWIMMING POOL ALARM TO BUILD

$99·50

SPECIAL READER OFFER
LL CASSETTE RECORDERS

*Registered for posting as a periodical — Category C

WHATEVER YOU PAY, YOUR EARS WON'T BE DISAPPOINTED

The true audiophile needn't look any further than the range illustrated to discover the exact speaker system he or she requires for superb sound.

Each system is the result of JVC's own intensive research programme.

The compact bookshelf type have power and performance out of all proportion to their size — the ideal union of efficiency and economy.

The 5313 is JVC's enthralling omni-directional system. Wherever it is placed in a room it fills every corner with magnificent, natural sound.

SK12 and SK15 represent our most impressive systems. 6 speaker 4 way systems housed in handsome, crafted cabinets, that richly produces the entire audio spectrum.

Put them through their paces at your JVC dealer. They have to be heard.

JVC

VICTOR COMPANY OF JAPAN LIMITED

For further information please write to— JVC Advisory Service P.O. Box 49 Kensington, N.S.W. 2033
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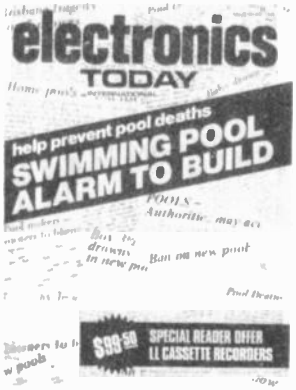


COVER: Every year dozens of children are drowned in home pool accidents. Help reduce this toll by installing a pool alarm (pages 42 onward — this issue). Newstories on cover montage have been simulated to avoid unnecessary personal grief.

PROJECTS

FEATURES

REVIEWS

NEWS & INFORMATION

news digest

ALFRED

Star of the recent IREE symposium and exhibition was Union Carbide's robot ALFRED. The two and a half metre tall robot had a digital and alphabetical readout at the end of each arm to display answers to questions asked by visitors.

A closed circuit colour TV camera in ALFRED's head enabled him to look at people to whom he was talking.

DICTATING BY PHONE CUTS OFFICE COSTS

A remote control dictaphone has been introduced by Plessey Communications Systems.

Simple to operate, the system is normally used in conjunction with many existing telephone systems. By dialling 8, the phone provides access to one of a bank of recorder units. Other digits are used to commence dictation and control playback and correction.

A central location point can be chosen for the equipment and the typing staff so that the material can be transcribed and returned promptly, or a number of small systems can be located at different points to allow departments dependent on specialised skills to operate at peak efficiency. Security and other needs may also be catered for in this way.

Other features of the system which is known as Telecord include high quality recorded sound, and an automatic cutout after four seconds of silence during dictation to eliminate long gaps in the recording. A foolproof privacy lock aids security and prevents inadvertent over-recording.

Plessey Communication Systems Pty. Ltd., 87-105 Racecourse Road, North Melbourne.

STATHMOLOGY COURSE

A one-week course in stathmology (the integrated and systematic study of measurement, instrumentation and control) will be run at The University of New England (Armidale NSW) from November 29 to December 5, 1975.

The course has been designed to impart subject knowledge to professionals and sub-professionals and should help engineers, technicians, research workers, etc., who are physically concerned with the actual hardware, and executives who need a basic knowledge of the principles and hardware involved to improve their communication with technical colleagues. As a guide, minimum educational prerequisite is completion of trade course or full secondary schooling.

The structure of the course develops from the general basis of measurement through the design of instrumentation, the classes of measurement sensors, data processing and information retrieval to the production of measurement systems. Lectures will be supplemented by slides and demonstrations. A small but select representation of instrumentation will be exhibited during the course.

The course is an improved version of the original designed by Dr Peter H. Sydenham of the University of New England following a nationwide survey by him in 1973. The lecturing staff have been chosen to present a balance between up-to-date theory and practice.

Details from :
Department of Continuing Education,
University of New England,
ARMIDALE. N.S.W. 2351
Tel: 067722911 ext. 2123.

ITALY CHOOSES PAL TV SYSTEM

Italy has now decided to use the Garman PAL system rather than the French SECAM for their new colour TV service.

Although the French are complaining that SECAM has been rejected for political reasons it is generally accepted that PAL is a superior system.

S.T.C. RELEASES COMMERCIAL MINI SYSTEM

Standard Telephones and Cables Pty Limited has introduced a range of commercial application software to augment its existing range of General Automation minicomputer systems. The move is seen as a determined effort to convince the management of small to medium sized companies that the S.T.C. system is well within their reach.

Commenting at the launching of the new system, National Sales Manager for S.T.C.'s Data Systems Division, Roger Parrack said literally thousands of smaller businesses in Australia were at a stage where routine operations

news digest

must be economically streamlined. "While costs and charges continue to climb" he added, "any medium-sized merchandising company which ignores the advantages of office automation is headed for big trouble."

The application software packages are designed as integrated systems capable of providing a range of management accounting suitable for the majority of businesses.

The heart of the system is the General Automation SPC-16 minicomputer – which, though small, has an ability exceeding that of many larger models.

Using visual display screens, the software packages are very flexible and operators may work on different tasks simultaneously. Each operator will have access to stored information for inquiry and the processing of normal business functions.

A secondary mode operation facility permits a batch function such as invoice printing to be performed while the terminals are in use in real-time mode.

The main application of the software range is on-line order entry. Commencing with the entering of a customer's number, product codes and quantities ordered, the operator can generate all data needed to produce packing slips, invoices, etc. At the same time it is possible to produce audit trails and perform credit checks and stock level revision. From this stage, cash receipts can be entered, with routine accounts receivable functions following in the usual manner.

The ability to enter stock purchases and at the same time monitor receipts provides a complete stock control facility and links the operation to the accounts payable package. A full file maintenance and inquiry system reinforces all these functions.

The constant flow of available information means that management can monitor critical areas and take immediate action to remedy difficulties whether it be inventory control, delivery delays or bad debts.

S.T.C.'s marketing support manager Mr. Michael Davies claims that the characteristics of the new software makes it relatively easy to modify packages to suit individual requirements. "In simple terms", says Mr. Davies, "it means an earlier installation at a lower cost."

All package programmes are written in Commercial Fortran – a development of Fortran IV combining the power of Fortran data manipulation with COBOL type data editing and disk input/output facilities.

By combining the best features of COBOL and FORTRAN, a powerful high level language has resulted.

Additional flexibility is provided by the File Management System which handles variable length disk records with an indexed sequential access method.

Following initial demonstrations, one Company has already placed an order valued at $60,000.00, which will be installed in October.

DIGITAL WATCH US$39.95

Litronix has just introduced a three function digital watch priced at S39.95 Five further watches in the company's new series are priced up to US$59.95.

Novus have recently cut the price of their Exelar series from US$70 – US$80.

It is interesting to note that the fall in price parallels that previously experienced in the pocket calculator field, and we may well expect to see the $13 digital watch within twelve months.

PRE-RECORDED PROGRAMS FROM H-P

To extend the usefulness of the HP-65 fully programmable scientific pocket calculator, Hewlett-Packard is offering three new HP-65 application packs of pre-recorded programs in the fields of statistics, microwave circuit design and machine design.

Each pack sells for $54 and includes up to 40 pre-recorded magnetic cards, an operator's manual and a pad of blank programming pads.

Machine design pack 1 contains 35 programs that provide solutions for the machine designer in dynamics, vibration, linkages, cams, gears, springs, power transmission and machine geometrics. (HP part number 00065-67052).

EE Pack II contains 27 programs to assist the microwave circuit designer in making microwave measurements, designing transistor amplifier, computing transmission in line properties and certain system properties, and performing difficult related mathematical operations. (HP part number 00065-67056).

The HP-65 application pacs are available through the HP sales force, many major department stores and college bookstores and by direct order from HP Sales Offices.

Hewlett Packard Australia Pty Ltd, 41 Joseph St, Blackburn, Vic. 3130.

(Continued on page 11)

For $879.00* you can have music that sounds like a million.

Why the big price tag?

The SX-1010 is the most powerful two-channel receiver we've ever built. Designed to deliver an earth-moving **100** watts RMS per channel, the SX-1010 was created to surpass the demands of the most discriminating audiophile. In doing this, we've elevated music listening to an experience that goes beyond all previous norms. But, of course, the man who chooses this unit is above average as well.

Why the big power?

To deliver really big sound. Not just in loudness—that only hurts the ears. But, big in realism of tonal quality. Big in purity of reproduction. And big in faithfu ness to the original performance. A skillful blend of advanced electronic engineering and a delicate sensitivity to the needs of the inner man. After all, isn't that what you really expect from Pioneer audio equipment.

At Pioneer, we uphold that trust with almost 40 years of exclusive commitment to audio excellence. And from our vast resources as one of the world's largest audio companies, we are privileged to offer seven new two-channel receivers. They're all great. It's just that some of them are greater (and naturally more expensive). Which one you choose depends on how demanding you want to be. Stop by and see your local dealer for a demonstration. You don't have to be a millionaire to listen to music like one. But it helps.

	RMS Power, 8Ω both channels driven (20Hz – 20KHz)	FM Sensitivity (IHF)	FM Selectivity (IHF)	Input				Output			
				Tape Monitor/ 4-ch. Adaptor	Phono	Mic	Noise-Reduction Adaptor	Speakers	Tape Rec./ 4-ch Adaptor	Noise-Reduction Adaptor	4-ch MPX
SX-1010	100W + 100W	1.7μV	90dB	3	2	2	1	3	3	1	1
SX-939	70W + 70W	1.8μV	80dB	2	2	2		3	2	1	1
SX-838	50W + 50W	1.8μV	80dB	2	2	1	1	3	2	1	1
SX-737	35W + 35W	1.9μV	60dB	2	1	1		2	2		
SX-636	25W + 25W	1.9μV	60dB	2		1		2	2		
SX-535	20W + 20W (40Hz – 20KHz)	1.9μV	60dB	2		1		2	2		
SX-434	15W + 15W (40Hz – 20KHz)	1.9μV	60dB	1		1		2	1		

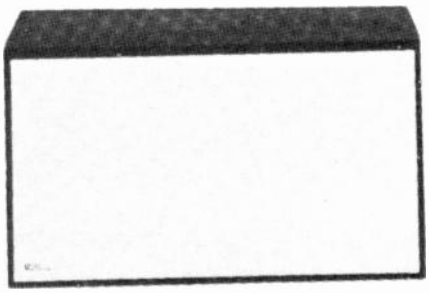
*Recommended retail price

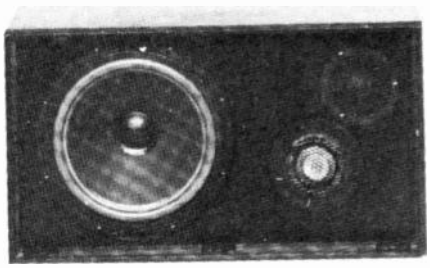
Pioneer Electronics Australia Pty. Ltd.
178-184 Boundary Road, Braeside, Victoria 3195, Phone: 90-9011 Sydney 93-0246, Brisbane 52-8213, Adelaide 433379, Perth 76-7776

PIONEER®
leads the world in sound.

THE AR 3a/IMPROVED an evolutionary new SPEAKER SYSTEM

AR
Acoustic Research
A TELEDYNE COMPANY





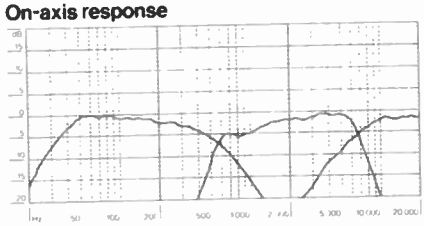
The AR-3a/Improved is the best home speaker system we know how to make. It has been designed to reproduce music as accurately as present-day knowledge of acoustics and electronics permits.

In addition to incorporating the 305mm (12in) bass driver with which AR introduced acoustic suspension to home listeners, the AR-3a/Improved also uses the two miniature hemispherical dome speakers developed for the AR-3a to offer an unprecedented degree of accuracy at middle and high frequencies.

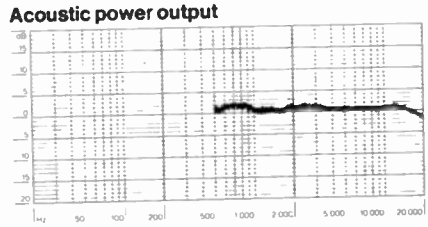
Concepts and techniques developed for the AR-LST and other AR speaker systems have now enabled AR engineers to improve the spectral energy characteristics of the AR-3a and further reduce its already small degree of coloration, while retaining all the virtues of the original design. These improvements have been accomplished by means of significant changes in the design of the crossover: all other components, including driver units and cabinet, are exactly the same as those of the AR-3a.

The AR-3a/Improved is capable of a more linear spectral energy output than was the AR-3a. A two-position switch makes it possible to tailor this characteristic for maximum realism under either reverberant or relatively damped listening conditions.

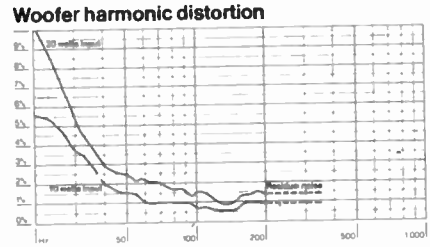
On-axis response



Acoustic power output



Woofer harmonic distortion



Drive units: 305 mm (12 in) acoustic suspension woofer, 38 mm (1½ in) midrange hemispherical dome, 19 mm (¾ in) high-frequency hemispherical dome

Crossover: 575 Hz, 5000 Hz
Impedance: 4 ohms nominal

Controls: Midrange and high-frequency driver level controls

Amplifier: Up to 100 watts per channel
Size: 356 x 636 x 289 mm deep (14 x 25 x 11⅜ in)
Weight: 24 kg (53 lb)
Woofer resonance: Free air 18 Hz, in enclosure 42 Hz
Volume of enclosure: 48.2 litres (1.7 cu ft)

'. . . the best speaker frequency response curve we have ever measured using our present test set-up . . . virtually perfect dispersion at all frequencies . . . AR speakers set new standards for low-distortion, low-frequency reproduction, and in our view have never been surpassed in this respect'. *Stereo Review*

'On any material we fed to them, our pair of AR-3a's responded neutrally, lending no coloration of their own to the sound . . . the speakers sounded magnificent, filling the place with a lot of clean, musical sound and an excellent stereo image . . . Our tests of the AR-3a simply confirm the manufacturer's design aims and claims for this system'. *High Fidelity*

'The harmonic distortion at bass frequencies was outstandingly low . . . The high-frequency dispersion is the widest of any speaker we have tested . . . a new high standard of performance at what must be considered a bargain price'. *Audio*

'Acoustic Research have achieved what they set out to do – a first class loudspeaker by any standard'. *Hi-Fi News*

'Finest bass performance I have heard or measured'. E J Jordan, *Wireless World*

The AR guarantee
The workmanship and performance in normal use of AR speakers are guaranteed for 5 years from the date of purchase. This guarantee covers parts, repair labour, and freight costs to and from the factory or nearest authorized service station. New packaging if needed is also free.

The acoustic research 3A improved is now on demonstration at these franchised dealers:

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

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

Adelaide
Blackwood Sound Centre

Darwin
Pfitzners Music House

Brisbane
Reg Mills Stereo
Stereo Supplies

Newcastle
Ron Chapman & Assoc.

Wollongong
Hi-Fi House

Canberra
Douglas Hi-Fi

Hobart
Quantum Hi-Fi

Launceston
Wills & Co

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

Geelong
Sound Spectrum.

A clear case of better sound.

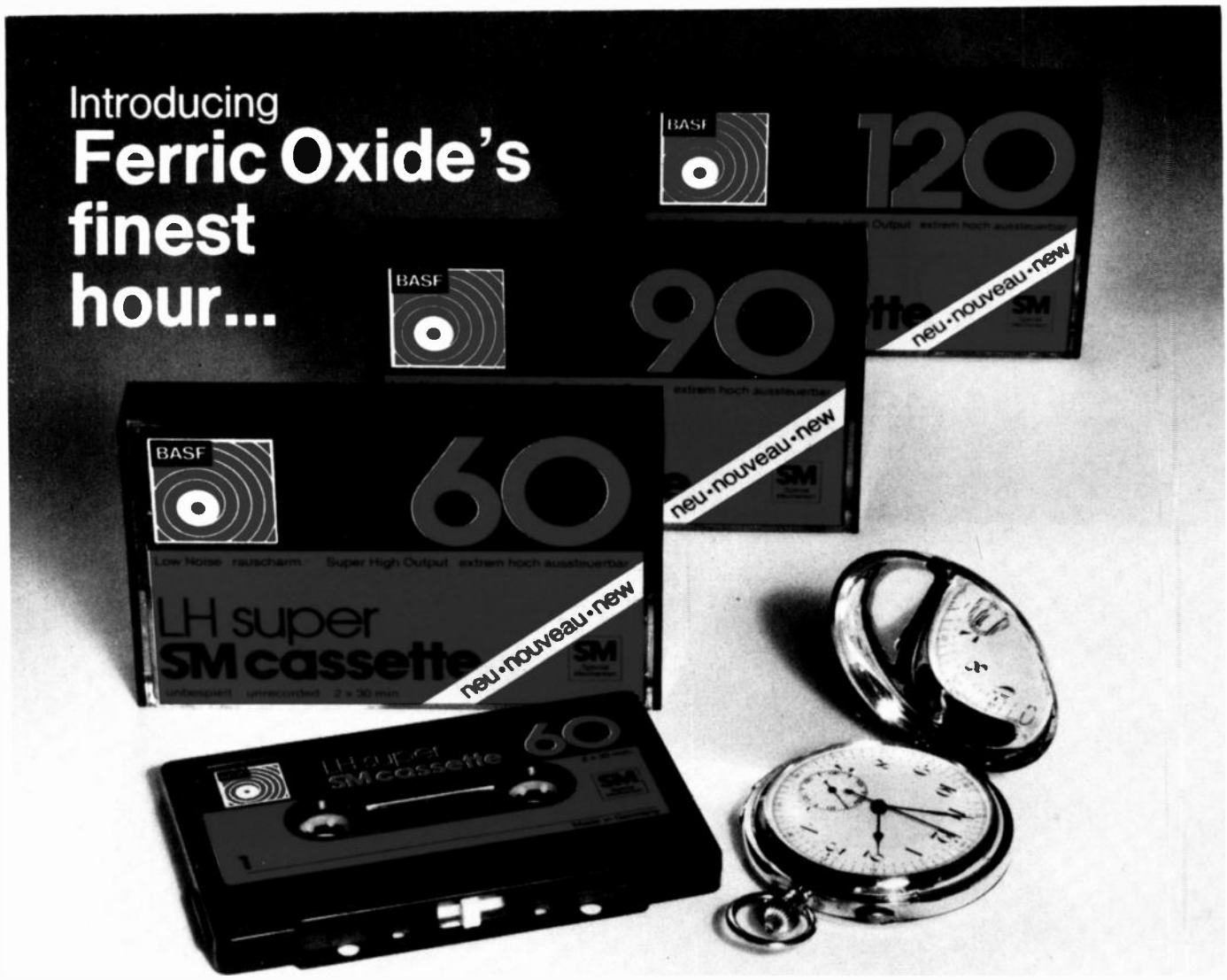
A clear case:
TDK's new 'True Mechanism' is something you can see. Better guide rollers and precision hubs give you better tape control, less binding, friction, wear.

Better sound:
'True Mechanism' helps eliminate wow and flutter. It gives you a better head contact and alignment. The tape itself is a new M-400gamma ferric oxide, high density, high resolution coating with a mirror smooth finish.

Ask for TDK TM Dynamic Cassettes. 60 and 90 minutes.

Australian Distributor: Convoy International Pty Ltd
4 Dowling Street, Woolloomooloo 2011. 3582088

PF634



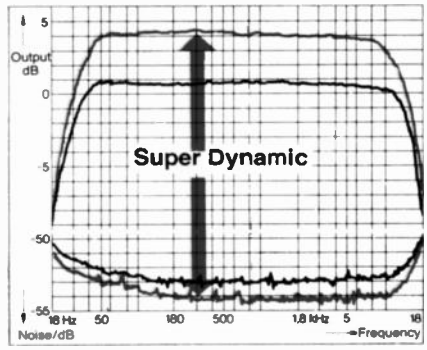
...hour and a half, and two hours

New BASF LH Super Cassettes with finer, more highly refined ferric oxide particles to give a 50% increase in volume without distortion.

Introducing a new standard of recording for all cassette recorders and decks without a CrO_2 bias switch. BASF LH Super cassette tape represents the ultimate in ferric oxide tape technology. Utilising a pure Meghemite oxide as well as a totally new binder system, LH Super features higher magnetic density and improved particle orientation.

This means more magnetic energy from the same tape surface area. The result:
50% increase in volume without distortion, across the full frequency range. An added 4 dB of low frequency, distortion-free dynamic output. A higher level of high reproduction is attainable flat to 20 kHz with a lower compression factor.

Low Noise characteristics are even lower **than standard Low Noise tape.**



Performance specifications of the higher quality cassette decks are exceeded, the reproduction of any recorder is improved.

No special bias switch is required. BASF LH Super provides professional results with standard bias settings found on all cassette recorders and decks.

BASF
the best in cassette sound

® BASF Aktiengesellschaft, 6700 Ludwigshafen/Rhein, Federal Republic of Germany.

Sole Australian Distributors: MAURICE CHAPMAN & COMPANY PTY. LTD. **Sydney:** 276 Castlereagh Street, Sydney 2000. **Melbourne:** 146-150 Burwood Road, Hawthorn, Vic. 3122. **Brisbane:** 123 Abbotsford Road, Mayne, Qld. 4006. Agents:—**Newcastle:** W. L. Redman & Co. Pty. Ltd.; **Canberra:** Sonney Cohen & Sons. State Distributors:—**Adelaide:** Neil Muller Pty. Ltd.; **Perth:** M. J. Bateman Pty. Ltd. **Launceston:** P. & M. Distributors; **Darwin:** Pfitzners Music House.

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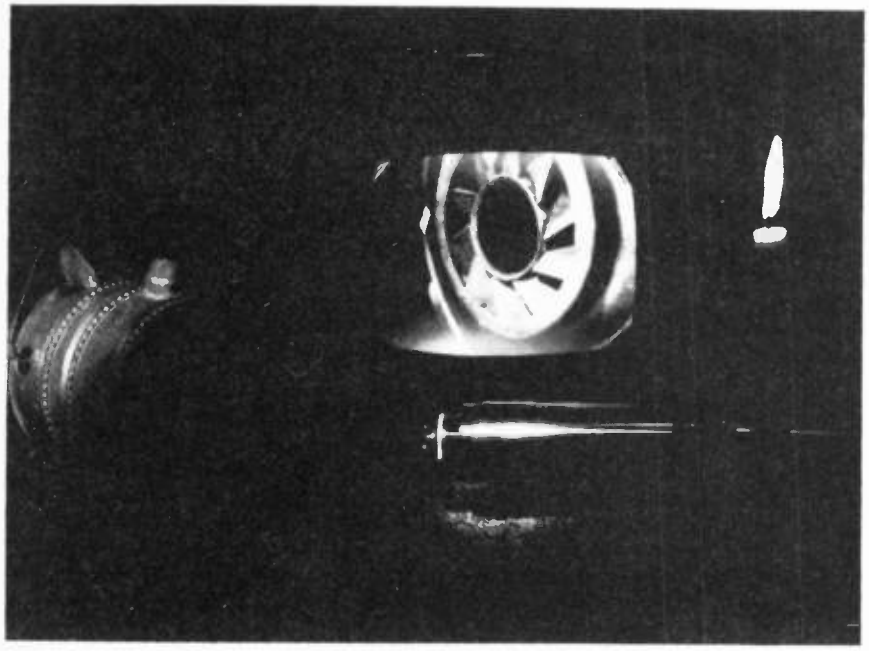
BRITISH MINIATURE TV CAMERA CAN 'SEE' BY CANDLELIGHT



By the flickering light of only one candle this new British miniature television camera captures a bright monitor screen image of a dull metal aircraft engine combustion chamber. Using a special silicon target tube which increases light sensitivity by as much as 100 times more than a conventional tube, the camera overcomes the problems of employing the powerful lighting normally required in small diameter TV inspection.

The Rees 60 miniature television camera has been developed to provide a high-resolution picture on the monitor screen in conditions where the unaided human eye would have difficulty in seeing anything. It is 2170 mm – only 50 mm in diameter.

INFRA-RED DETECTORS

Two new infra-red detectors have been produced by the Plessey Optoelectronic and Microwave Unit in Britain. They will be available through Plessey Australia.

The first is a highly sensitive miniature lead tin telluride photovoltaic infra-red detector. Designated Type LGC 600 it provides voltaic elements suitable for the 8-14/um spectral region, encapsulated in a rugged miniature dewar suitable for operation in a limited working volume.

The dewar has a precision inner bore which can accept standard Joule Thompson mini coolers, or liquid nitrogen, for operation at 77° K. Applications range from CO_2 laser detection and communications to infra-red line scan, thermal imaging for medical, military and industrial applications and infra-red spectroscopy.

Peak detectivities of greater than 2×10^{10} are readily available while rise times can be better than 10 nanoseconds.

The composition of the lead tin telluride material, can be adjusted to provide a peak sensitivity anywhere between 10 and 13 um. The material has a uniform composition and quality suitable for the fabrication of monolithic detector arrays.

The high quantum efficiency of this epitaxial material makes the diodes particularly suitable for heterodyne detection. The quantum efficiency, which can be as high as 80 percent, provides a current responsivity approaching seven amps/watt.

The second device is a new broadband infra-red detector specifically designed for intruder detection, fire alarm and pollution for monitoring applications.

Designated PPC522, this is the first in a series based on the Plessey pyroelectric ceramic, which will complement the well-known Plessey range of triglycine sulphate devices.

The PPC 522 consists of a pyroelectric ceramic element with an impedance matching JFET preamplifier encapsulated within a T05 transistor can. The complete unit, which has an output impedance of a few kilohms, requires only the addition of a simple operational amplifier to build a complete detection system.

The Plessey pyroelectric ceramic detector material, which is ferroelectric, exhibits a large temperature – sensitive polarisation while maintaining a high Curie temperature. As thermal radiation heats the pyroelectric element, charge appears on the electrodes on opposite faces of the detector element.

This charge variation can be detected as a voltage by the high impedance JFET preamplifier. The detector responds only to changes in the incident radiation level. A steady radiation level will not produce an output signal.

A passive IR intruder alarm can therefore be constructed by adding an inexpensive plastic faceted mirror and some simple op-amp circuitry. The faceted concave mirror provides a number of sensitive detection zones and an ac alarm signal is produced as an intruder moves through these zones. Typical intruder signals of a few volts at 20 metres can be achieved with the suggested circuitry.

The responsivity of a pyroelectric device operating in the voltage mode is inversely proportional to frequency of operation and the detector dielectric noise depends inversely on the square root of the frequency. Therefore, a signal-to-noise ratio of this thermal device falls off only as the square root of the frequency within the usable bandwidth.

The spectral response of the PPC 522, which is essentially flat, is determined by the transparency of the detector window. Potassium bromide windows provide a response between 0.2 and 35 microns while special bloomed germanium windows can be supplied to restrict the response to the 8-14 um region for intruder detection. Narrow band pass filter windows can also be incorporated for use in an inexpensive gas analyser in pollution-monitoring equipment. The device has a detectivity of 10^8 at 10 Hz and a frequency response which extends from below ¼ Hz to beyond 1 kHz.

Inquiries: Professional Components, Plessey Australia, Christina Road, Villawood, NSW 2163.

Professional Trio Test Gear at Amateur Prices*

VT108FET Volt-Ohm-Meter

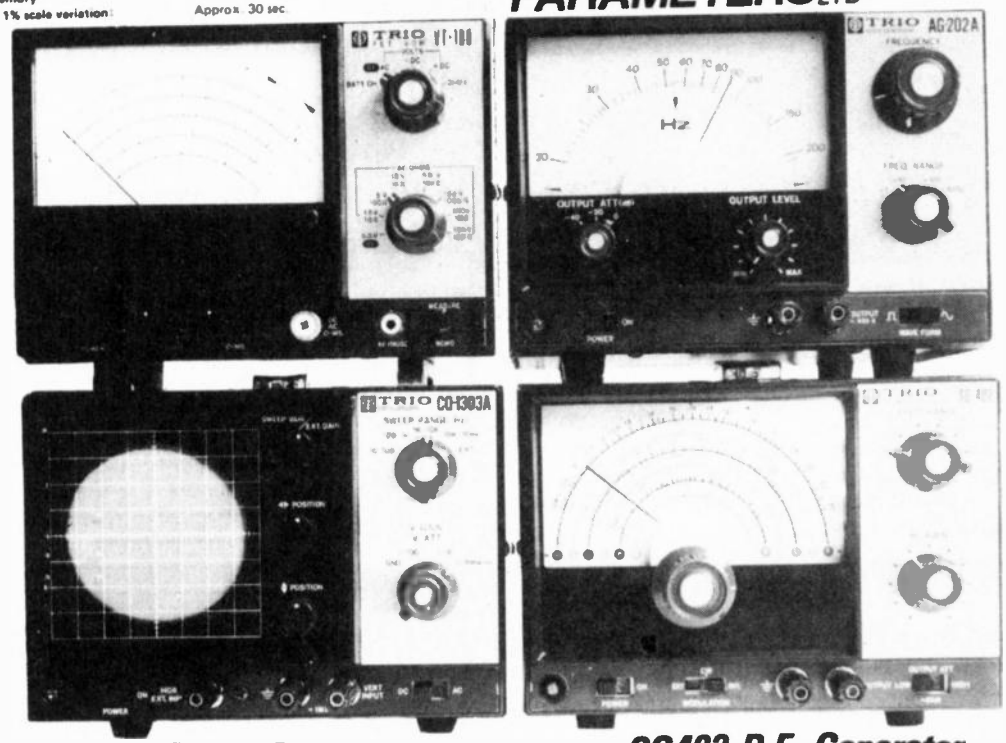
DC volt meter:	
Range:	0.5 to 1,500 V in 8 ranges.
Input impedance:	11 MΩ on each range
Accuracy:	±3% at full scale
AC volt meter:	
Range (Sine wave voltage):	1.5 to 1,500 V r.m.s. full scale in 7 ranges
(dB):	−15 to +66 dBm
(Any other voltage):	4.2 to 4,200 Vp-p full scale in 7 ranges
Input impedance:	1 MΩ 80 pF at 500 to 1,500 V range 145 pF at 1.5 to 150 V range using (PC-14) probe
Accuracy:	±5% at full scale
Freq. response:	15 Hz to 5 MHz ±10% 30 Hz to 2 MHz ±3%
Ohm meter	
Range:	0.1 Ω to 1,000 MΩ in 7 ranges
Accuracy:	±5% of setting range at scale 0.3 to 3 ±10% of setting range at scale 0.1 to 10
Memory	
1% scale variation:	Approx. 30 sec.

★ Ideal gifts for experi-menters ★

AG202A Audio Generator

Frequency range:	20 Hz to 200 kHz in 4 ranges
Freq. accuracy:	±(3% + 2 Hz)
Sine wave characteristics:	
Output voltage:	10 V r.m.s. ±10%
Distortion:	0.5% at 50 Hz to 100 kHz 1% at 20 Hz to 200 kHz
Square wave characteristics:	
Output voltage:	10 Vp-p
Overshoot:	3%
Sag:	10% at 20 Hz
Output impedance:	600 Ω
Output attenuation:	HIGH/LOW (40 dB) and variable control (±10% variation)
Drift with line voltage:	Freq. ±0.5% Level ±0.5 dB
External synchronization:	
Synchronization voltage:	1%/V approx.
Max. input voltage:	3 V r.m.s.
Input impedance:	10 kΩ

PARAMETERS PTY LTD



CO1303A 75mm Scope

CRT:	T C308P1
Vertical Sensitivity	20 mV/cm
Attenuator	1/1, 1/10, 1/100 plus fine control
Bandwidth	DC: DC to 1.5 MHz (−3 dB) AC: 2 Hz to 1.5 MHz (−3 dB)
Input R and C	1 MΩ, 30 pF
Max. input voltage	300 V (DC + AC peak) or 600 V p-p
Horizontal Sensitivity	500 mV/cm
Attenuator:	Continuously variable
Freq. response	DC to 250 kHz
Input R and C	1 MΩ, 40 pF
Sweep Freq:	10 Hz to 100 kHz in 4 ranges
Synchronization:	Internal (−)
Power requirements:	100/117/230 V AC 50/60 Hz, 15 W.

bankcard welcome here

SG402 R.F. Generator

Freq. range:	100 kHz to 30 MHz in 6 ranges
Freq. accuracy:	±1%
Output Voltage.	0.1 V r.m.s.
Attenuator	HIGH/LOW (10:1) and variable control
Modulation:	
Internal	400 Hz, 40% mod. degree
External.	Requires 1.5 V r.m.s. for 40% mod. degree
Power requirements	100/117/230 V AC 50/60 Hz, 6 W
Dimensions	W 186 mm x H 131 mm x D 220 mm (W 190 mm x H 154 mm x D 245 mm Max. dimensions)
Weight.	2.5 kg

JPM29

Simply mail coupon or call in:– **Sydney:** 68 Alexander Street, Crows Nest. 2065. Tel: 439-3288. **Melbourne:** 53 Governor Rd., Mordialloc. 3195. Tel: 90-7444. **Take advantage of your Bankcard.**

Please supply me with:		inc. Sales Tax. ☑	*Less Sales Tax. ☑
_____ 1303A Oscilloscopes	@	$192 ☐	$167 ☐
_____ AG202A Audio generator	@	$104 ☐	$91 ☐
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news digest

TRUE DUAL BEAM OSCILLOSCOPES

The Tektronix 5444 True Dual-Beam Oscilloscope is a new member of the 5000-Series Oscilloscope line. The 5444's two gun structures – two electron sources, two vertical deflection systems, and two horizontal deflection systems – provide completely independent operation and full beam overlap. Full beam overlap is the ability to position each beam anywhere over the entire 8-division crt area. The 5444, with the 5B44 Dual Time Base (a plug-in with two independent time bases) and two appropriate amplifiers, is virtually two oscilloscopes in one.

With these design features, the 5444 will display one signal at two sweep speeds or two signals at the same or different sweep speeds. These signals may be positioned anywhere on the crt face. This capability allows you to compare any two traces easily and accurately, even those from fast, single-shot events. If you need to compare more than two signals, the 5444 can display up to four repetitive waveforms at 60 MHz in the alternate or chop mode (or up to eight at reduced bandwidth), and four multiple-trace, single-shot events at sweep speeds up to 100 μs/div in the chop mode.

The crt readout automatically documents the sweep speed and vertical deflection factor for each beam. A user-addressable readout option allows the user to program photograph number, device under test, and other pertinent information (up to two 10-character words) on the crt screen.
Tektronix Australia, Sydney..

FAST DETERMINATION OF MOISTURE CONTENT

A major problem for many industries has been to find a reliable method of determining the moisture level in a product fast enough to correct production processes. Most conventional methods take a matter of hours and can thus only report on moisture levels after a production batch has been completed.

The new range of Microwave Laboratories from Apollo Microwave Products Inc., of Illinois, claim to overcome this problem. Some typical testing times are:

Flour	1½ minutes.
Sausage	4-8 minutes.
Sugar	5 minutes.
Paint	1½ minutes.
Chemical Detergents.	1-2 minutes.
Tobacco	1-2 minutes.
Cosmetics	3-5 minutes.

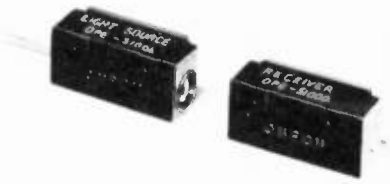
The Apollo's magnetron power train is an electronic magnetic structure giving an average energy transfer efficiency of around 70%. The unit also contains a precision balance. Optional accessories include an interface for connection to a computer or digital printout equipment and a cavity floor vacuum for making moisture determinations in a vacuum. i.e., on samples which are heat sensitive. With microwave energy the heat is selectively generated within the molecular structure of the water itself. Thus, high temperatures resulting from heat conduction to the centre of the sample are eliminated. The tendency for samples to char, crust, or otherwise deteriorate is greatly reduced.

A six page illustrated catalogue is available from the distributors: Tecnico Electronics, Premier St., Marrickville, 2204. N.S.W. or Tecnico Electronics, 2 High St., Northcote, 3070, Vic.

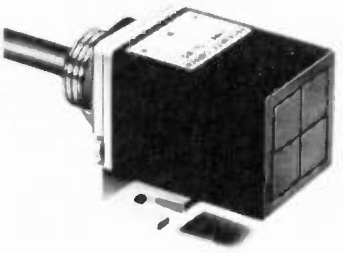
MINIATURE PHOTOELECTRIC SWITCHES

Omron type OPE-S100 series miniature photoelectric switches feature an LED light source, thus eliminating lamp failure and assuring long service life.

The tolerable external interference light is 1000 lux, thus allowing its use in relatively bright areas.
H. Rowe & Co Pty Ltd,
185 Hoddle St, Richmond, Vic. 3121.



OMRON PROXIMITY SWITCHES.



Type TL-N series general purpose proximity switches from OMRON, are designed for the detection of ferrous and nonferrous metals in production processes and other applications, and feature a wide range of sensors offering versatility and interchangeability with controller units.

These switches are of the high frequency oscillation type, and in applications where two or more sensors are placed close to one another, sensors of two different frequencies are made available to ensure the elimination of interference and malfunction.
H. Rowe & Co Pty Ltd,
185 Hoddle St, Richmond, Vic. 3121.

LEMO CONNECTORS HERE

John Barry Group has been appointed Australian Distributors for LEMO ELECTRONIQUES S.A. Switzerland's largest manufacturer of precision high quality electrical and coaxial connectors.

Lemo Connectors are used extensively throughout the electronic manufacturing industry and enjoy large government contracts for specialised usage in Europe and U.S.A.

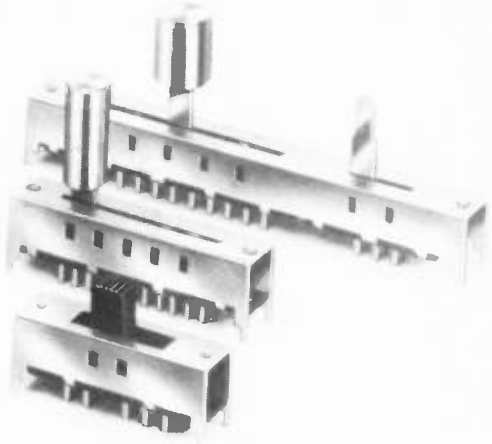
Details from the John Barry Group, 105 Reserve Road, Artarmon, NSW 2064.

SIEMENS MAKES YELLOW-LIGHT LEDS

Siemans is adding yellow-light elements to its line of luminescent diodes. The new LEDs are based on gallium phosphide and are installed in yellow diffuse plastic cases with a diameter of 3 mm (LD35) or 5mm (LD55). A diode array (LD 48) with a maximum of 10 systems per row is also available.

news digest

MULTIPOSITION SLIDE SWITCHES



ALCO ELECTRONIC PRODUCTS, INC. SS 110 13, SS 111, SS 24 SERIES

A range of multiposition slide switches have been introduced by Namco Electronics. These switches complement other slide components such as potentiometers.

The switch design permits high density placement. A double ball bearing spring detent gives a positive feel when switches are operated. Contacts have a self-cleaning wiping action and are sealed for protection against environmental contamination. Terminals are silverplated. All styles feature make-before-break action and are rated at 300 mA at 30 Vdc.

These switches have many practical uses. They may be used to test circuit continuity and sequence quickly and accurately. Other uses include matrix, crossbar and X-Y positioning applications. They may be used as adjustable voltage dividers, preset counters, and channel selectors.

Namco Electronics, 239 Bay St., North Brighton, Vic. 3186.

NEW TRIO INSTRUMENTS

A new family of test instruments by Trio of Japan is now available from Parameters Pty. Ltd. There are four instruments in the range, an audio oscillator, an Rf generator, a FET voltmeter and a 75 mm CRO.

The audio oscillator covers the range 20 Hz to 200 kHz in four ranges, has an output capability of 10 volts into 600 ohms with a distortion of less than 0.5% up to 100 kHz, and provides sine or square wave output. A large meter — type, frequency-dial scale is provided that has a five-to-one vernier drive.

The RF signal generator is an all solid state instrument that provides an output of 100 kHz to 30 MHz in six ranges with an amplitude of up to 0.1 volts RMS. The output can be AM modulated either internally (approximately 40% at 400 Hz) or externally (1.5 volts RMS for 40% modulation between 50 Hz and 10 kHz).

The FET voltmeter measures ac or dc voltages in eight ranges from 0.5 volts to 1500 volts full scale. The input resistance on the dc range is 11 megohms, and 1 megohm on the ac range in parallel with 145 pF (1.5 to 150 volt range) or 80 pF (500 to 1500 volt range). Accuracy is typically plus or minus 3% and the frequency range is 20 Hz to 5 MHz with the standard probe. An RF probe is available to extend the frequency capability. The unit is battery operated and thus fully portable.

Finally there is a 75 mm CRO with a vertical deflection sensitivity of better than 20 mV/cm and a frequency response, dc, of dc to 1.5 MHz and, ac, of 2 Hz to 1.5 MHz. Rated maximum input is 600 volts peak-to-peak.

All instruments are attractively priced and should appeal to the experimenter or amateur requiring to set up a test facility at minimum expense.

Further details available from: Parameters Pty. Ltd, 68 Alexander St., Crows Nest, N.S.W.

ERRATA AND ADDENDA. Synthesizer (Oscillator) Nov 1973.

The accuracy of the zero volt reference may be improved by adding a 10 k resistor between pin 9 and pin 10 of IC6.

Excessive current in IC6 has also been found to cause latch-up of the power supply. This may be cured by removing the link marked 10, directly under IC6, and by replacing it with a 1 k resistor.

This errata supersedes that published in the October 1975 issue; as the changes noted here have been found to be simpler and more effective.

CONTENTS CHANGE

The crossover-speaker project and switch mode supply originally planned for this issue will now be published in our December issue. See page 28 for further details of December issue content.

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DESIGN YOUR OWN FM RECEIVER

Brian Dance explains.

DURING the past few years the availability of specially designed linear integrated circuits, ceramic filters and complete front-end units has revolutionised the design of FM receivers. It is now easy for both the receiver design engineer and for the amateur enthusiast to construct receivers of the highest quality. No longer is it necessary to carefully align IF strips and ratio detectors with the knowledge that audio distortion will be the probable penalty if one does not achieve satisfactory adjustment of all the tuned circuits.

This article provides readers with a general review of the techniques developed in the past few years, with particular reference to the needs of the amateur constructor. Many of the devices however are so new that they are not generally available at the time of writing.

Even relative newcomers to electronics should have no difficulty in constructing a receiver using the circuits described. One must take reasonable precautions to keep the length of leads carrying radio frequencies (including IFs) short, but this is less important today than when thermionic valve circuits were used (high circuit impedances rendered stray coupling more probable).

FM receivers will be considered in three main sections.

(i) **The front-end,** in which the incoming signal frequency (88 to 108 MHz) is converted to the normal intermediate frequency of 10.7 MHz.

(ii) **The 10.7 MHz amplifier and demodulator circuits.**

(iii) **The stereo decoder circuit.**

THE FRONT-END

The aerial feeds a signal to the front-end of the receiver where it is first amplified by the RF stage before being fed to the mixer. An oscillator signal generated in the front-end is also fed to the mixer. The mixer circuit produces the difference frequency between the input signal and the oscillator frequency. The tuning of the receiver (including the oscillator) ensures that this difference frequency is always kept at 10.7 MHz no matter what frequency is being received.

The home constructor can build a front-end unit from discrete components, but inexperienced constructors are not advised to do so. Lead lengths (and hence the positioning of components) can be very critical at frequencies of the order of 100 MHz. The stray capacitance and inductance of even 10 mm of wire are often important in such circuits. Then the front-end has to be aligned, although this is not generally very difficult.

The commercially-built front-end units currently available will be discussed in detail. However, there is no reason why an experienced constructor should not make a front-end unit himself for use with the other circuits to be discussed. A front-end unit using one of the latest ICs can give a very high performance and will be described for the benefit of experienced workers.

TYPES OF FRONT-END

Perhaps the most important decision one has to make when selecting a front-end unit is whether to employ one which is tuned by a ganged variable capacitor or one tuned by 'Varicap' (varacator) diodes. The latter are silicon diodes specially designed for use as variable capacitors, the value of their junction capacitance changing with the voltage applied to them. As the applied voltage is increased, the distance across the semiconductor junction increases and the capacitance becomes smaller.

If a Varicap diode is connected across a tuned circuit, the resonant frequency of the circuit can be changed by altering the voltage applied to the diode. In practice this same tuning voltage is applied to several diodes connected across different tuned circuits so that the resonant frequencies of the latter change simultaneously. This arrangement of Varicap diodes can thus replace a ganged capacitor. As the tuning voltage is increased, the frequency to which the receiver is tuned also increases; the relationship between the tuning voltage and the frequency of the signal being received is non-linear.

A typical Varicap tuning system favoured by the writer is shown in Fig. 1. When S1 is in position 1, the tuning voltage fed to the Varicap diodes in the front-end is obtained from the Beckman (Helipot VR1). This is a ten-turn helical potentiometer which thus provides a good slow motion action for fine tuning. A Beckman type RB dial or a digital dial is fitted to VR1. Although this dial does not provide an indication in MHz of the

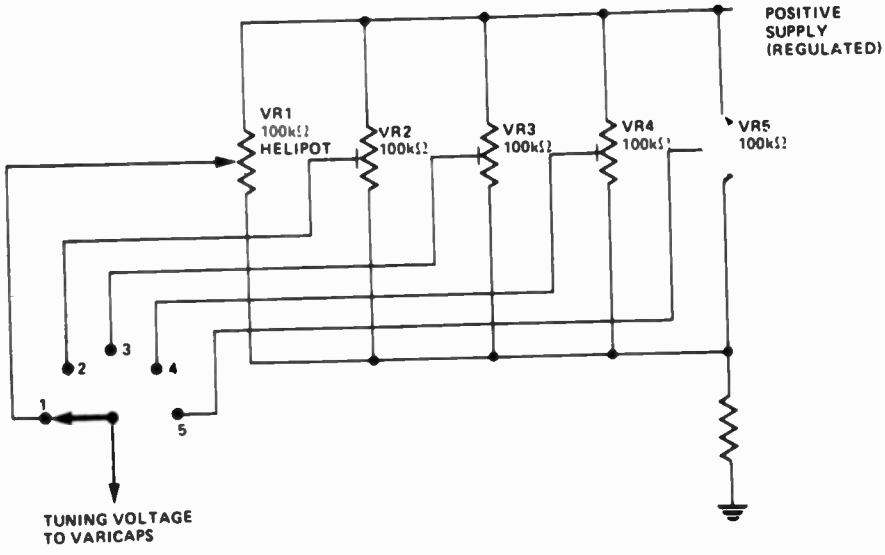

Fig. 1. Simple tuning circuit for a Varicap front-end providing both switched and continuous coverage.

frequency being received, it can be accurately reset to any point used previously.

For ordinary domestic reception, it is much more convenient to have switched tuning than continuously variable tuning. Each of the other positions of S1 enables a preset frequency to be received, these preset frequencies being determined by the preset trimmers VR2, VR3, etc. Any reasonable number of switched frequences can be employed by employing a separate trimmer for each. The writer has used Beckman type 89P 15-turn preset trimmers for this application since they can be adjusted far more easily than a single turn potentiometer.

The circuit of Fig. 1 thus provides both switched and continuous frequency coverage. If desired, only continuous tuning may be used.

In a receiver for use in the home, switched tuning alone is often satisfactory, but in a car radio receiver one also requires continuous tuning unless the car is used in only one locality. Otherwise one would have to adjust the trimmers whenever one moved into a new area.

When using Varicap diodes the optimum performance is obtained with 'back-to-back' diodes connected as in Fig. 2. The tuning voltage is applied to the junction of the diodes which are both reverse biased; they therefore present a very high impedance to the tuned circuits.

The use of Varicap tuning in an FM receiver has the advantage that the tuned circuits being controlled can be placed in any position, whereas the use of a ganged capacitor necessitates the circuits being placed close to the capacitor. The latter position may not be the most favourable one from either electronic considerations or from the constructional point of view.

Varicap tuning systems enable the tuning unit to be placed at a point remote from the front-end unit and the individual tuned circuits can be placed in any convenient position. The tuning voltage can easily be obtained from a tapping on a ten-turn helical potentiometer. However, the Varicap tuning voltage must be very well smoothed, since any 50 Hz ripple in this voltage will cause a 50 Hz frequency variation in the IF signal which will be demodulated to produce hum. The use of Varicap tuning therefore involves the use of a voltage regulator circuit and this adds to the cost. The writer normally uses a TBA 625B (SGS-Ates) integrated circuit voltage regulator when a 12 V supply is required or a TBA 625C when a 15 V supply is needed. These regulators contain internal circuitry which limits the short circuit current to about 30 mA and this should prevent damage to any devices if the constructor accidentally shorts any component.

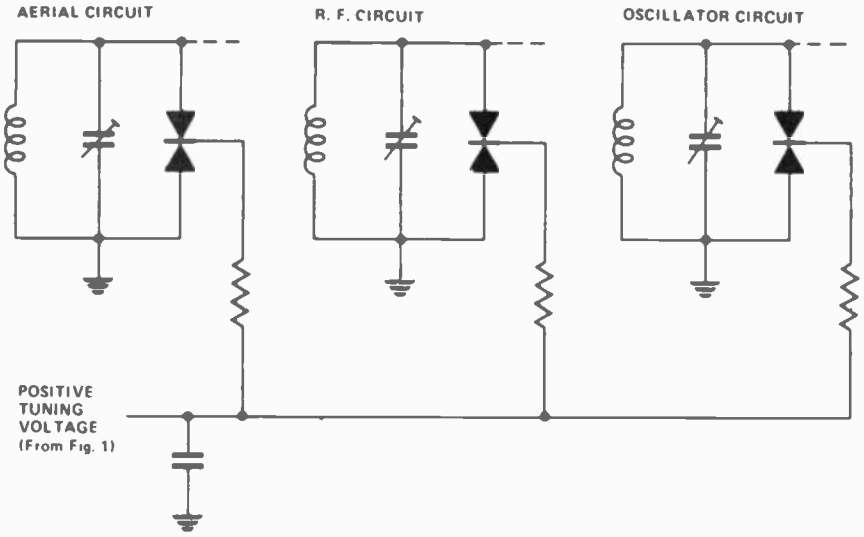

Fig.2. Basic circuit showing tuning with back-to-back Varicap diodes.

In FM/AM receivers, a ganged tuning capacitor is normally employed with separate sections in each gang for the AM and FM tuning. Unfortunately variable capacitance diodes with an adequate capacitance swing for AM tuning are quite expensive and it is not normally economical to use Varicaps for AM reception. It is common practice to use a ganged capacitor and scale in such receivers.

To summarise, it is generally preferable to use Varicap tuning in an FM receiver for optimum performance and convenience. However, one may use ganged capacitor tuning – for reasons of economy or because one wishes to have a common tuning control in an FM/AM receiver.

OTHER FACTORS

The performance and price of FM front-ends is also affected by other factors. In general, a VHF front-end employing a MOSFET (Metal Oxide Semiconductor Field Effect Transistor) as an RF amplifier will provide lower cross modulation than front-ends which employ only bipolar transistors. Cross modulation causes problems when one wishes to receive a weak signal close in frequency to a much stronger one.

Some front-ends also employ a MOSFET device as a mixer to reduce cross modulation in this stage, and to provide much better isolation between the oscillator and the input. Another approach involves the use of a number of tuned circuits between the RF stage and the mixer to reject unwanted signals before they reach the mixer. Such units are normally tuned by Varicaps, since the use of a ganged capacitor with enough sections would be inconvenient.

It is desirable that a front-end should provide high rejection of image and other spurious signals, especially if one lives near to an FM station or if one lives in a large city where fire-police and ambulance transmissions are likely to be present.

The noise level of a tuner can also be important, since it affects the minimum signal strength which can be received. It is normally expressed as a 'noise figure' or 'noise factor', a value of 6 dB being typical. The lower the noise figure, the less the amount of noise added to the signal in the front-end. A difference of 2 dB to 3 dB is only just noticeable.

The input impedance of a front-end unit normally has one of two values. It may be about 75 ohms unbalanced for matching to the co-axial cable used to connect the aerial. Alternatively the input may be balanced with an impedance of about 300 ohms for matching to twin feeder cable. (In a balanced input, neither side is earthed, but in an unbalanced system, the outer braiding of the co-axial cable must be connected to the earthed side of the front-end input). Although matching is by no means critical, it is advisable to obtain a reasonable match when the signal strength is low, especially if stereo reception is required. At high signal levels two metres of wire can be used as an aerial, but a better outdoor aerial will reduce noise from passing traffic, etc.

The output impedance of a front-end unit is not very important, but it is wise to consider it when matching the succeeding circuit. Note whether your front-end has provision for AGC and/or AFC and how much the frequency of the oscillator drifts with temperature and the power supply voltage.

DESIGN YOUR OWN FM RECEIVER

SOME FRONT-ENDS

Details of a number of front-ends are given in Table 1. The Toko EF-5600U and EF-5603U are high performance units, the difference between them being that the EF-5603U does not have provision for the application of AGC and AFC control voltages. They are neither the cheapest nor the smallest front-end units, but they have an exceptionally good specification. Both of these units have three tuned circuits between the RF stage and the mixer and this enables the high rejection figure of 90 dB to be obtained against all spurious frequencies. The dimensions of the EF-5600U/5603U are 90 x 70 x 33 mm. BB-104 back-to-back dual Varicap diodes are used in the five tuned circuits to cancel out the non-linearities in each individual diode.

The emitter of the mixer circuit is connected to a test point (normally left unconnected). The output from the collector circuit of the mixer is fed into two 10.7 MHz inductively coupled tuned circuits and then into an emitter follower output stage. This provides a low impedance output. A 0.01 μF series capacitor is included in the output circuit enabling direct connection to any succeeding circuit.

TOKO EC-3302U

The Toko EC-3302U front-end is another Varicap tuner but smaller and cheaper than the EF-5600U/5603U types. It uses three single Varicap dioes and provides less rejection of spurious signals than the more expensive Toko front-ends. Nevertheless it provides a perfectly adequate performance. As shown in Table 1, the supply voltage can be lower than that required for the EF-5600U/5603U.

The EC-3302U output is obtained by

TABLE ONE

	TOKO EF-5600U/ EF-5603U	TOKO EC-3302U	LARSHOLT 8319	MULLARD LP1186	TOKO MT-3302UG	TOKO ET-703UA
Type of tuning	VARICAP	VARICAP	VARICAP	VARICAP	GANGED CAPACITOR	GANGED CAPACITOR
Recommended supply (V)	+12	+9	+12	+8	+9	+6
Minimum supply (V)	+9	+6.3		+6	+6.3	
Supply current (mA)	17 (max)	16 (max)	25	6.1	18 (max)	5
Frequency range (MHz)	87 to 109	87 to 109	87.5 to 108.5	87.4 to 104.5 +2 to +12V	87 to 109	87 to 109
for Varicap supply (V)	+3 to +25	+2 to +20	+2.3 to +18	87.4 to 108 +2 to +17V		
Gain (dB)	30 (min)	22 (min)	32	30	25 (min)	16 (min)
Noise figure (dB)	7 (max)	7 (max)	5	6.5	8 (max)	10 (max)
Aerial impedance (Ω)	75	300 (bal.)	75 or 300 (bal.)	75	300 (bal.)	300 (bal.)
Output impedance (Ω)	75	300	Recommended load 150	75	300	1000
Image rejection (dB)	90 (min)	45 (min) (108MHz)	56	40	45 (min) (108MHz)	25 (min)
I.F. rejection (dB)	90 (min)	50 (min) (108MHz)	80	65	50 (min) 98MHz	45 (min)
Spurious rejection (dB)	90 (min) (98±5MHz)	50 (min) (98±5MHz)			50 (min)	30 (min)
Osc. stability with respect to (i) supply voltage		±50kHz (max) for 10% change	50kHz/V	60kHz/V	±150kHz (max) for 10% change	
(ii) Temperature	±100kHz (max) 25°C to 55°C	±150kHz (max) 25°C to 55°C		−10kHz/°C rise	±150kHz (max) 25°C to 55°C	
A.F.C.	Only EF5600U	±120kHz (min) (108MHz)	1.5MHz/V	±200kHz	±120kHz (min)	±200kHz for 0.5V at 108MHz
Output bandwidth (−3 dB)	300kHz +120 −60	200kHz (min) (98MHz)	300kHz	200kHz (min)	350kHz	
Gain spread (dB)	6 (max)	4 (max)		1 (max 6)	4 (max)	
R.F. Amplifier	Dual gate MOSFET	Single gate MOSFET	Dual gate MOSFET	MOSFET	Single gate MOSFET	Bipolar
Mixer	Bipolar	Bipolar	Dual gate MOSFET	Bipolar	Bipolar	Bipolar
Total no. of transistors	4	3	3	3	3	2
No. of Varicaps	5 back-to-back	3 single	4 back-to-back	3 single		
No. of 10.7 MHz tuned circuits	2	1	2	2	1	1
Capacitor Angle of rotation					540° ±6°	540° ±6°
A.M. tuning (pF)					190.6 -76.5 (osc)	323 323
A.M. Trimmers (pF)					12	12

means of a coil coupled to the 10.7 MHz tuned circuit which is the collector load of the mixer. In many circuits it will therefore be necessary to connect a series capacitor in the output of this front-end to prevent a steady current flowing from the succeeding circuit through the output coupling coil.

The EC-3302U has provision for the application of AFC, but not AGC.

LARSHOLT 8319

The Larsholt 8319 has a slightly better noise figure than the other Varicap tuners shown in Table 1, whilst its capability of rejecting spurious frequencies is intermediate between that of the two Toko types. Four 'back-to-back' BB-104 Varicap diodes are employed and there are two tuned circuits between the RF stage and the mixer.

An unusual feature of the 8319 is the two aerial input impedences. Either a balanced 300 ohm feeder or a 75 ohm unbalanced co-axial cable can be matched by using appropriate tappings on the front end aerial coil. Dual gate MOSFETs are used in both the RF and mixer stages of this unit. There is provision for the application of AFC to the oscillator stage, but AGC is not used with this tuner.

MULLARD LP1186

The LP1186 is one of a series of Mullard modules and is 62 x 31 x 17 mm in size. Although it was originally designed for use with a LP1185 IF amplifier/demodulator module, a somewhat better performance can be obtained by using one of the integrated circuit IF units to be discussed later.

Eight wire connections project from the base of the LP1186 and can be fitted into a standard 'Lektrokit' board which has holes spaced at 0.1 in intervals. When connecting wires are soldered to these connections, the solder will hold the module in position. The writer found the LP1186 a very convenient module to use, but at the time of writing it is in short supply. It requires less operating current than the other Varicap tuners covered here.

GANGED CAPACITOR TUNING

The Toko ET-703UA is one of the most economical FM tuners currently available. It employs a two-gang tuning capacitor with a two-gang AM section. The aerial circuit is fixed tuned. A slow motion drive (ratio 3:1) with spring loaded gears is incorporated. Although its specification (see Table 1) is not up to the standard of the more expensive front-ends, the writer has used an ET-703U and found it very satisfactory except when used with a NE563 demodulator circuit. This is because an appreciable oscillator voltage is present at the output of the unit. Whilst this can be reduced, by connecting a capacitor (about 82 pF) from the output to ground, there is still enough voltage to cause beats with a NE563 oscillator stage. A single transistor is used as mixer and oscillator in the ET-703UA. The output impedance (1 k) is rather high. There is provision for the application of AFC but not AGC.

SD6000

In the past, VHF receivers have always employed discrete semiconductor devices in the front-end unit, since linear ICs which can operate at 100 MHz have not been available. This position has been changed, however, by the recent development of the SD6000 device by Signetics in California.

The SD6000 is encapsulated in a normal eight-pin dual-in-line package. As shown in Fig. 3, it contains an RF dual gate field effect transistor and a similar device used as a mixer. These devices are manufactured by the special Signetics D-MOS (Diffused Metal Oxide Silicon) process which has been used in earlier Signetics discrete devices. It enables precisely controlled channels of less than 1 micron in length to be produced with extremely low parasitic capacitances.

D-MOS devices, like all MOSFET transistors, have very high impedances in their gate connection. They could

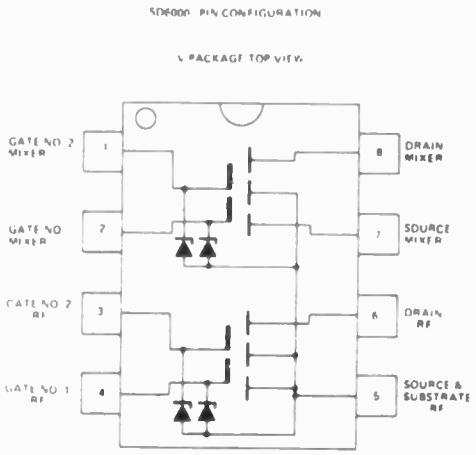

Fig.3. The internal components of the SD6000.

easily pick up static voltages which would ruin the devices, by puncturing the insulated layer, if the zener diode connected from each gate to the substrate were omitted. These diodes bypass any static or other voltages which are more positive than + 25 V or more negative than 0.3 V. No special precautions are therefore required in handling the SD6000 or when soldering it into the circuit. If one does not use an IC socket, it is naturally advisable to use an earthed soldering iron — as with all low power semiconductor devices.

The two D-MOS devices in the SD6000 are positioned in the package in such a way that coupling between them is reduced to a minimum. This not only reduces radiation of the local oscillator signal from the aerial, but also eases stability problems.

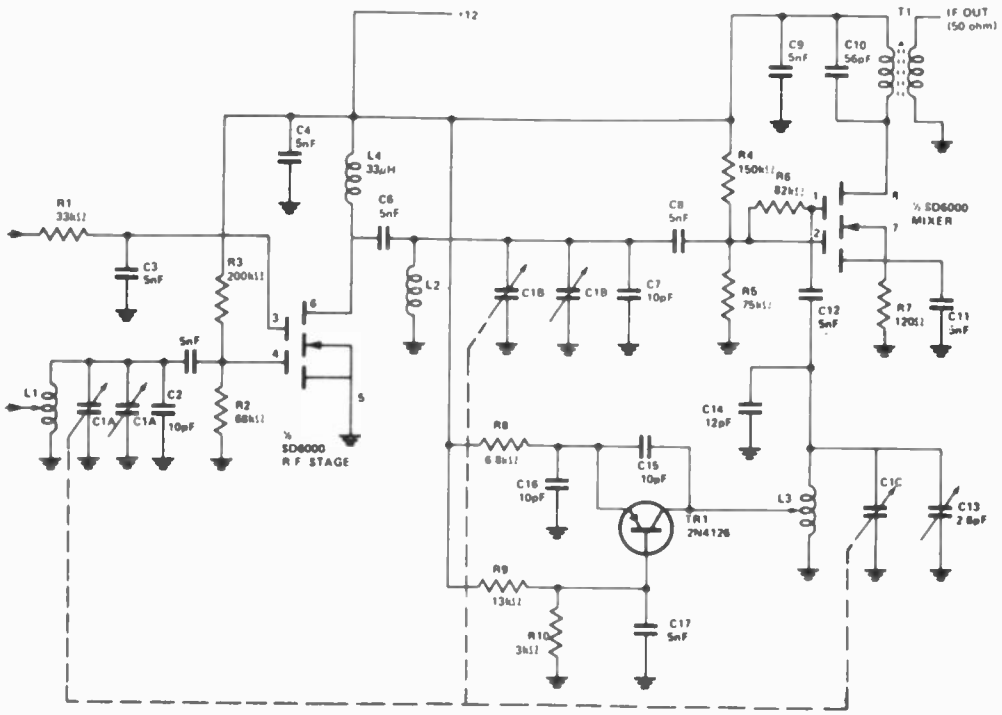

Fig.4. A typical SD6000 circuit using a three-gang capacitor.

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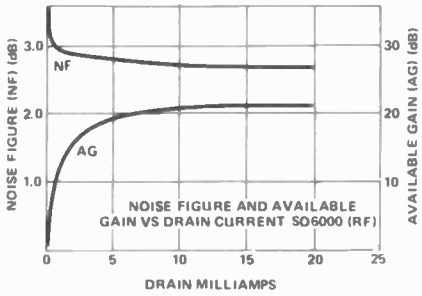

Fig.5. Noise figure and available gain of the SD6000 RF stage at various values of the drain current.

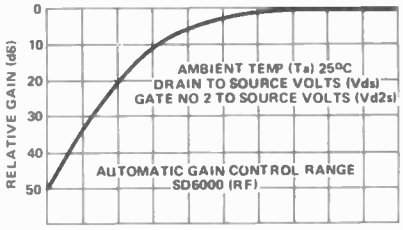

Fig.6. AGC characteristic of the SD6000 RF stage.

The two devices in the SD6000 package each have a maximum permissible drain current of 50 mA. The gate leakage and drain currents are each typically 1 nA, whilst the feedback capacitance has the very small value of about 0.03 pF.

TYPICAL CIRCUIT

A typical high performance front-end circuit using the SK6000 is shown in Fig. 4 It tunes over the normal range of 88 to 108 MHz. The SD6000 has also been used in high performance Varicap tuned front-ends.

The noise performance of the SD6000 is really first class, the typical figure being 2.5 dB at 100 MHz (maximum 3 dB). The power gain at the same frequency is typically 30 dB. The typical variation of the noise figure and gain of the RF stage with the drain current is shown in Fig. 5. The bandwidth is about 300 kHz, this being determined almost entirely by the 10.7 MHz output transformer.

The incoming signal is tuned by the aerial circuit, after which it passes to gate 1 (pin 4) of the SD6000. AGC is applied to gate 2 (pin 3) of the device. The excellent AGC characteristic is shown in Fig. 6, 50 dB variation of gain being attainable at 100 MHz.

Oscillator voltage from the 2N4126 oscillator stage is fed to gate 2 of the mixer, whilst the signal voltage from the RF stage is applied to gate 1. The use of separate gates of the D-MOS device in this way provides very high isolation between the local oscillator and the aerial circuit and hence minimises spurious radiation. The oscillator stability is of the order of 40 kHz per volt change in the supply voltage, whilst a rise in temperature of 10°C may increase the oscillator frequency by about 100 kHz.

Details of the coils in Fig. 4 are shown in Table 2. However, newcomers to electronics are advised not to try VHF circuitry.

This article has shown how the incoming signal from the aerial can be amplified at low noise and converted into a 10.7 MHz IF signal.

Next month we shall consider how this output from the front-end unit can be used to provide the required audio output signal.

TABLE 2

T1	10.7 MHz transformer	Cambion type 533-3652-003
L1	Aerial coil	4 turns 18 gauge, 3/16 in diam. Air core. Tap 1 turn from the ground side
L2	RF coil	4 turns 18 gauge on 3/16 in. diam. air core.
L3	Oscillator coil	4 turns 18 gauge on 3/16 in. diam. air core, centre tapped
L4	Choke	33 μH approx
Tuning capacitor		5 to 20 pF, 3 gang

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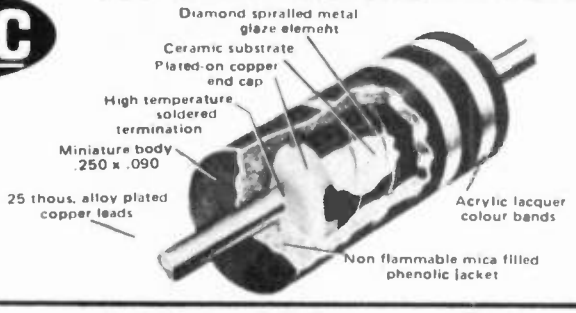

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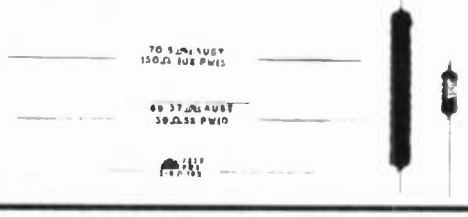

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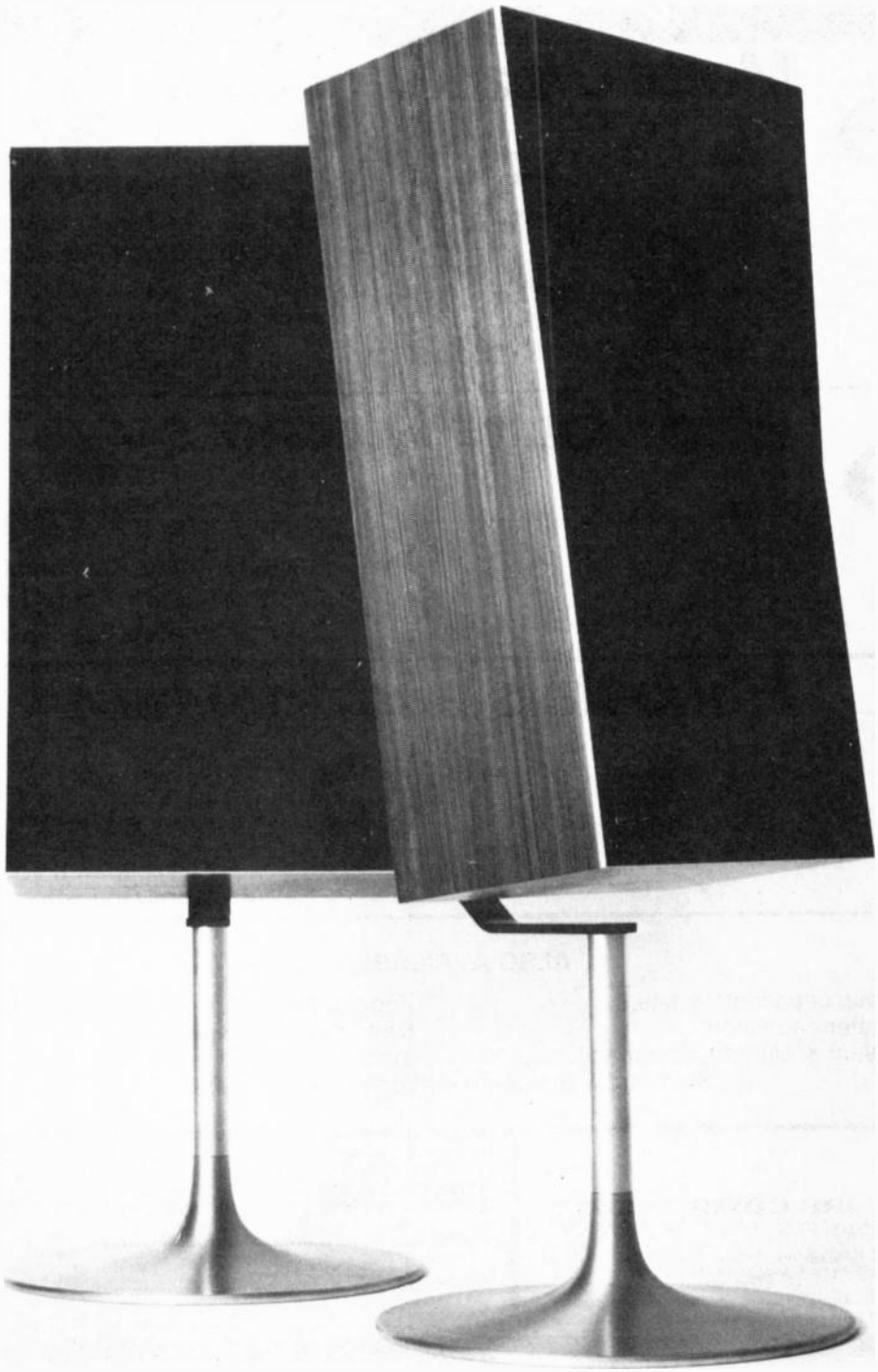
G/6.75

Announcing a breakthrough in speaker design that took Bang & Olufsen's best brains four years to develop~ the new B & O Uni-Phase speakers.



Pictured: the M70, top-of-the-range of new B & O Uni-Phase speakers, featuring optional stand. Ask about the full range of Beovox Uni-Phase Speakers at any of the B & O dealers listed on the opposite page.

Bang & Olufsen is far from being among the largest manufacturers of high fidelity equipment in the world. Yet, in recent years they have astounded the world with their products.

Within the past two years, B & O have put the only quadraphonic music set with ultrasonic remote control on the market: The Beosystem 6000. And the only gramophone with an electronically controlled tangential tone arm, which reproduces your records exactly the same way as they were cut.

These products have met with the unreserved acclaim of critics and music lovers throughout the world.

Now Bang & Olufsen is introducing a speaker series that will undoubtedly be received the same way: **The Beovox Uni-Phase speakers.**

It took Bang & Olufsen's best brains four years to create these speakers, plus some assistance from the largest computer in the world, at Cleveland, Ohio, which is also used by NASA in the American space programme.

Although at first sight the new **Beovox Uni-Phase speakers** resemble other pressure chamber speakers, they have little in common with them. In order to create these new speakers, B & O scientists have had to reject old established design theories and start from basic principles.

The results are just as revolutionary as their techniques: The new **Beovox Uni-Phase speakers** are **the only** pressure chamber speakers whose transient response lies in the same class as that of amplifiers. And **the only** ones in which all the units in the cabinet operate in the same phase even in the crossover range–**the only** speakers in which the sound from all the units reaches the ear simultaneously.

One of the secret developments which made all this possible is the "patent pending" Baekgaard Phase-Link crossover network combined with the dynamic impulse corrector.

As well, there are other developments–like the fact that here is a loudspeaker that can reproduce the sound of a whole orchestra yet takes up little space in your living room.

The main development, of course, is the entirely unique sense of reality the new Phase-Link crossover network brings to your music.

The purpose of this advertisement has been to let you know that speakers no longer need be the weakest link in the high fidelity chain.

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U691/95

What's left to say about speaker systems?

It's all very confusing. Speaker advertisements promise all sorts of wonderful things . . . better bass response, magnificent transient handling, higher power rating, unfailing reliability, superior treble performance . . . you name it, they've all reached the peak of all these parameters.

Interdyn speaker systems are distinctive. There are four models, ranging from a 10 litre bookshelf system to a 3-way, four drive unit enclosure with a capacity of 60 litres. They're fitted with proven Danish drive units which are well known for their **natural musical reproduction**, over a **wide frequency range**, encompassing the response (including the harmonics) of all known musical instruments. Interdyn sound is **fatigue-free** and **remarkably faithful**.

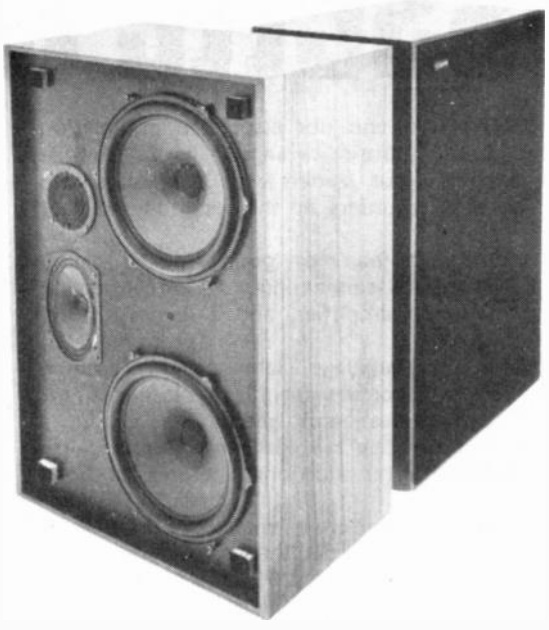
Above all, Interdyn speaker systems represent outstanding **value for money** . . . in both performance and finish. Every cabinet is hand finished in selected walnut veneer and has been designed in the classical manner, so it won't be out of date this time next year. Listen to Interdyn systems — see how much more you get for your investment. Choose from four models:—

INTERDYN MODEL 10-2. An effective 2-way system, with a 16.5 cm bass/mid-range speaker and a dome tweeter, crossing over at 1500 Hz. Frequency response is 45-20,000 Hz., power rating 20 watts RMS. Size 36 x 23.5 x 23 cm.

INTERDYN MODEL 30. Measuring 53.5 x 30.5 x 26 cm, the Model 30 features a 25 cm woofer/mid-range drive unit crossing over to a 3.75cm dome tweeter at 1500 Hz. Frequency response is 30-20,000 Hz. and power rating is 35 watts RMS. This popular Interdyn enclosure sounds like a much larger system.

INTERDYN MODEL 35. Rated at 60 watts RMS, the Model 35 measures 59 x 34 x 26 cm. and has a frequency response of 30-20,000 Hz. Low frequency performance is quite outstanding, thanks to the use of two 21.3 cm bass reproducers with long throw voice coils, and a soft neoprene surround. Crossover frequency is 1500 Hz.

INTERDYN MODEL 60. A 3-way system using four drive units, the Interdyn Model 60 employs two 25 cm bass units, an oval mid-range speaker and a 3.75cm dome tweeter. Response is 25-20,000 Hz, and size is 67.5 x 46 x 29 cm. Crossover frequencies are 600 Hz. and 3000 Hz. Power handling capacity is 70 watts RMS.



Listen to Interdyn speaker systems at your specialist hi-fi stereo store. **Listen critically.** *Compare the value as well as the performance. You'll choose wisely when you select Interdyn!*

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1D-SS175

SPECIAL ETI OFFER

$99.50 Cassette Recorder

CONVOY CONTUTOR
LL Teaching Machine
Cassette Recorder

ELECTRONICS TODAY and our associated publication Hi-Fi Review have jointly arranged with Convoy International to supply our readers with the well-known Contutor LL cassette recorders at the very low price of $99.50.

The price includes a pair of good quality stereo headphones, a DIN to DIN connecting cord for connecting the recorder to a stereo amplifier, and a demonstration cassette.

The Contutor LL (language laboratory) Teaching Machines are cassette recorders specifically intended for educational applications and made to Convoy's specification by Sanyo. They are basically a high quality stereo cassette machine with additional features, outlined below:—

The machines operate from either mains or batteries. A power cord is supplied to enable the machine to be connected to the 240 volt ac mains. Provision is also made for operation from six dry cells which fit into a holder within the unit (batteries are not included). The unit may also be powered via a vehicle's 12 volt supply if the user obtains a 12 volt to 9 volt converter. A simple unit of this type was described in Electronics Today International February 1972.

Unlike most conventional recorders, the LL machines have an inbuilt condenser microphone. Two separate microphone inputs are also featured thus enabling true stereo recordings to be made.

A two-watt amplifier and 120 mm loudspeaker are inbuilt. These facilities enable recorded cassettes to be listened to immediately. It also enables the machine to be used independently of other equipment, or even a mains supply, virtually anywhere. The reproduction quality is of a surprisingly high standard.

The main difference between the LL recorders and conventional machines is that *additional* facilities have been provided for teaching purposes.

In essence, extra controls and circuitry have been included to perform a number of functions.

One of the most useful and important facilities is the LL key. When this is depressed the erase head is not operative on the machine's first channel. This enables the teacher to record a series of words or musical phrases on one track — leaving gaps between each sequence of sounds. The pupil can then record his own attempts at reproducing these sounds on the second channel whilst listening to the teacher. Once this has been completed the pupil can then compare his attempts with the original simply by replaying the cassette. He can then wipe off his own track *without erasing the teacher's recording.* Removing the cassette tab makes accidental erasure of teacher-track impossible.

This LL facility is of enormous value — not only in language teaching but also in musical applications where a direct audible comparison is required between an original and a subsequent recording. It also allows 'self duets'!

A pause control is included. This enables recording to be started or stopped instantaneously. It also enables record levels to be set without setting the cassette in motion.

Two VU meters are provided. The left-hand one doubles as a battery condition indicator.

As with conventional recorders, the LL machine may be connected directly to a stereo amplifier and speaker system. A DIN to DIN connecting cable is provided for this purpose. Reproduction of mono or stereo cassettes is first class – as may be seen from the accompanying specification table. Thus recorded music can be replayed with excellent fidelity – a most valuable feature if the machine is to be used for musical demonstrations. Stereo recordings of high quality can also be made via the DIN cord from the amplifier.

The LL facility is also of value where a slide projector is to be synchronized with voice or musical accompaniment. The user can build a simple device that will cause pulses to be recorded on the right-hand channel. These pulses will then trigger a slide changing mechanism in the projector in synchronism with the accompaniment which will then be recorded on the left hand channel. Details of how to do this were published in the April 1972 issue of Electronics Today. Photostat copies of this project are available from our back issue dept for $1.00.

Another most valuable feature is a variable speed control. This enables the playback speed to be varied by +5% and –15%. Thus when the machine is to be used for music teaching the pitch of recorded music can be varied to match exactly the pitch of the accompanying instrument/s. The speed facility is also valuable for syllable analysis and for fast revision.

Unusual extra facilities are also provided for fast winding. In one mode the wind and rewind facilities are as conventional machines. However if the 'play' key is depressed at the same time as the wind/rewind keys then the recorded part of the tape will be heard (at high speed) whilst fast winding is in progress. These facilities are very useful for rapidly selecting any required part of the tape. On the LL machines the rewind key is labelled 'review', the fast forward key is labelled 'cue'.

NOTES

This offer is exclusively limited to readers of Electronics Today International and Hi-Fi Review.

Six hundred machines only are available – and from previous experience with offers of this nature we expect our limited supply to be sold out very quickly.

The machines will be supplied to the purchasers by Convoy International – who will also be responsible for subsequent servicing and warranty rectification and/or repairs. Please remember that we run magazines, not the Post Office – so do please allow four weeks for delivery.

Delivery will be made by road freight or certified post. The cost of this is included within the offer price. We regret that we cannot offer any discount to readers who collect their machines directly from Convoy International.

Organisations wishing to claim sales tax exemption – please refer to note elsewhere in this offer.

Readers who would prefer to see a unit before committing themselves to purchasing may see a demonstration model at Convoy Technocentre. Their address is 1 Maclean St, Woolloomooloo, Tel. 358 2088. (The large white building facing the end of Plunket St.). They are open late on Thursday evenings and also on Saturday mornings. Ample car parking is available opposite the Technocentre.

All Contutor LL cassette recorders sold under this offer are warranted for a period of 90 days from delivery against defective workmanship and materials.

The warranty includes the cost of parts and labour, but not the cost of freight to and from Convoy International Pty. Ltd., 1 Maclean St, Woolloomooloo, NSW.

The special offer price of $99.50 includes sales tax. Schools, Universities, religious bodies and certain other organisations can claim sales tax exemption.

For these organisations the special offer price is $88. A valid official tax exemption certificate *must* be supplied.

WHAT IS OFFERED

The price of $99.50 ($88 if a sales tax number or exemption certificate is supplied) includes the following:

1/ One Contutor LL cassette recorder
2/ One pair of stereo headphones
3/ One DIN to DIN connector
4/ Instruction manual

MANUFACTURER'S SPECIFICATION

CONTUTOR TEACHING MACHINE
MODEL CT 5500LL

Manufacturer	Sanyo
Tape Speed	1 7/8" per second
Speed Adjustment	+5%, –15%
Fast Forward Time	120 secs (C 60 cassette)
Fast Rewind	120 secs (C-60 cassette)
Wow & Flutter	0.3% rms
Signal/Noise	+45 dB
Hum & Noise	–30 dB
Frequency Response	50 to 10 000 Hz

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Companies offering goods for sale at discount or special offer prices are now required by law to state the price at which the goods offered were previously available for a reasonable period of time before the offer.

However because of the specialised nature of the Contutor LL recorder, sales were not generally sought at retail level. Convoy's price list dated 6th May 1975 quotes a recommended retail price of $129.50.

The cost of packing and freight is included within the offer price. Units can *only* be obtained via the order form on this page. Readers wishing to collect the units directly from Convoy International may do so but cheques must still be made out to Electronics Today International using our official order form.

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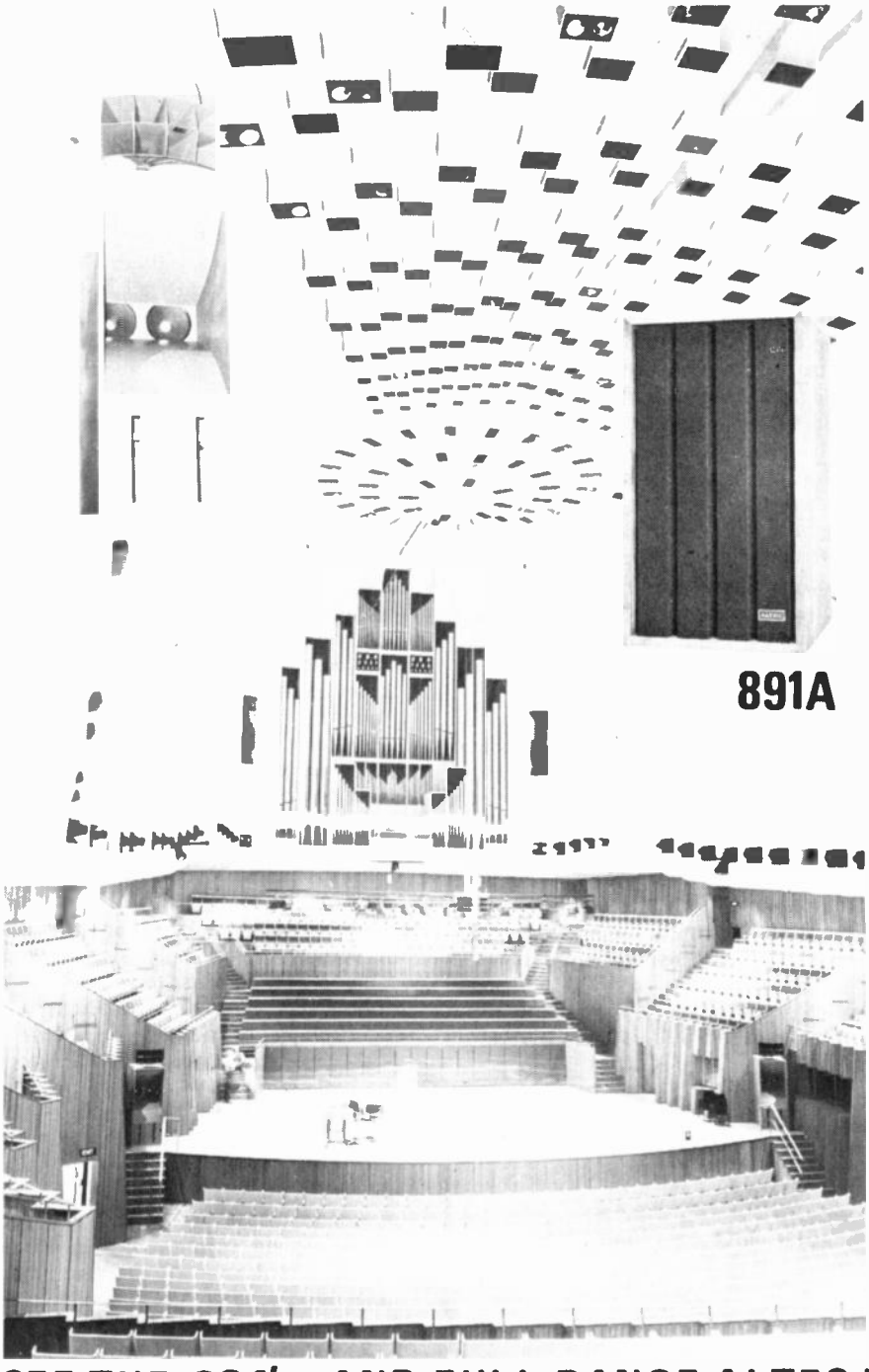

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*Quoted from Consumer Guide Magazines, USA 1974. Publishers Lawrence Teeman.

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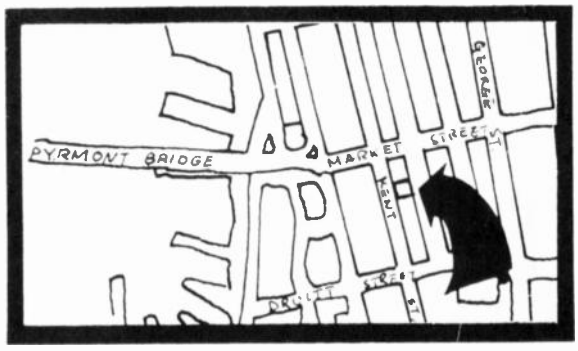
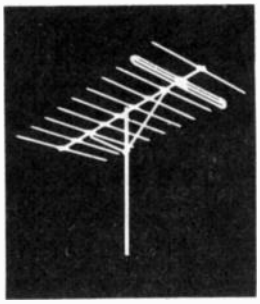




TV DISTRIBUTION SYSTEMS

How to optimize your antenna system for colour.

MOST colour TV buyers spend up to a $1000 on their set. There's not much left over for a good antenna.

Which is unfortunate for the advantages of a properly designed aerial system are great indeed. A good system can provide sparkling, ghost free pictures where previously the picture was full of snow and multiple images. In some poorly designed systems a good picture may be received on one or two channels but other channels are unwatchable due to multipath ghosts or, a strong local channel may interfere with a weak distant channel rendering it unwatchable. These defects may quite often be cured relatively inexpensively with a properly designed system.

Apart from the basic antenna system requirement there is also the occasional need to operate more than one set from the same antenna or to provide multiple outlet points for a portable set within the home.

The purpose of this article is to discuss methods of coupling the antenna to the set in order to prevent or overcome reception difficulties, or to provide better facilities than are at present available with existing systems.

It is assumed that a properly designed antenna is available, and suitably mounted, such that adequate signal pickup is obtained on all channels of interest. It must be remembered that a clean and ghost free signal must be available at the antenna terminals — nothing thereafter can improve the quality of the signal. For example adding an amplifier can only boost the signal to a point where cable losses and noise do not degrade the picture. It cannot improve the signal-to-noise ratio which exists at the antenna output. Thus a good antenna properly mounted in the best and highest location possible is a prime requirement in low-signal areas.

RIBBON OR COAX

The signal at the antenna terminals must be conveyed to the input terminals of the set by means of a cable. At the frequencies used in television the cable is in fact a transmission line which must be matched to both the antenna and to the set if maximum signal transfer is to be obtained. Most antennas have an output impedance of 300 ohms and many receivers have an input impedance of 300 ohms. One would naturally think that the best procedure would be to use a 300 ohm twin line to couple them together. However with colour, all installations (even single outlet home installations) should be made with 75 ohm coaxial cable. Even though 300 ohm ribbon may well be adequate in many high signal locations, there are many good reasons why 300 ohm ribbon should not be used.

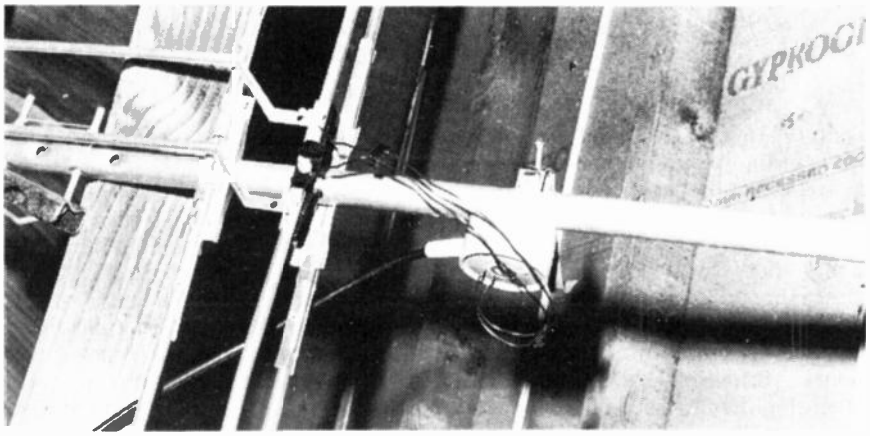
Although ribbon is cheap and signal attenuation is low the full advantages of using it are only obtained when it is dry and suspended in free space. When a signal is being transmitted, magnetic and electrostatic fields surround the conductors, and any interference with these fields will degrade performance. Hence the ribbon should at all times be air spaced, it should never be taped to aerial masts, gutters or metal roofs and must not be installed in metal conduit or rendered into cement walls. Even the recommended stand-off insulators will cause some distortion of the field and consequent signal loss and standing waves. In addition the losses of ribbon increase greatly when the cable is wet. Another limitation is that ribbon acts like an antenna itself and radiation from power or telephone lines can cause interference. Further, the television signal itself can be picked up along the length of the ribbon and will be out of phase with that from the antenna, resulting in ghosts on the picture. Remember that ghosts in colour transmissions appear in the wrong colour on the receiver which makes them far more objectionable than they would be on black and white sets.

Coaxial cable, on the other hand, is impervious to its surroundings, it can be run underground, in steel pipes alongside power cables and even under water without affecting its transmission qualities. Nor will it pick up signals along its length whether from power lines or television transmitters.

Finally although coaxial cable is more expensive than ribbon it will last for many years longer than ribbon and hence is more economical in the long run as well as providing superior performance under adverse conditions. Coaxial cable does have higher losses

AUSTRALIAN TELEVISION CHANNEL FREQUENCIES

Channel No.	Band MHz	Vision MHz	Sound MHz
0	42–52	46.25	51.75
1	56–63	57.25	62.75
2	63–70	64.25	69.75
3	85–92	86.25	91.75
4	94–101	95.25	100.75
5	101–108	102.25	107.75
5A	137–144	138.25	143.75
6	174–181	175.25	180.75
7	181–188	182.25	187.75
8	188–195	189.25	194.75
9	195–202	196.25	201.75
10	208–215	209.25	214.75
11	215–222	216.25	221.75



A balun, in the cylindrical box receives the signal from the antenna via a 300 ohm open line and matches it to 75 ohm coaxial cable.

than ribbon but in practice this is not of great importance. For example the loss of ribbon at 200 MHz is typically 1.5 to 2 dB per 30 metres whereas with coaxial cable the loss is 3.5 to 4 dB per 30 metres. However in practical installations the inevitable problems due to spacing and moisture cause ribbon losses to at least equal those of coax.

THE NEED FOR BALUNS

You will remember we said that the cable must be matched to the antenna and to the set, and that the typical antenna has an impedance of 300 ohms whilst coaxial cable has a characteristic impedance of 75 ohms. We must therefore match the antenna to the cable otherwise there will be a serious mismatch with corresponding loss of signal and production of standing-wave ghosts. The matching is commonly done with a device known as a BALUN. The balun is a small transformer wound with a two-to-one turns ratio (4:1 impedance) on a small ferrite core. The balun therefore performs the desired impedance match. A further problem is that the antenna output is balanced with respect to earth whereas the coaxial cable is not (shield is earthed). The balun is used to convert from balanced to unbalanced operation – hence its name. If the set has a 300 ohm input then another balun must be used at the set end of the cable. Most colour sets have 75 ohm inputs however and in this case a balun at the set input will not be required.

One might well think that that is the end of the matter but this is far from the case. It is generally accepted that a colour set needs at least 150 microvolts of signal to get out of snow level and in fact the Australian Standards Association have laid down, in their code of practice for antenna installations, that a minimum signal of one millivolt and a maximum of 15 millivolts be available at any outlet in an antenna installation. With the losses in baluns and cables it may well be that, in low signal areas, there just is not sufficient signal to bring the set out of snow. In such cases a masthead amplifier is called for. Amplifiers of differing gain and output capabilities are available and care must be taken to choose that most suitable for the particular installation.

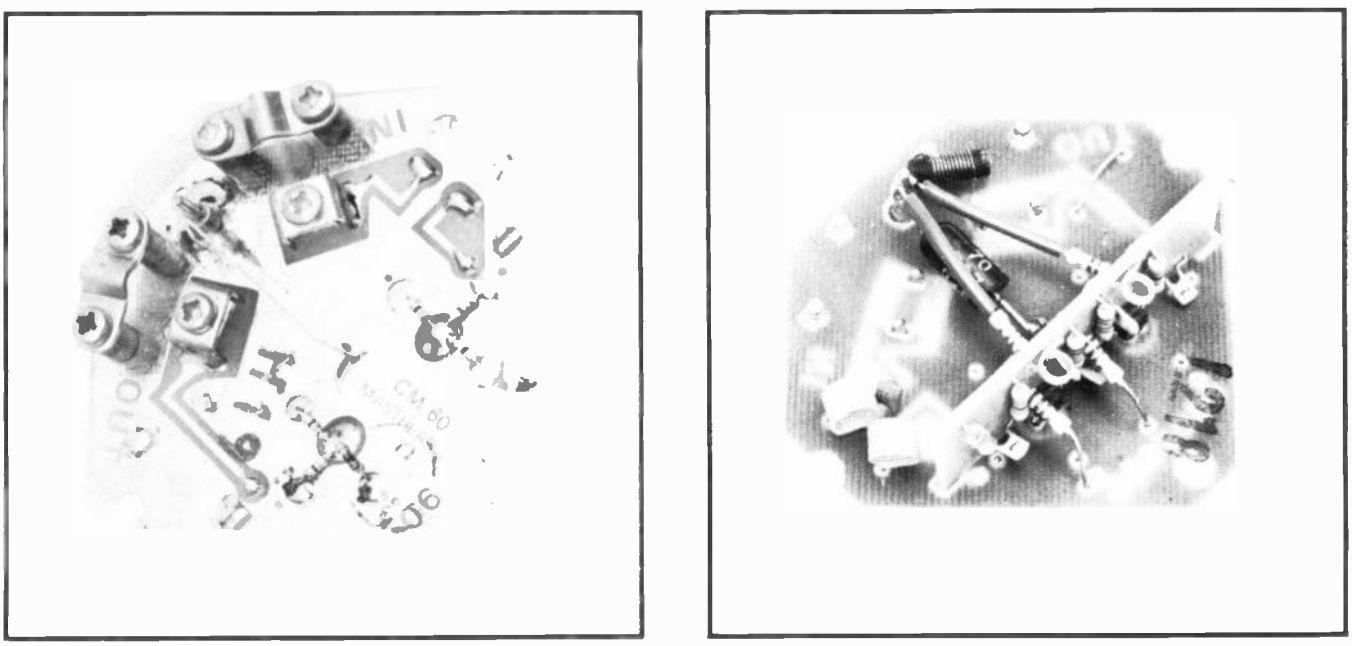
MASTHEAD AMPLIFIERS

In a good signal area the signal available at the antenna terminals may be of the order 30 to 35 millivolts on channel 2 and 20 millivolts on channels 7, 9 and 10. The average signal available in metropolitan areas, however, is seldom above 10 millivolts. As we move further away from the transmitter the signal level will fall below one millivolt and the performance of the set starts to deteriorate. The snow on the picture is in effect noise picked up on the feeder cable together with that generated in the input stage of the tuner. The signal-to-noise ratio at the antenna terminals may still be quite good and an amplifier installed right at the antenna terminals will raise the level of the signal before the noise contributions of cable and tuner can degrade it.

Amplifiers are available with a wide variety of gains and output capabilities and care must be taken to choose a type that is suited to the particular system. To do this we must have some idea of what the various specifications means.

Amplifier Gain

This is quoted in decibels of voltage gain, that is an amplifier having 20 dB



The printed circuit module of a Labgear masthead amplifier (front and back)

TV DISTRIBUTION SYSTEMS

gain will provide an output voltage 10 times the input voltage.

Maximum Output Level

If the signal at the input of an amplifier is too high, overload or cross modulation will occur. An amplifier is therefore given a maximum output voltage rating typically within the range of 15 to 500 millivolts. For example if an amplifier had an output capability of 200 millivolts and a gain of 20 dB (X10) then the maximum input signal allowable would be 20 millivolts.

Cross Modulation

This is a form of interference caused by signals of one channel over-riding the signals of a weaker channel. It shows up on the weaker channel as black bars that drift up and down or across the screen. This kind of interference occurs when a masthead amplifier is over-loaded.

Sync Clipping

When a masthead amplifier is driven by too much input signal the synchronising pulses may be clipped off. The effect of this is either a jittery picture or horizontal tearing.

If overload occurs on a strong channel due to the fitting of a masthead amplifier to amplify weak channels, a selective filter may be used to reduce the amplitude of the strong channel. This allows the full potential of the amplifier to be utilized for the weak channels.

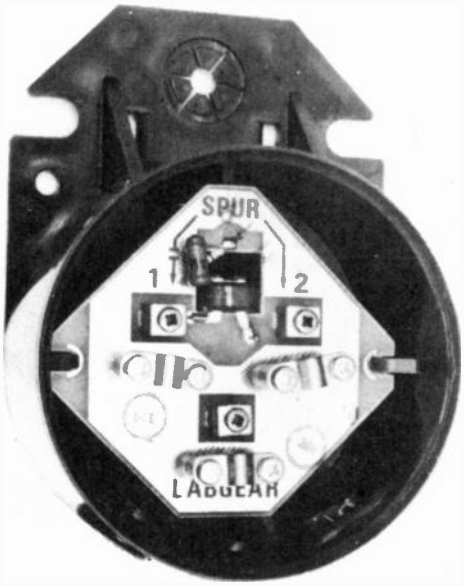
An amplifier should have a low-noise input stage and this requires that special low-noise transistors be used and that AGC not be used on the first stage. The amplifier should also be capable of protecting its input transistors against damage due to static build-up.

SPLITTERS AND COMBINERS

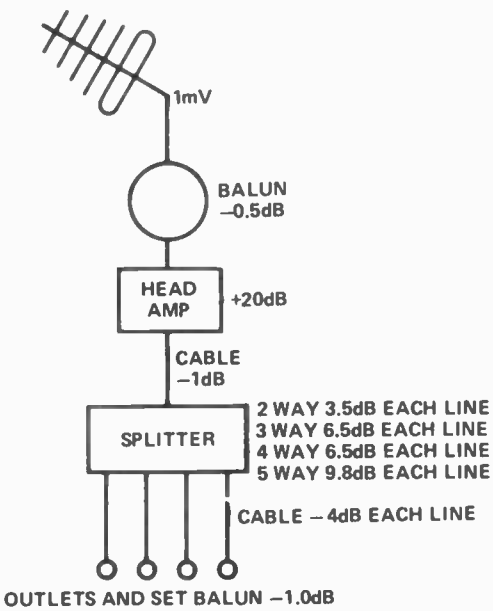
Where two receivers are required to be operated from the same antenna it is not feasible to simply parallel them onto the same feeder line. This is because the paralled impedance of the two sets will be 150 ohms and a mismatch will occur. In addition another problem would be encountered in that the isolation between sets would not be great enough to prevent the local oscillator of one set interfering with the other set.

When a signal is required to be split into two or more lines a device called, a SPLITTER is used. Although splitting can be done by a resistor network, this results in higher losses than necessary and a far preferable method is to use a transformer type device. The transformer type has the further advantage that it can be used in reverse as a combiner – but more about that in a moment. The name splitter is restricted to those devices that divide the signal into two or more equal parts. But if it is used to provide more signal to one line than to another then it is known as a directional splitter, a spur unit, a directional coupler or just simply as a tee-off. Its purpose is to provide a small amount of signal to a branch line, eg one set, whilst giving very little attenuation to the through line to other sets. This may not seem to make such sense, but it is a technique used in larger systems to ensure that isolation between sets is very high whilst at the same time the value of attenuation for each spur line can be chosen so that all sets in a very large installation will receive the same amount of signal – regardless of feeder cable losses. Naturally such a system will require an amplifier with even more gain. Amplifiers which are designed for such systems generally have several output ports, that is a splitter is built-in. These amplifiers are known as distribution amplifiers.

A transformer type splitter may be used in reverse as a combiner for



Two types of splitter/combiner from Labgear. The one on the right is in a weather-proof housing and the one on the left is intended for indoor use.



GAIN TO EACH SET

2 WAY SPLITTER +10dB SIGNAL AT SET 3mV
3 WAY SPLITTER +7dB SIGNAL AT SET 2.2mV
4 WAY SPLITTER +7dB SIGNAL AT SET 2.2mV
5 WAY SPLITTER +3.7dB SIGNAL AT SET 1.5mV

Fig. 3. A simple amplifier/splitter system allows sets to be used at different points within the home.

A simple low band attenuator which reduces channels by 24 dB.

combining one or more groups of signals where interaction between signals does not occur. Thus for example in a deep fringe area separate antennas may well be used for channels 1 and 3, but a simple combiner cannot be used to combine these two antennae because the channel 1 antenna will also pick up a small amount of channel 3 signal, and vice-versa. When these two signals are combined, differing phase relationships and the lack of isolation between antennas will result in a signal that is severely degraded. A combiner can be used for combining signals that do not have any common components.

For example the output of a TV game or of a video tape recorder could be combined with the signal from the antenna at the set terminals. The use of such a device avoids the necessity of changing the input to the set terminals whenever the TV game etc, is to be used.

FILTERS

In country areas there is usually a strong local channel most often on a low frequency, eg. channels 0 to 5, whilst channels 7, 9 or 10 may be picked up from a city transmitter but at a much lower level. For example, Newcastle receivers commonly get about 10 mV of signal on channel 3 but only around 200 microvolts on channels 7 and 9. If an amplifier is added to boost 7 and 9, cross modulation will occur with channel 3 breaking through into channel 7. This condition may be cured by adding a low-band attenuator, which attenuates channels 0 to 5A by up to 24 dB whilst giving very little loss on the high channels. Single channel attenuators are also available to reduce the level of any single channel which may cause an overload condition.

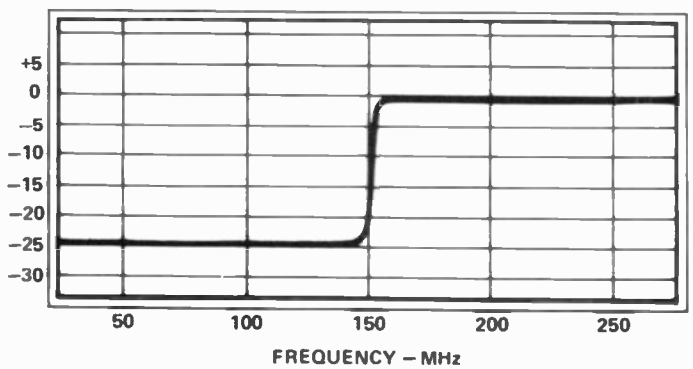
DIPLEXERS

The diplexer is a special kind of combiner/splitter unit that can be used to combine two or more bands of signals. Interaction between the separate bands is prevented by using band-pass filters for each input. These bands are arranged to cover the International bands 1 to 5 as follows:—

Band 1 40-70 MHz Channels 0,1,2
Band 2 88-108 MHz FM, Channels 3,4,5
Band 3 175-220 MHz Channels 5a to 11
Bands 4,5 470-860 MHz UHF band.

Most diplexers available in Australia have provision for combining bands 1 and 3 only, and at present this is entirely adequate. There are a few,

COAXIAL LOW BAND FILTER TYPE No F75. D/A



SPECIFICATIONS

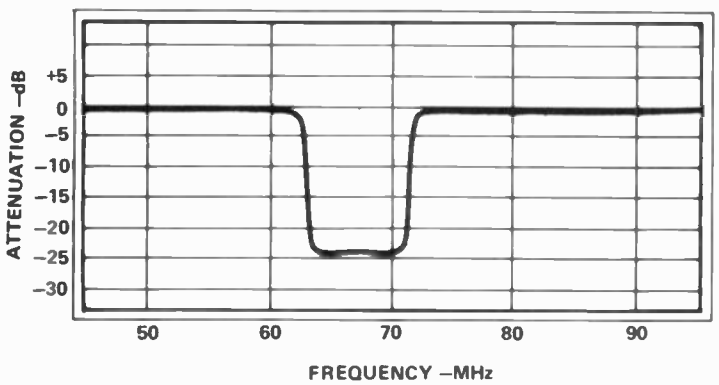
INSERTION LOSS: 0.25dB (ON CHANNEL 6-11)

ATTENUATION: 24dB (ON CHANNELS 0-5A)

IMPEDANCE: 75 OHMS

Fig. 1. Channels 0 to 5A are attenuated by means of this coaxial low-band filter from Standard Components. The 24 dB attenuation on strong low channels allows high-band channels to be amplified without cross modulation occuring.

SINGLE CHANNEL LOW BAND FILTERS TYPE F75 B



SPECIFICATIONS

INSERTION LOSS: 0.25dB

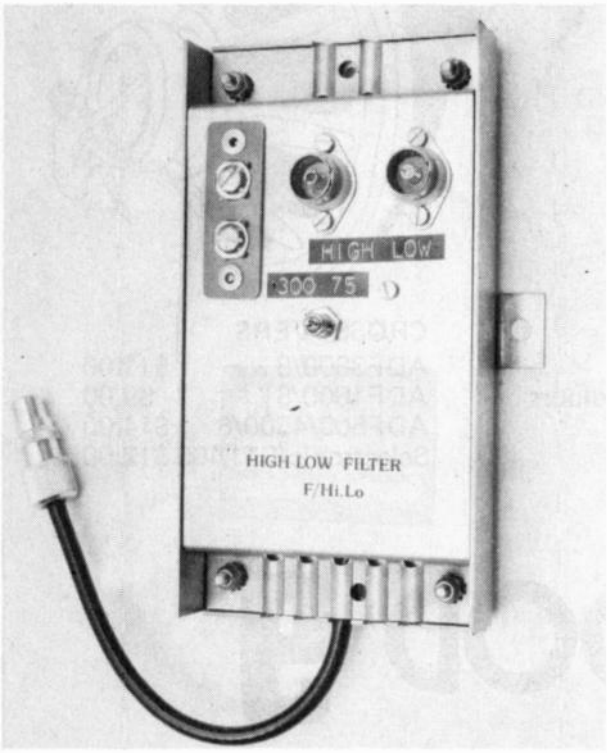
ATTENUATION: 24dB ± 2dB

IMPEDANCE: 75 OHMS

ATTENUATED CHANNEL	PART No.
0	F75. B/0
1	F75. B/1
2	F75. B/2
3	F75. B/3
4	F75. B/4
5	F75. B/5
5A	F75. B/5A

Fig. 2. A single low-band channel may be attenuated with a filter such as this. Thus channel 2, in this case, may be attenuated by 24 dB without affecting Channel 3. Filters are available for any channel. The type shown is from Standard Components.

TV DISTRIBUTION SYSTEMS



This unit combines the output of low and high band antennas whilst attenuating the low band by 15 dB.

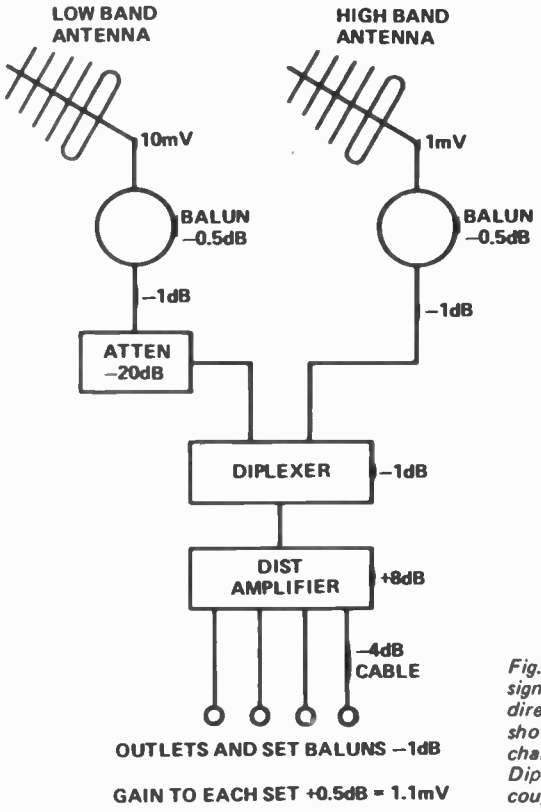


Fig. 5. A two antenna system for signals from the same or different directions may be implemented as shown. Note the attenuator for low channels to balance signal levels. Diplexers are also known as Hi-Lo couplers . . .

such as the Labcraft CM 6032, which cover all bands and such units will be needed in areas where UHF translators are to be installed.

Such diplexers can be used in reverse to split low and high band signals thus allowing an attenuator to be inserted in the low band path to equalize signal levels. Making all signal levels the same in this manner allows the distribution amplifier to work at maximum gain without overload or cross modulation.

PRACTICAL SYSTEMS

Examples of practical systems are given in Figs. 3 to 6. In each case the signal available at the antenna is assumed to be one millivolt which would correspond to that received in moderately difficult areas. Note also that typical balun losses are taken as being 0.5 dB and a cable loss of 4 dB per 30 metres is assumed. A typical coaxial outlet will also have an insertion loss of around 0.5 dB.

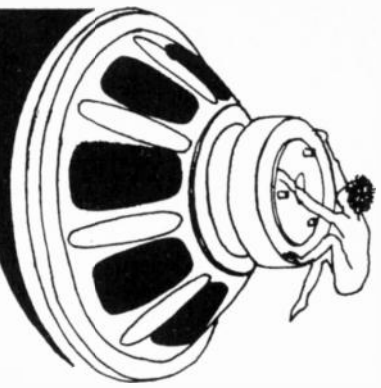
In the system of Fig. 3, we have used a masthead amplifier with a gain of 20 dB and show the typical losses encurred with splitters. Note that just with a two-way splitter the signal available to the set is only three millivolts — not a great deal more than the recommended one to two millivolts for colour reception. This type of installation is suitable for homes etc providing that the cable lengths from the splitter are not too great — coaxial cable is relatively expensive. The second system, Fig. 4, is an alternative which uses an inexpensive distribution amplifier. This kind of system is not as suited to fringe areas as the previous one as there could be an appreciable amount of cable loss before the amplifier with the consequent loss of signal-to-noise ratio.

The third system, of Fig. 5, illustrates how two antennas may be combined for low and high channels that may be located in the same or different directions. Note that an attenuator has been used on the low channel to balance the signals before the distribution amplifier. It may also be necessary in such a system to include bandpass filters to prevent any interaction between the signals from the two antennas.

In the final system of Fig. 6 we show an alternative distribution arrangement which is commonly used in blocks of units or high-rise buildings. The advantage of this system is that the amount of cable used is minimized and that isolation between sets is increased. The tee-offs used are available with different values of spur attenuation so that the signals reaching sets with differing amounts of line loss may be balanced. The tee-off offers very little attenuation to the signal passing down the line but attenuates the signal to the spur line by 12 to 20 dB. This of course means that a much higher gain is required in the amplifier but the isolation between sets is increased by the spur attenuation.

This discussion of systems must necessarily be fairly brief but it

PHILIPS SPEAKERS



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AD5060/SQ8	$26.00
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AD 8066/W8	$20.00
AD 9710/M01	$36.00
AD 10100/W8	$50.00
AD 12100/HP8	$54.00
AD 1265/W8	$33.00
AD 12100/W8	$52.00

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25 LITRE	$26
35 LITRE	$34
45 LITRE	$34
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ADF1600/8	$9.00
ADF500/4500/8	$14.00
Selectronic/ETI.400	$12.00

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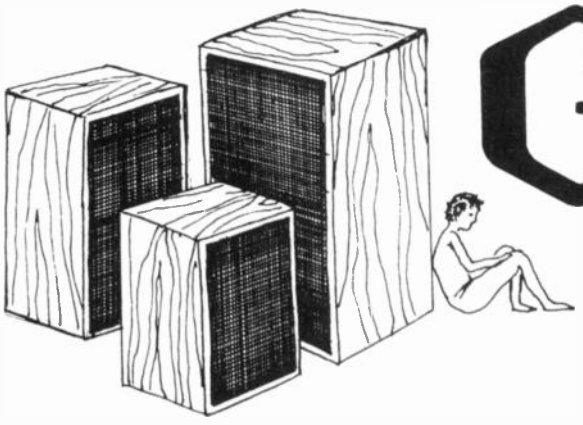

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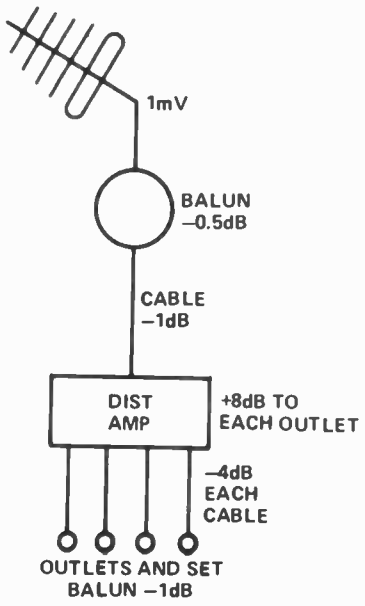
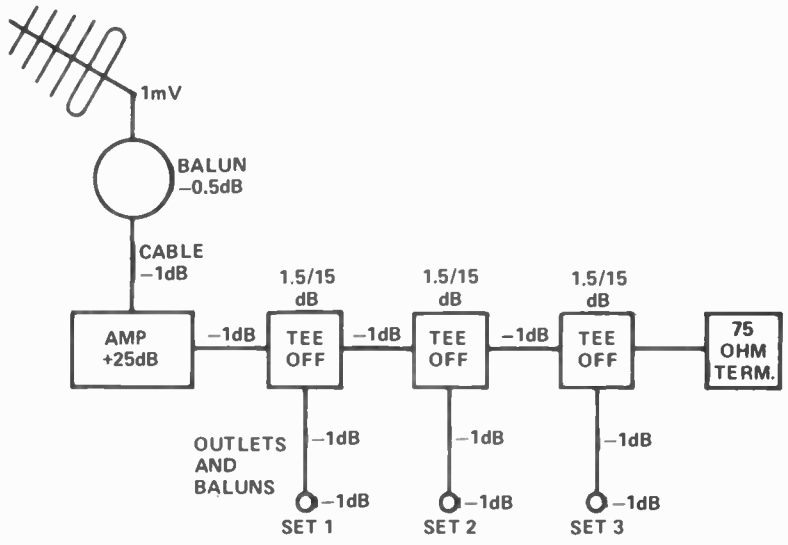
suffices to show how the performance of even small systems can be dramatically improved by the intelligent application of distribution equipment. Such equipment is readily available from a large number of manufacturers who will be only too pleased to offer advice on specific problems. ●



GAIN TO EACH SET +2.5dB = 1.3mV

Fig. 4. In reasonable signal areas an inexpensive distribution amplifier such as the Labcraft CM 6034 gives 4 way distribution plus a convenient amount of gain.

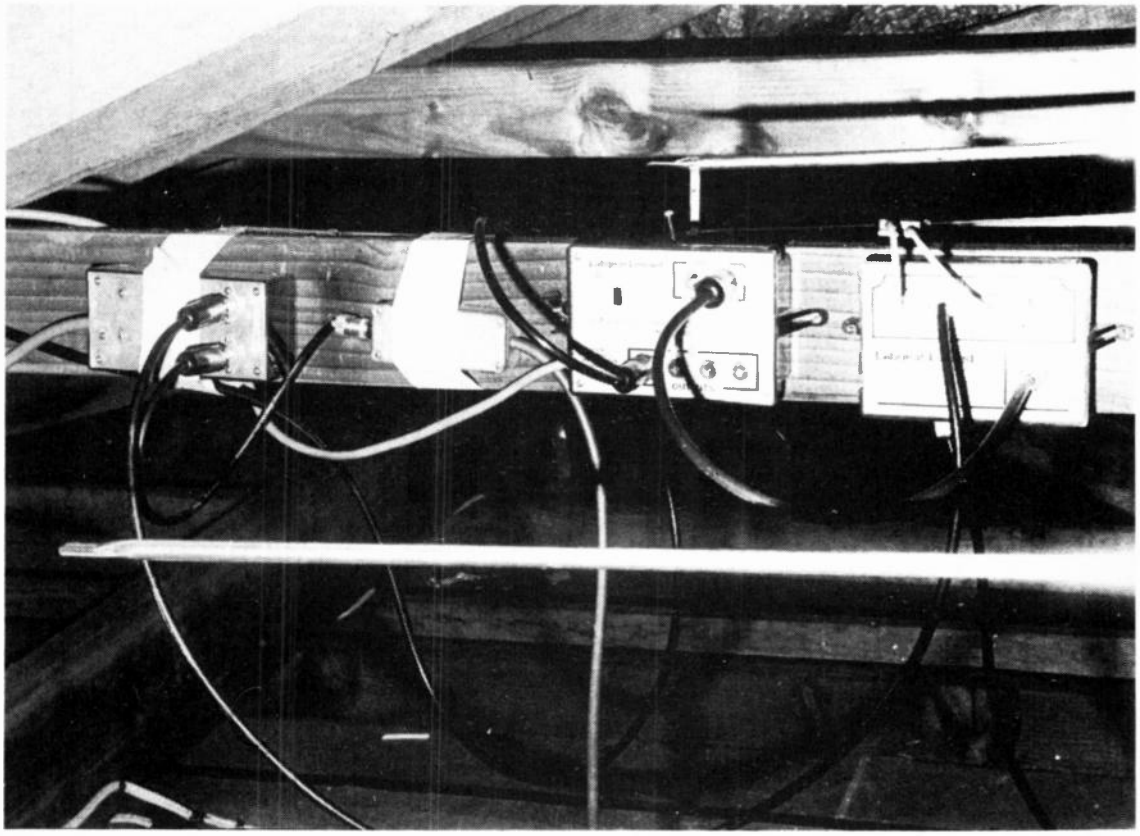


GAIN TO FIRST SET +5.5dB OUTPUT TO SET 1.9mV

GAIN TO SECOND TEST +3.0dB OUTPUT TO SET 1.4mV

GAIN TO THIRD TEST +0.5dB OUTPUT TO SET 1.1mV

Fig. 6. System using tee-offs to increase isolation between receivers and to reduce the amount of cable required. Note that a higher gain amplifier is required than with other systems and that the end of the through line must be terminated in 75 ohms. Tee-offs are available with this termination built in.

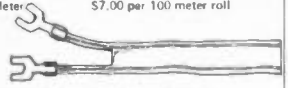


In this installation an antenna, mounted in the ceiling, feeds, via a splitter, bands I and III of a Labgear band filter. The signal from a second external antenna, orientated for Wollonggong, is amplified by an ETI 701 masthead amplifier before being fed to the Band II input of the filter. The combined output of the filter is then fed to a Labgear 4-way distribution amplifier.

TV. Accessories

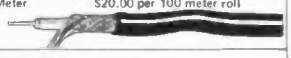
T.V. RIBBON AND CABLE

TV Ribbon and Cable 300 ohm clear ribbon – designed for indoor applications – very low loss – maintains perfect balance.
10¢ per Meter $7.00 per 100 meter roll



300 ohm Black Ribbon Especially designed for outdoor applications and long runs where an extremely low loss cable is required.
13¢ per Meter $10.00 per 100 meter roll

75 Ohm Coaxial Cable 3C2V This cable is designed for for television feeder systems. Excellent dielectric and suitable for use up to 400 MHz. 5/16" diameter, solid centre conductor and braided shield, black.
30¢ per Meter $20.00 per 100 meter roll

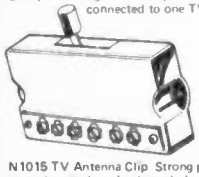


300 OHM (Twin Ribbon) ACCESSORIES

N9022–5029 4 Set Coupler Handles colour, black & white, and FM signals with minimum loss of signal strength even when all 4 sets are operating at the same time. Compact plastic case can be mounted at any location near antenna lead in. 300 ohms input output impedance. $3.50

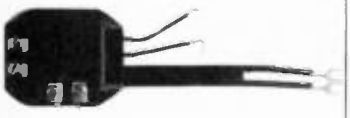
N9021–5028 Same as above but for two sets only $2.50

N5228 3 Way Antenna Switch Attaches to the back of TV or any other convenient location. Gives instant 3 way switching – allows up to three antennas to be connected to one TV or FM set. $3.50

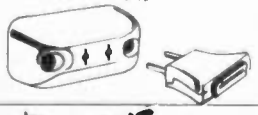


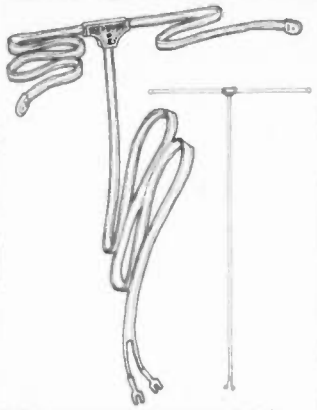
N1015 TV Antenna Clip Strong plated springs with screw terminals and coloured plastic handles. Quick way to connect or disconnect antenna lead in wires to TV set., FM radio, etc. Also ideal for portable sets. 40¢ each

N4695–9068 AM/TV Splitter The useful unit splits the incoming signal on a standard 300 ohm TV lead and gives 3 different outputs TV–VHF, TV–UHF and FM. This is the ideal unit for the person who wishes to operate his FM tuner from the normal TV aerial. $3.50



300 Ohm plug and socket set designed to mount on wall or skirting board – for professional connection of 300 ohm twin ribbon. Complete with mounting screws .50¢





N10020 Indoor FM Antenna 300 ohm dipole FM antenna brings in good signals in all local areas. May be placed behind set, or hidden out of sight. Moulded ends make mounting easy. Long hook up lead terminates in spade lugs for simple hook up to set. $1.00

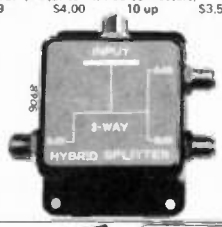
75 OHM (Coaxial Cable) ACCESSORIES

9066 Set Balun High quality, low loss ferrite balun for converting 75 ohm coax impedance to 300 ohm set impedance – designed to be mounted at rear of TV or FM set. Completely shielded and balanced. Also features AC blocking.
1–9 $2.00 10 up $1.50
(Requires one F59 connector)

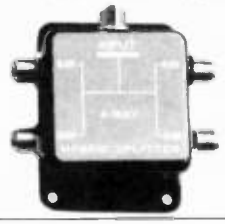
9052 Weatherproof Aerial Balun Designed for indoor (TV set) or outdoor (aerial) mounting. This matching transformer converts from 75 ohm coax impedance to 300 impedance. Completely moulded construction and is supplied with rubber boot for weatherproof operation.
1–9 $2.50 10 up $2.00
(Requires one F59 connector)

9067 Two Way Hybrid Splitter This compact splitter provides two 75 ohm outputs from one 75 ohm input. Designed to provide two outlets from one TV aerial. Passes AC/OC power. Frequency response 5 to 300 MHz VSWR 1.3:1, insertion loss 3.5 DB, isolation 30 db.
1–9 $3.00 10 up $2.50
(Requires 3 x F59 connectors)

9068 Three Way Hybrid Splitter Designed to operate up to 3 TV sets from the one aerial. 75 ohm input, 3 75 ohm outputs, passes AC/DC power. Frequency responses 5-300 MHz, insertion loss 5 db isolation 30 db. (Requires 4 x F59 connectors)
1–9 $4.00 10 up $3.50



9069 Four Way Hybrid Splitter Four way 75 ohm VHF/FM/TV hybrid splitter provides four separate 75 ohm outputs from one 75 ohm input. Passes AC/DC power. Frequency response 5 to 300 MHz insertion loss 8 db isolation 30 db.
(Requires 5 x F59 connectors)
1–9 $4.50 10 up $4.00



Coaxial Connectors & Adaptors For all coaxial TV connectors we recommend the range of "F" type connectors. New to Australia these connectors are standard in many overseas countries including the USA. Their greatest feature is the fact that they require no soldering. When used with standard "3C2V" solid conductor – coax cable this connector retains a very high VSWR – far higher than normal connectors using screw terminals.
They can also be easily connected and disconnected without the necessity of tools. This type of connector can only be used with solid centre conductor coaxial cable.

F59 Male Cable Connector For use with 3C2V and RG59/U cable. Mates with F61A and F81 connectors and all our series of splitters. Supplied with separate female for cable coupling.
1–9 30¢ 10 up 25¢

F61A Female Chassis Fitting Accepts F59 connectors Mounts in 3/8" diameter hole. Supplied with nut and washer.
1–9 35¢ 10 up 30¢

F81 Female Adapter Mates with F59 connectors. The ideal way to connect lengths of coax without soldering and while retaining low VSWR.
1–9 50¢ 10 up 45¢

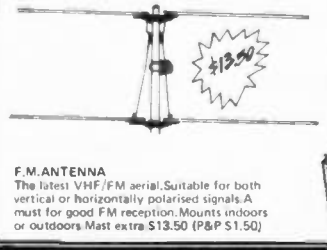
Lightning Arrestor 75ohm/300ohm This lightning arrestor mounts on the mast near the aerial. Suits all types of lead-ins – coax, twin lead, etc. May be used indoors or outdoors. Simply run lead along arrestor and tighten screws – no soldering necessary.
1–9 $2.50 10 up $2.00

75 OHM OUTLET
Surface mounting Co-Ax outlet suitable for up to 850 MHZ. Ivory plastic case. $1.50

LOW COST CONNECTORS

Handy Insulated Coaxial Connectors
Moulded in tough, black plastic for TV, radio and instrument use. 75ohm.

		1-9	10up
Line plug	COP1	35c	32c
Chassis socket	COS2	50c	40c
Cable/Panel joiner	COS5	50c	40c



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FANTASTIC LOW PRICE RHYTHM UNITS
Ideal for groups etc., wanting to add that extra rhythm dimension. Simply plug into high impedance input of your amplifier.

RF5 CONCERT RHYTHM BOX
Provides slow rock, latin beat, rock'n'roll, foxtrot and waltz, at push of button. Produces sound of Drum, Conga, claves, maracas, cymbal and snare drum. Tempo control continuously adjustable – volume control and start switch. 15 transistor 27 diode circuit. This sort of unit could cost you $90, but our direct import price is only $57.00 (P&P Road Freight $3.00)

$57.00

RH12 NORTON RHYTHM BOX
Must be the ultimate, giving a choice of 12 rhythms – March, Foxtrot, Rock, R & R, Ballad, Shuffle, Bossa Nova 1 & 2, Latin, Mambo, Waltz, Jazz Waltz. "Instruments" include bass drum, high range, snare drum, claves, high hat. Has tempo and volume controls and start switch. Pilot light flickers in time with beat. Circuit has 22 transistors and 50 diodes. You must hear one to realise potential and incredible value. Beaut timber finish. Why pay up to $140 for the sound the RH12 gives you for only $99.75 (p&p road freight $5.00)

$99.75

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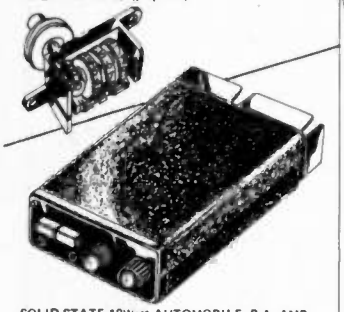

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* Complete with 4foot power and 15foot speaker cords.

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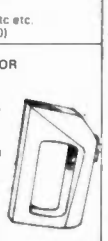

Just tell a builder or handyman about this fantastic gadget – locates any metal object – wires, pipes, reinforcing steel, even nails, inside walls and plaster etc.

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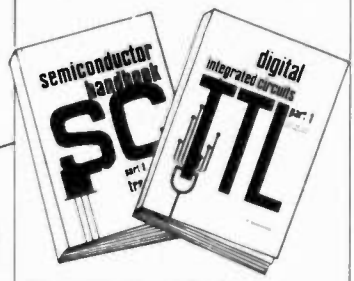
Range depends on size of metal object. Ideal for electricians who once had to pay $30 - $40 for such a unit. And only

(9V battery 75c extra) **$9.75** (P&P $1.00)



TRANSISTOR EQUIVALENTS, 9th edition, entirely revised and extended, 312 pages. $4.90 p&p 50c. This reference book enables the user to find substitutes for given transistors. To this end approx. 9,500 transistor types of European, American and Japanese make have been included together with equivalent substitutes.

As it is very rare that one can speak of real substitutes or "equivalents" for given transistors it is recommended to check the detailed features of the chosen substitute by consulting its full specifications in the "SEMICONDUCTOR HANDBOOK, Part 1, Transistors."

DIODES EQUIVALENTS, 1st edition, 144 pages $3.75 p&p 50c. No less than 9024 equivalent types for close to 6100 given diodes of European, American and of Japanese origine have been included in these tables: triacs, diacs, leds, thyristors, light-sensitive and luminous semiconductors, with the exception of phototransistors.

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SEMICONDUCTOR HANDBOOK, PART 1, TRANSISTORS, 1st edition, 164 pages. $6.90 p&p 75c. This manual includes over 108,000 details of 6,750 current transistor types of European, American and Japanese manufacture. Of each transistor type the mechanical and electrical features have been given including diagrams of transistor cases.

For easy reference the details have been arranged in alphabetic-numerical classification. This reference work offers a comprehensive source of indispensable information about current transistor types.

TTL-DIGITAL INTEGRATED CIRCUITS 1, 1st edition (series 7400–74132), 172 pages $7.50 p&p 50c. NEW! Recording complete data and essentials of Digital Integrated Circuits, – series 7400 – covering 13 principal manufacturers in USA and Europe, this directory provides an all-in-one survey of details including equivalents.

Filed in numerical order and indexed for easy reference this vast directory has been planned as an efficient and practical working tool for both professionals and students in electronics. The editor has, in compiling this work, drawn on his practical experience in this particular and specialistic field.

ELECTRONIC TUBE HANDBOOK, 16th edition, 440 pages. $6.90 p&p 75c. This book covers the principal data of a large number of European and American types of receiver and amplifier tubes as well as of cathode ray tubes for television sets and oscilloscopes.

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Written by an Australian for Australia, this book is an introduction to drawing and provides an understanding of mechanical and technical drawing. Coming with a set of questions and exercises, this text fulfils the needs of Electrical and Electronic Trade and Post Trades Students doing First Year Drawing.

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James F. Lowe – 111 pages, $3.50 (p&p $1.00).
A practical laboratory manual suitable for either advanced or basic courses. Experiments are graded into three levels – basic, standard and advanced and are designed to use equipment in Australian Technical Colleges.

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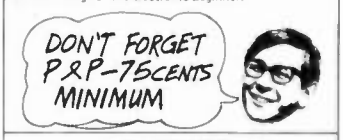
INTROOUCING ELECTRONICS.
E. R. Jones – 45 pages, $2.00. (p&p $2.00)
Essentially a practical approach, this book, published in Australia, covers the basics of electronics and is ideal reading for the electronic beginner.



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SCL4006AE	18 Stage Shift Register Static	2 75	2 65	2 60
SCL4007AE	Dual Complementary Pair Plus Inverter	45	40	40
SCL4009AE	Hex Buffer/Converter, Inverting	1 25	1 20	1 17
SCL4011AE	Quad 2 Input Nand Gate	45	40	35
SCL4012AE	Dual 4 Input Nand Gate	45	40	35
SCL4013AE	Dual D Type Flip Flop with Reset	1 25	1 15	1 05
SCL4014AE	8 Stage Static Shift Register	2 75	2 65	2 60
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SCL4017AE	Decade Counter/Divider	2 85	2 55	2 50
SCL4018AE	Presettable Divide BY 'N' Counter	2 80	2 70	2 65
SCL4021AE	8 Stage Static Shift Register	2 60	2 55	2 50
SCL4022AE	Divide by 8 Counter with 8 Decoder Outputs	2 25	2 20	2 15
SCL4023AE	Triple 3 Input Nand Gate	45	40	35
SCL4025AE	Triple 3 Input NOR Gate	45	40	35
SCL4027AE	Dual J-K Type Flip Flop with Reset	1 25	1 20	1 15
SCL4028AE	BDC to Decimal Decoder	2 10	2 00	1 95
SCL4029AE	Presettable Up/Down 4 Stage Counter	2 85	2 75	2 70
SCL4030AE	Quad Exclusive or Gate	1 00	95	90
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SCL4050AE	Hex Buffer/Converter, non inverting	1 00	95	90
SCL4071AE	Quad 2 Input or Gate	45	40	35
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SCL4416AE	Double Pole Double Throw Switch	1 00	95	90
SCL4426AE	Decade Counter/7 Segment Decoder/Driver	3 40	3 30	3 25
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SCL4518AE	Dual BCD Up Counter	2 50	2 40	2 35
SCL4520AE	Dual 4 Stage Binary Up Counter	2 80	2 70	2 65
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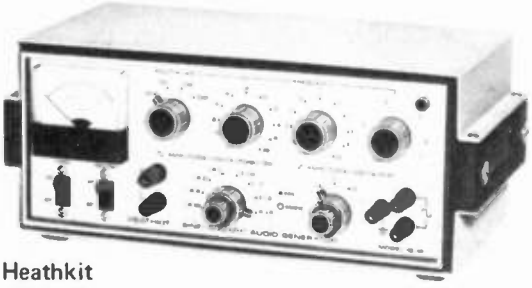

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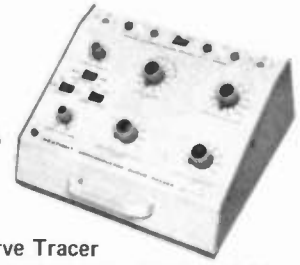
Sine-square Wave Generator

A low cost, portable signal source that will be invaluable in a variety of service and laboratory applications. Sine wave output is 1 Hz to 100 kHz with 5% accuracy and less than 0.1% distortion from 10 Hz to 20 kHz. Rise time is less than 50 ns on the 5 Hz to 100 kHz square wave output. The level of each output is independently adjustable. Both signals are floating and may be used simultaneously or independently. A front panel switch allows choice of internal or external load.

IG-18 PARTIAL SPECIFICATIONS – GENERAL: Frequency selection: 0-100 switch (steps 10), 0-10 switch (steps of 1), 0-1 control (vernier) & multiplier switch (x1, 10, 100, 1000). **SINE WAVE OUTPUT: Output voltage:** 8 ranges, 0.003 to 10 Vrms (full-scale) with 10 K ohm or higher external load. 6 ranges, 0.003 to 1 V (full scale) with 600 ohm internal or external load. **dB ranges:** –62 dB to +22 dB, –12 dB to +2 dB on meter and –50 to +20 dB on amplitude switch in 10 dB steps. +2 dB max into 600 ohm load. (0 dB = 1 mW in 600 ohm). **Output variation:** ±1 dB 10 Hz to 100 Hz. **Output indications:** Two voltage and one dB scale on meter. **Output impedance:** 10 V range: 0-1000 ohm; 3 V range: 800-1000 ohm; 1 V range and lower; 600 ohm. Meter accuracy: ±10% of full scale with proper load termination. **SQUARE WAVE OUTPUT: Output voltage (peak-to-peak):** .1, 1, 10 V into 2000 ohm load or higher. **Output impedance:** .1 V and 1 V ranges: 52 ohm; 10 range: up to 220 ohm. **Power requirements:** 105-125 or 210-250 VAC, 50/60 Hz, 6 watts.

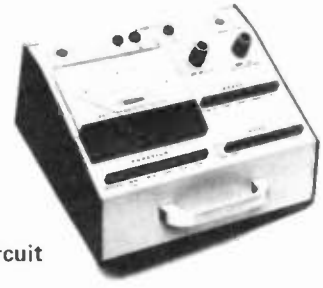


Check operating parameters of any discrete semiconductor with your scope and the IT-1121 Curve Tracer

Anyone who works with solid-state circuits will appreciate the Heathkit IT-1121 Semiconductor Curve Tracer. Just connect it to any oscilloscope with horizontal sensitivity of 0.5 V/div. and vertical sensitivity of 1 V/div. and get an accurate display of operating parameters for virtually any discrete semiconductor. Devices such as bipolar transistors, diodes, SCRs, triacs, FETs, etc. can be inspected or tested for specific applications. Extra leads are included for tests of large devices or for in-circuit tests.

Kit IT-1121, 11 lbs.

IT-1121 SPECIFICATIONS – Sweep Voltage Ranges: 0-40 volts at 1 ampere max. 0-200 volts at 200 mA max. **Sweep Voltage Sampling:** .1, .2, .5, 1, 2, 5, 10, 20 and 50 V/div. ±3%. **Sweep Current Sampling:** .5, 1, 2, 5, 10, 50, 100 and 200 mA/div. ±3%. **Sweep Dissipation Resistors:** 0, 10, 50, 100, 500, 1000, 5000, 10 k, 50 k, 100 k, 500 k, 1 M ±10%. **Step Currents Available:** .002, .005, .01, .02, .05, .1, .2, 2, 5, and 10 mA/step, ±3%, ±250 nA offset current max. **Step Voltages Available:** .05, .1, .2, .5, and 1 volt/step, +3%, ±5mA maximum offset voltage. **Calibration Source:** 9 volts ±2% in 1 volt steps. **Oscilloscope Requirements:** Bandwidth to 20 kHz or greater. (DC-coupled oscilloscope is recommended). **Operating Temperature Range:** 10°C to 40°C. Temperature variation, referenced at 25°C, will have a maximum effect of ±1% on all other specifications. **Power Requirements:** 110 to 130 or 220 to 260 VAC. **Dimensions:** 4½" H x 11¼" W x 10" D.



Component testing is fast and accurate with the IT-121 In-Circuit FET/Transistor Tester

Single circuit board design makes the IT-121 an enjoyable two-evening project to assemble and the high performance at low cost makes it a top value service and design tool.

Kit IT-121, 6 lbs.,

IT-121 SPECIFICATIONS – DC Beta: 1 to 5000 in ranges of 1 to 50, 5 to 250, 10 to 500, 50 to 2500, 100 to 5000. **Collector currents available:** 1 mA, 5 mA, 10 mA, 100 mA, 500 mA, and 1 A. **Gm:** 0 to 50,000 μohms. **Leakage measurements:** Five ranges, 0 to 100 μA, 0 to 1 mA, 0 to 10 mA, 0 to 100 mA, 0 to 1 A. **Out-of-circuit accuracy:** ±5% for DC beta and leakage. **In-circuit accuracy:** Indicates good or bad transistor, FET, diode, SCR or triac. **Diode test:** Tests for forward conduction and blocking. **Unijunction transistor test:** Measures V_{eb2s}, Rbb, and emitter current (out-of-circuit). **Power Requirements:** Two 1½ V cells, (alkaline for best performance). **Dimensions:** 5" H x 9-7/16" W x 8-1/8" D.

Test transistors in- or out-of-circuit with the Heathkit IT-18

You don't have to remove transistors or diodes from the circuit when you use the Heathkit IT-18 In-circuit/Out-of-circuit Transistor Tester. Its low internal impedance and handy color-coded test leads assure easy, reliable in-circuit checks. The large, easy-to-read meter permits direct reading of DC Beta (gain) on two ranges, 2-100 and 20-1000. The IT-18 also makes out-of-circuit leakage measurements for transistors and diodes, range 0-5000 μA. It will also match and identify NPN or PNP transistors. The 1.5 V battery-powered circuit will not damage a transistor or diode that is incorrectly connected. Not for use with high power or switching transistors.

Kit IT-18, 4 lbs.

IT-18 SPECIFICATIONS – D.C. Beta: x1 range – 2 to 100, x10 range – 20 to 1000. **Out-of-circuit accuracy:** ±5%. **In-circuit accuracy:** Indicates good or bad. Iceo (out-of-circuit only) – – 0-5000 μA. Icbo (out-of-circuit only) 0-5000 μA diodes; forward or reverse current – 0.5000 μA. **Power:** One standard "D" cell (not supplied). **Dimensions:** 4¼" H x 8½" W x 7-1/8" D.

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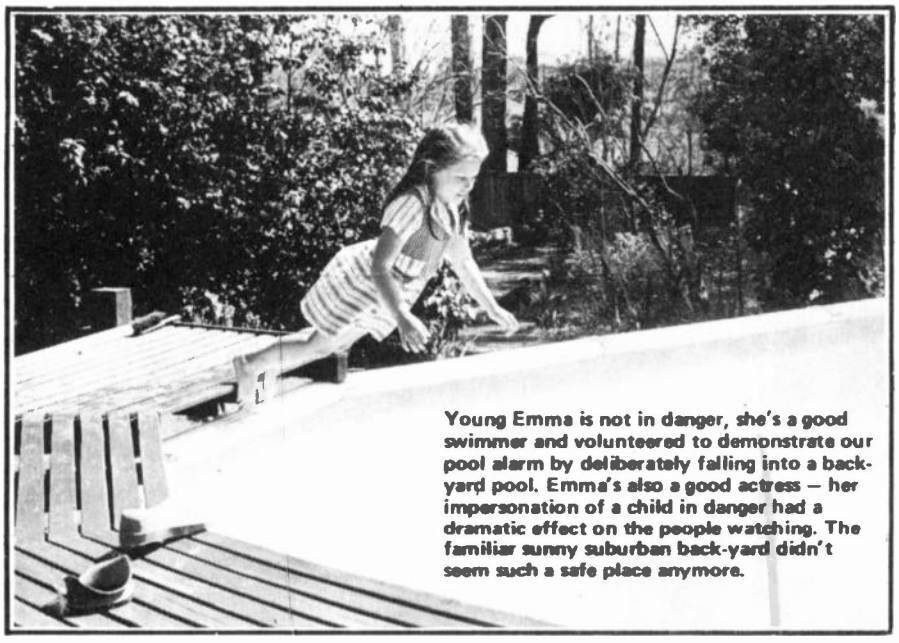
SWIMMING POOL ALARM

Safeguard children with this easy-to-build alarm



Young Emma is not in danger, she's a good swimmer and volunteered to demonstrate our pool alarm by deliberately falling into a back-yard pool. Emma's also a good actress – her impersonation of a child in danger had a dramatic effect on the people watching. The familiar sunny suburban back-yard didn't seem such a safe place anymore.

EVERY YEAR fifteen to twenty children are drowned in home swimming pools. And that's in NSW alone.

In some States it is now compulsory to erect a high fence – with a lockable gate – around the pool. But even three and four year olds can and do climb fences, and gates are only too easily left unlocked. Even if fenced in, some form of reliable warning device is essential.

Some time ago Electronics Today ran a design contest inviting readers to submit their solution to this increasing problem.

Three main types of alarm were submitted.

1/ Floating devices that sense water ripples.
2/ Hydrophonic devices that detect the sound component of the splash.
3/ Light beams and sensors guarding the perimeter of the pool.

The most completely effective entry was a hydrophonic device that detected the sound of the splash. This unit had an inbuilt spectrum analyser to eliminate false alarms. Although ingenious and effective the device ultimately proved too complex to present as a constructional project.

A light beam and photocell barrier can also be very effective but it is difficult (in practice) to ensure the alignment of the system right around the pool. One entrant suggested that three parallel beams be used. The first two were spaced close together – the third was about one and a half metres from the ground. The outputs from the photocells were connected to a logic system set up so that no alarm would sound if all three beams were broken – or only one was broken. Thus birds and adults could pass through the beams at any time without causing alarm. A toddler however would break the lower *two* beams thus sounding the alarm.

The simplest and potentially most reliable systems used some form of differential float to sense water surface ripples. The basic principle of these devices is that only ripples *shorter* than the spacing between the floats will cause one float to move with respect to the other. Long wave ripples (such as those caused by wind blowing across the pool) will move the assembly as a whole.

One design of this type was submitted by Mr. G. Goodwin. This system has been further developed and extensively tested since the contest and is presented here in a form suitable for building by anyone who can use simple tools.

The sensing part of the alarm consists of an upright central tube which is supported in the water by three small floats. The central pillar carries a further small float which is free to move up and down the pillar.

This moving float has a pair of small magnets sealed within it, and a magnetically operated reed switch is housed within the central pillar – near the top.

The whole assembly floats in the water, with the central float normally resting some short distance below the point at which the reed switch is actuated.

In the event of a short sharp wave, such as that caused by a toddler or animal falling or slipping into the pool, the central float will be caused to momentarily rise with the wave thus actuating the reed switch.

Waves of longer pitch will move the assembly as a whole – there will be no differential movement.

Once the switch is triggered the alarm locks on and the warning mechanism will continue to sound even though the disturbing ripples have ceased. The alarm can only be turned off by pressing a reset button.

The unit's sensitivity is adjusted by moving the main float assembly up or down the central pillar. It is quite simple to set the unit so that it will respond only to the kind of waves produced by a child falling into the pool – but to ignore wind produced ripples.

As mentioned above it is necessary to have some type of circuit associated with the sensor to ensure that the unit, once triggered, will continue to sound an alarm even though the initial ripples die away.

The simplest way to do this is to use a relay with two pairs of contacts. One pair is used to connect power to the alarm bell – the second pair is used to cause the relay to 'self-latch'. This method is very reliable and has the advantage that almost any type of alarm bell can be used.

Figure 2 shows how the relay is connected to the float assembly. Twin bellwire or plastic coated lighting flex will be adequate for the wiring between the two parts of the unit. House the relay assembly and battery indoors so that it is dry and accessible.

We have not included an on/off switch in the circuit – it's too easy to forget to turn the unit back on. It's less convenient, but safer, to lift the sensor unit from the pool and to place it somewhere totally obvious when the pool is in use.

Connections may differ from relay to relay but if in doubt anyone with basic

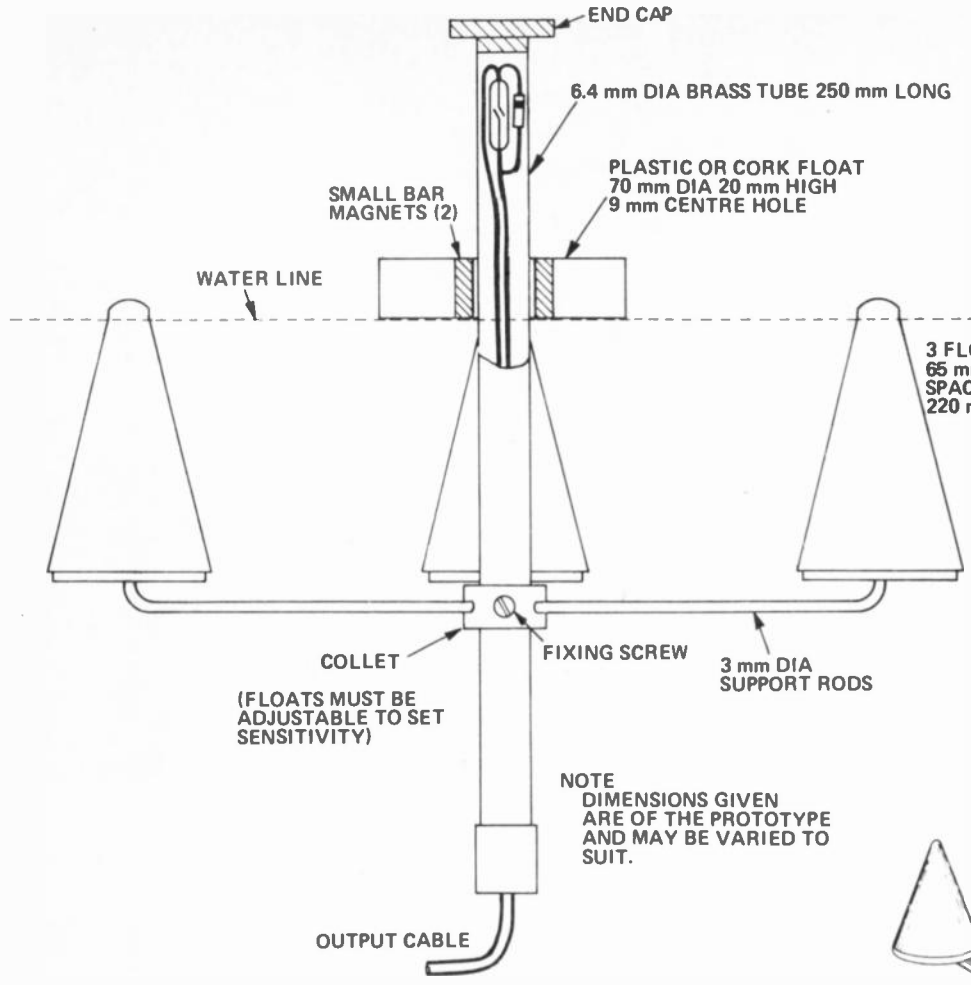
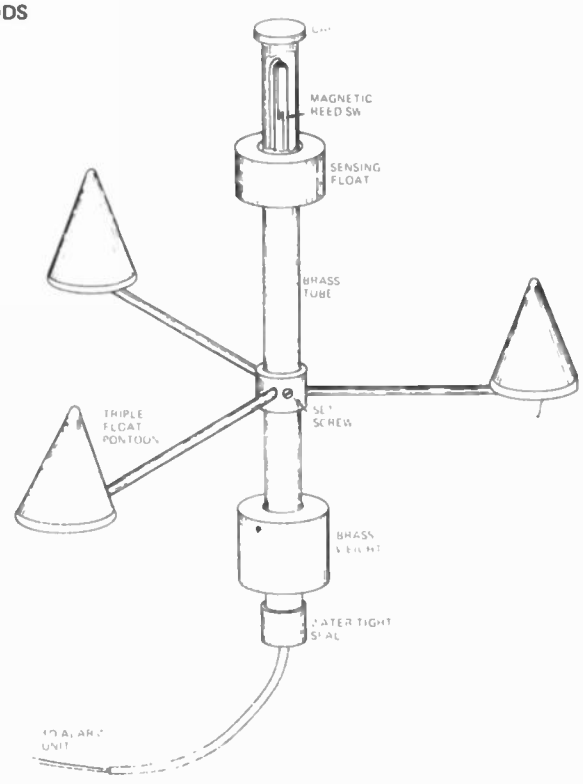
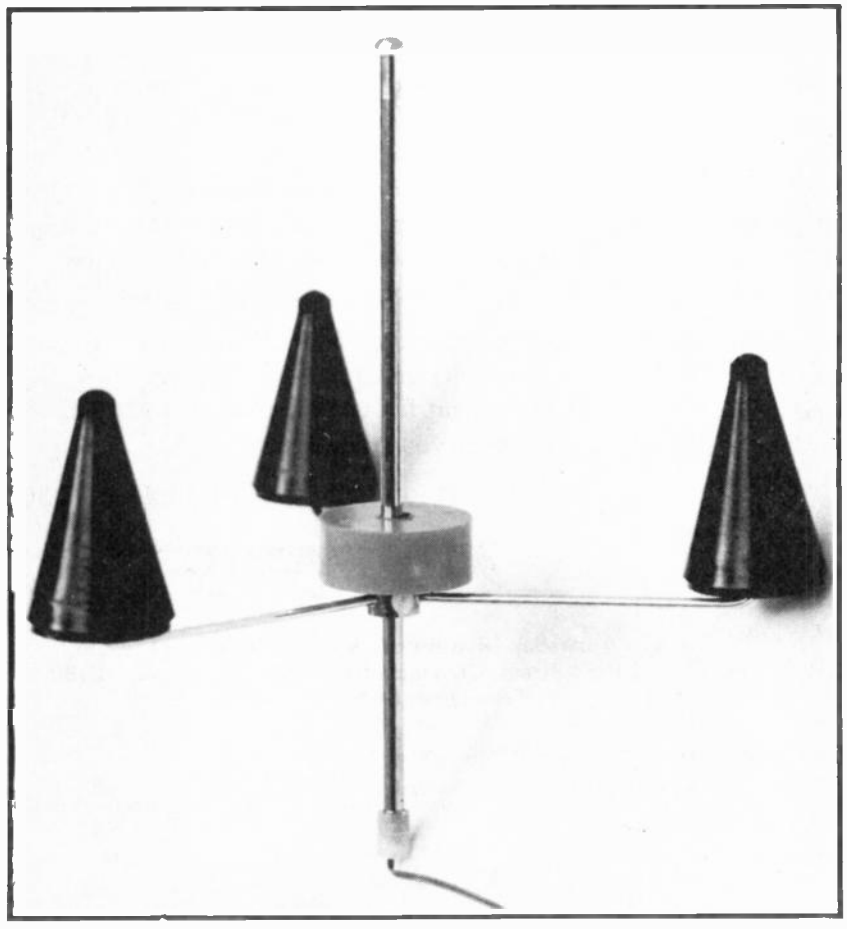


Fig. 1. This drawing shows the basic details, the dimensions are not critical but should not be varied without prior experimentation. It may be found necessary to add a weight to the lower part of the central pillar as shown in our sketch of an earlier prototype (right).

Materials chosen must be corrosion-proof and sealed against the ingress of water. Note how the diode is wired across the reed switch.

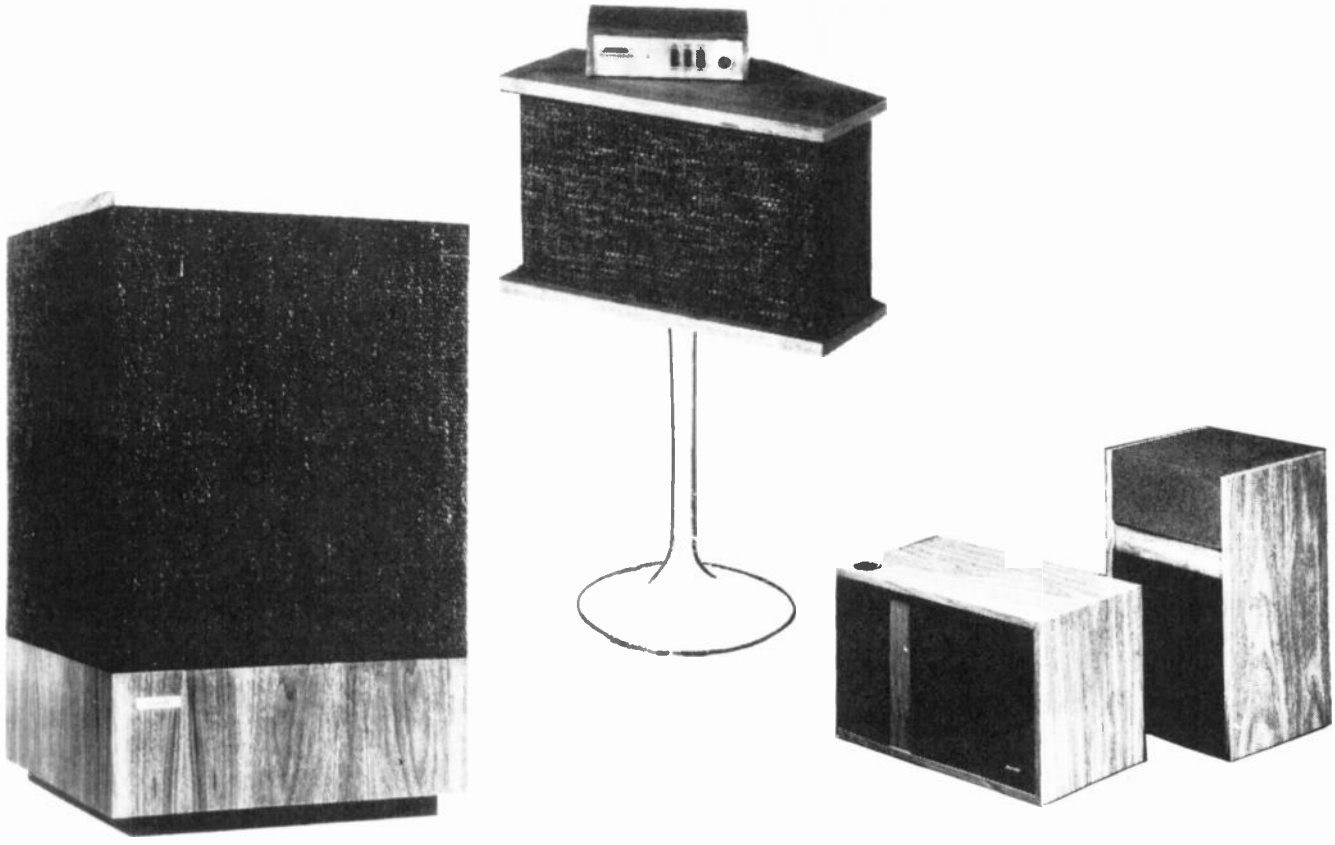
NOTE: The complete unit must be moored near the centre of the pool by a suitable cord and weight. Leave enough slack in the cord to allow for water level variations.





PARTS LIST

One double pole change over switch- any type
One push-to-break pushbutton switch
One double pole single throw (or change over) relay suitable for 12 volt operation.
One diode – any signal diode
One ORD 234B reed switch (or similar)
Two FM 454 magnets
Materials for float as obtainable



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The Bose 901, 501 and Model 301. Three-speaker systems that meet the two basic requirements for preserving the qualities of live music in reproduced sound: the proper balance of reflected and direct sound for spaciousness and clarity; and flat power radiation to assure correct frequency balance and accurate reproduction of instrumental timbre in an actual listening environment.

The internationally acclaimed 901® system utilizing nine full range drivers with an active equalizer to provide the ideal balance of reflected to direct sound at all frequencies, setting the standard for lifelike music reproduction in the home.

The unconventional 501 incorporating an exceptionally linear 10" woofer and two rearward facing tweeters to furnish many of the performance advantages of the 901 system, but at substantially lower cost.

The new Model 301 offering a unique combination of features: Asymmetrical Design, a Direct Energy Control and a Dual Frequency Crossover network. This achieves reflected and direct sound with flat power radiation in a bookshelf enclosure, producing a sound quality that is extraordinary from so compact a speaker at so low a price.

The innovative speakers. From Bose. Each unique in concept and design to provide the maximum musical enjoyment for your home. One of them will ideally meet your requirements.

Shown above, left to right, 501, 901, and Model 301.

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Telephone: 642-3993 – 642-2595.

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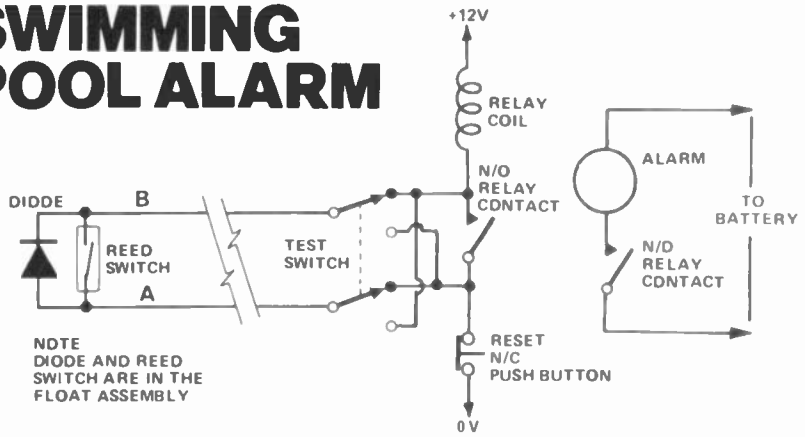
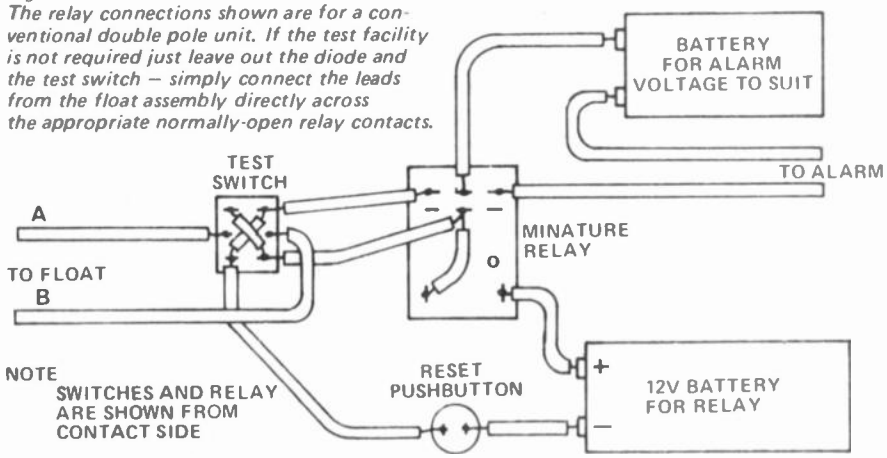
SWIMMING POOL ALARM



Figures 2 and 3 show how the unit is wired. The relay connections shown are for a conventional double pole unit. If the test facility is not required just leave out the diode and the test switch – simply connect the leads from the float assembly directly across the appropriate normally-open relay contacts.



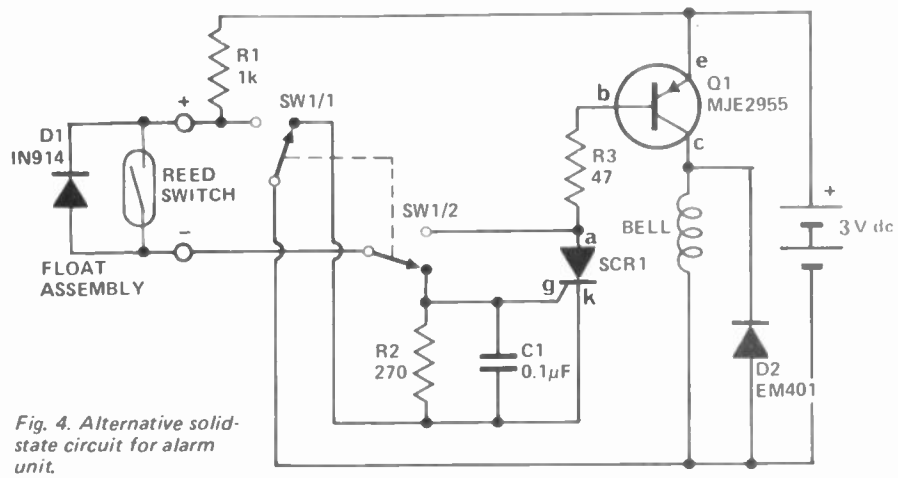


Fig. 4. Alternative solid-state circuit for alarm unit.

electrical knowledge will be able to tell you which connection is which.

The float assembly should conform generally to the drawing shown in Fig. 1. The central pillar may be made of brass or plastic tubing – but not steel. The floats were originally moulded specifically for the project out of polythene. They can however just as readily be made from light wood (well varnished to prevent water absorption) or cork. Plastic bottles or jars can also be adapted.

The reed switch and diode must be very securely fixed within the central pillar – which must then be securely sealed to prevent the ingress of water. An excellent way to do this is to fill the entire column with windscreen sealant or similar plastic goo.

The completed float assembly should be moored in the centre of the pool by a cable and weight resting in the bottom of the pool. Allow sufficient slack in the cable to allow for variations in the depth of water in the pool.

Figure 3 shows an alternative electronic switching and latching circuit. This is a form of construction suggested by Mr. Goodwin. It has been chosen so that the whole unit will fit into an existing Friedland door bell – which is powered by an inbuilt three volt battery.

This form of construction is certainly neat but in our opinion a simple double pole relay does the job equally well and with greater potential reliability. A 12 volt bell may also be used with the simple relay system and this will be heard over far greater distances than a simple door bell – no matter how adequate the latter may be for its originally intended purpose.

A diode is wired across the reed switch in both circuits. The purpose of this diode is to enable the entire wiring circuit to be checked for integrity by pressing a 'test' button. This facility does not of course check the reed switch itself nor the actual floating assembly. In our opinion the whole unit should be checked daily by throwing a suitable mass into the pool. (A water filled football or one gallon can simulate the mass of a small child very adequately). ●

REED SWITCH AND MAGNETS

A reed switch consists of two springy metal strips inset into a glass tube filled with inert gas.

The strips are caused to close together and make contact by a magnetic field.

A suitable reed switch for this project is the type ORD 234B from Plessey Ducon. Suitable magnets are type FM 454 also from Plessey. Two magnets are required for each assembly.

Plessey have kindly agreed to supply our readers with a set of one reed switch and two magnets for $1.50 per set including packing and postage.

The components may also be stocked by kit set and component suppliers.

Copy this coupon on plain paper if you don't wish to cut up your copy of this issue.

To:

Plessey Ducon Ltd.
Professional Components Division
Christina Ave.
Villawood NSW

Please forward one reed switch type ORD 234B and two magnets type FM 454, I enclose cheque/postal order to the value of $1.50 to cover cost of same

Name: . . . . . .

Address: . . . . . .

. . . . . .

. . . . . Postcode . . . . . .

NOTE

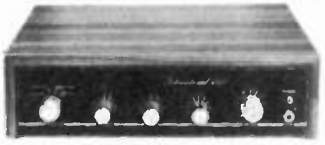
This unit has been extensively tested and has proved to be both effective and reliable.

However like any mechanical or electrical device, failures can occur. It is therefore imperative to follow normal swimming pool safety precautions even though this alarm is in use.

ELECTRONIC HOBBY KITS

To-days Technology for Your Enjoyment

ETI 440 SIMPLE 25 WATT AMPLIFIER



PACK 1	Fibreglass PC Board with Screened Component Overlay	$ 5.00
PACK 2	Set of all Resistors, Capacitors	$ 8.00
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PACK 9	Top Quality Walnut Veneered Cabinet	$10.00
PACK 10	Detailed Step-by-step Assembly Manual	$ 3.00
Total Cost of Individual Purchased Packs		$95.00

Designed by the ETI Team the International 440 is a remarkable combination of high performance, easy construction and low cost.
We offer our own exclusive step-by-step assembly manual, the choice of buying individual packs or the full kit and a really good looking Walnut Veneered Cabinet that guarantees you a professional finished product anyone would be proud to own.
With our full Technical support and Warranty Service (see below) you just can't fail to build this kit!

FREE WALNUT CASE WITH FULL KITS $85.00

Delivered Free Anywhere in Australia.
$115 Assembled and Tested.

ETI 704 CROSS HATCH/DOT GENERATOR

$27.50

This incredibly popular project now given the HOBBY KIT treatment.
- Pre drilled/screened front panel.
- Fibreglass PC Board with screened Component Overlay.
- Pre-wound coils.
- Sockets for all IC's.

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

MR 25 SCORPIO CD1

Based on one of the most popular CDI projects in the world, this proven design has been updated and re-engineered to ensure that the kit can be readily assembled by anyone from a novice to an expert design engineer. The kit comes complete in every detail including all components and hardware; screened, etched and drilled PC Board, machined and finished metal work, pre-wound and tested transformer and a unique, easy to follow assembly manual that converts the assembly task to sheer pleasure.
If you have any problems before, during or after assembly — just call on our exclusive Technical support and Warranty Service.

$28.50

(Assembled and tested $36.00)

FULL TECHNICAL SUPPORT AND WARRANTY SERVICE

All Applied Technology HOBBY KITS are covered by our exclusive 90 days warranty against faulty components and packaging (full details with each kit).
Yet another exclusive is the full technical support service. If you are unable to make your HOBBY KIT operational, help is just a phone call or a letter away. If you do have to return any KIT for factory attention, it will be repaired for a nominal service fee.

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ETI-11

FANE

HI-FI LOUDSPEAKERS FROM ENGLAND

10" The model B101/10LR is a 10" loudspeaker with a 2" voice coil working within a 10,000 guass magnet structure, total flux 100,000 maxwells. The free air-resonance of the loudspeaker is 25Hz thus making it suitable for a small sealed cabinet of between 1½ and 2 cu.ft.

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

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

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

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

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

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

FANE PUBLIC ADDRESS & MUSICAL INSTRUMENT UNITS

12" CRESCENDO 12A — Super High Efficiency, Wide Frequency Response and 100 Watt r.m.s. power handling. This beautifully finished loudspeaker is particularly suitable for lead guitar, organ and public address work. VOICE COIL DIAMETER: 2", FLUX DENSITY: 20,000 Guass, IMPEDANCE: 8 ohms. **$79.00**

15" CRESCENDO 15/100 BASS. Specially designed for high power, high efficiency bass performance. This magnificent unit is rated at 100 watts r.m.s. and has a resonant frequency of 40Hz. VOICE COIL DIAMETER: 3", FLUX DENSITY: 15,000 Guass, IMPEDANCE: 8 ohms. **$99.00**

920 HORN UNIT. This unit has just been released on the Australian market and features super high efficiency of 109 dB and power handling of 100 Watts r.m.s. above 600 Hz. VOICE COIL DIAMETER: 2", FLUX DENSITY: 20,000 Guass, IMPEDANCE: 8 ohms. **$149.00**

12" POP 50. A general purpose 50 watt r.m.s. loudspeaker of high efficiency, but economically priced. VOICE COIL DIAMETER: 2", FLUX DENSITY: 13,000 Guass, IMPEDANCE: 8 ohms. **$39.50**

18" POP 100 An outstanding 18" bass loudspeaker for musical instruments, the POP 100 handles 100 watts r.m.s. at high efficiency. Resonant frequency is 55 Hz. VOICE COIL DIAMETER: 3", FLUX DENSITY 14,000 Guass, IMPEDANCE: 8 ohms. **$79.00**

FREEMAN FT-3A STEREO TUNER

The Freeman FM Stereo tuner features 2 IC'S, 1 FET, 2 transistors and 4 diodes. Stereo reception is automatic and indicated by light emitting diode visible on the front panel. The FT-3A measures 165mm (w) x 140mm (D) x 60mm (H). Specifications are as follows:
Frequency range 88-108MHz, Sensitivity 5μV, Output over 150 mV, Stereo separation 30 dB, The FT-3A FM TUNER.

OUTSTANDING VALUE **$49.50**

NEW CHALLENGE TURNTABLE SEMI-AUTOMATIC BELT-DRIVE

$ 129

FEATURES

Cast non-ferrous 12" platter belt-driven by a 4-pole syncronous motor,

wow & flutter: less than 0.1% WRMS
rumble: — 50 dB weighted.

S-shaped tone arm with removable lightweight headshell fitted with magnetic cartridge and diamond stylus, 0.7mil conical. (Standard ½" mounting).

Anti-skate mechanism and lateral balance weight are incorporated in the tone arm.

Tone Arm return is automatic at the end of the record and may be operated at any stage of the record by using the reject lever located at the front right hand corner of the CSP-1. This return mechanism is simple and effective to ensure years of trouble-free service.

An independent oil-damped cueing lever is also incorporated into the CSP-1 and allows selection of the required record tracks without having to activate the auto-return mechanism. Very handy for safely "skipping" unwanted tracks.

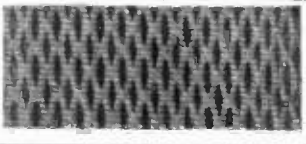
Joinless polyurethane drive belt ensures long term reliability and consistent performance.

Simulated Walnut finish plinth and moulded perspex cover feature tension spring hinges to prevent free fall of the cover onto the plinth.

12 months guarantee covering faulty workmanship and including free parts and labour.

SPEAKER GRILLE CLOTH

An attractive selection of speaker grille cloths are available ex stock at very reasonable prices. Free sample pieces are available on request and will be forwarded per post anywhere in Australia together with our price list.



challenge

HI-FI STEREO PTY LTD

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TONE BURST testing is a technique which is rapidly gaining acceptance in a wide variety of applications. Typical applications are in testing of hydrophones, signal-to-noise in telephone channels, reverberation chamber testing and in the determination of peak distortion in loudspeakers. With loudspeakers, tone burst testing has the further advantage that the speakers may be tested with their maximum peak power level whilst keeping the average sound output level low enough to not annoy the neighbours — a considerable advantage indeed.

Some time ago our audio consultants, Louis Challis and Associates, asked us to build them a tone-burst generator and the resulting instrument has been used by them ever since with much success. The tone-burst test has been mentioned in several speaker reviews and, as a result, many people have asked for constructional details of this instrument.

DESIGN FEATURES

A tone burst must always be an integral number of cycles. If the burst is switched on or off part way through a cycle then undesirable transients will be produced that will mask the test results. Thus the burst must start and end exactly at the zero-crossing point of the sine wave in the burst.

In the original unit, designed for Louis Challis, preset times can be independently selected for the on and off periods of the burst with the exception that the burst time is automatically modified to give an integral number of cycles. The preselected on/off ratio, however, is independant of the burst frequency. To give the required control range, six switched ranges as well as a variable control are provided for both the on and off periods. Other features of the original unit are the ability to start at any point in the cycle as well as the zero crossing point, a phase-inverting switch to select either the positive or the negative half cycle first and an OFF LEVEL control to set a base tone level which is modified when the tone burst occurs. In addition the dc level of the output can be set and a switch is provided to select burst, pure tone or off as required.

When it came to redesigning the unit as a project we decided that many of the features offered by the original design were unnecessary for the user concerned only with testing speakers. Hence the unit has been redesigned in a greatly simplified form.

Instead of using monostables to generate variable on/off times we now divide the input with a counter to

eti

PROJECT 124

TONE BURST GENERATOR

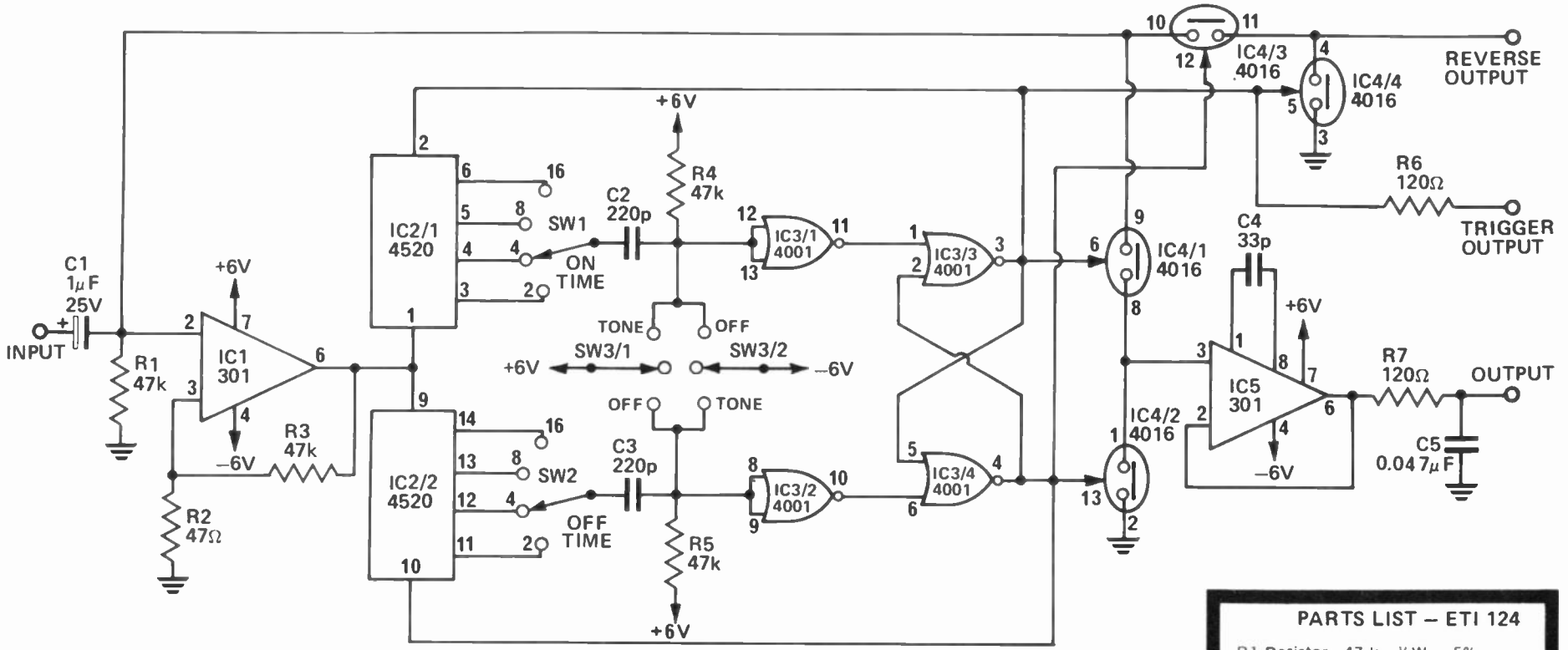
A valuable tool for testing loudspeakers.

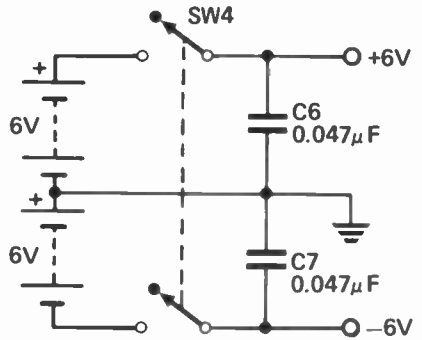
MEASURED PERFORMANCE

TONE BURST GENERATOR.

On Time Cycles.	2,4,8 or 16
Off Time Cycles	2,4,8 or 16
Frequency Response 3 Hz – 300 kHz	+0 –3 dB
Distortion 3 V input at 1 kHz	<0.02%
Input Level Maximum Nominal range	3 V RMS 100 mV to 1 V
Input Impedance	47 k
Output Noise Voltage with no input	<25 μV
Power Supply Current	4 mA

TONE BURST GENERATOR

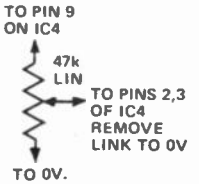




POWER RAILS OF IC2, IC3, AND IC4 NOT SHOWN
PIN 16 OF IC2 IS +6V
PIN 8 OF IC2 IS −6V
PIN 14 OF IC3 AND 4 IS +6V
PIN 7 OF IC3 AND 4 IS −6V
PIN 7 AND 15 OF IC2 ARE RESET PINS AND −6V

Fig. 1. Circuit diagram.

Fig. 4. How to add a potentiometer to the generator for burst-on-tone operation. That is the generator gives a continuous tone level with tone bursts of higher amplitude at intervals.

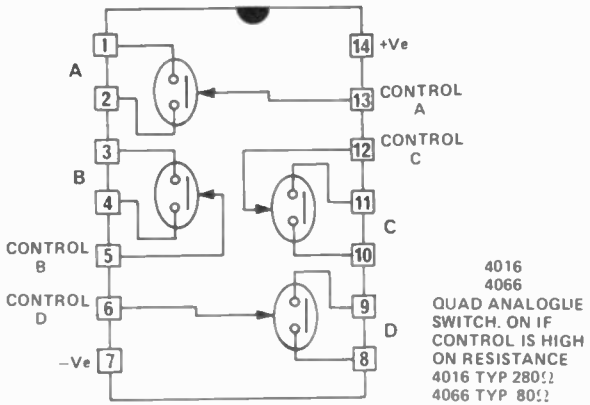


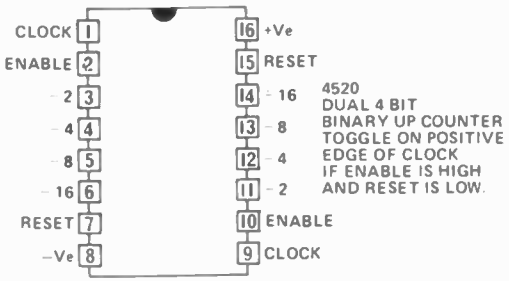
PARTS LIST – ETI 124

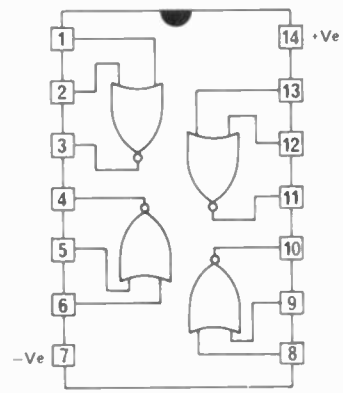
R1	Resistor	47 k	¼W	5%
R2	"	47 Ω	¼W	5%
R3	"	47 k	¼W	5%
~~R4~~	"	47 k	¼W	5%
R5	"	47 k	¼W	5%
R6	"	120	¼W	5%
R7	"	120	¼W	5%
C1	Capacitor	1 μF 25V electro		
C2	"	220 pF ceramic		
C3	"	220 pF ceramic		
C4	"	33 pF ceramic		
C5	"	0.047 μF polyester		
C6	"	0.047 μF polyester		
C7	"	0.047 μF polyester		
IC1	Integrated Circuit	LM 301A		
IC2	"	"	4520 (CMOS)	
IC3	"	"	4001 (CMOS)	
IC4	"	"	4016 (CMOS)	
IC5	"	"	LM301A	

SW1 Switch 1 pole 4 position rotary
SW2 Switch 1 pole 4 position rotary
SW3 Switch DPDT Toggle with centre off
SW4 Switch DPDT Toggle

PC Board ETI 124
8 AA size batteries
2 4-way battery holders and clips
Plastic case
Escutcheon
3 single RCA sockets
2 knobs







INPUTS		OUTPUT
A	B	
0	0	1
0	1	0
1	0	0
1	1	0

Fig. 3. Pin connections of the ICs used in the generator.

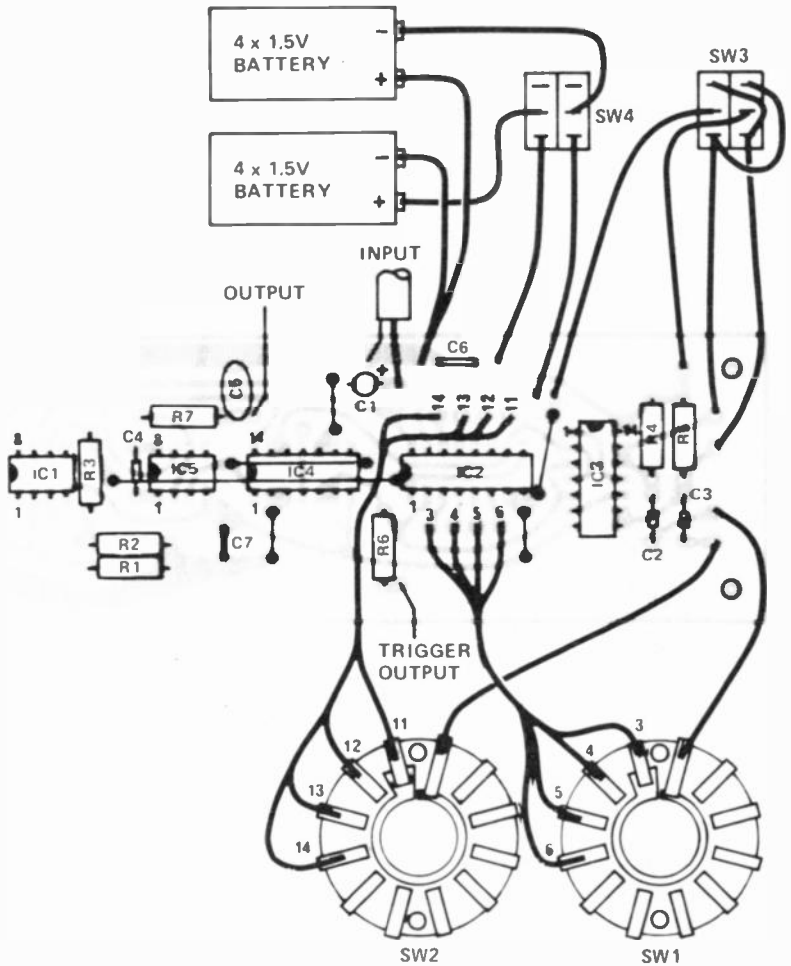


Fig. 2. Component overlay and interconnection diagram. Note that there are six links on the board, including two under IC4, which should be installed first.

HOW IT WORKS – ETI 124

The input signal is squared by comparator IC1 such that the output of the comparator will be high if the input is above +6 mV, and low if the input signal is below −6 mV. Resistors R2 and R3 provide the necessary positive feedback to cause the IC to act as a compatator. The output of the comparator is connected to both clock lines of IC2. If the enable line is high these counters (IC2) will toggle at the input frequency.

IC3/3 and IC3/4 form an RS flip flop where the output must be in either a high or a low state, that is the flip flop has only two stable states. If the output of IC3/3 is high IC2/1 is allowed to clock and, after the number of input pulses selected by SW1 have been counted, the output from SW1 goes low. This low is coupled to the flip flop by C2 toggling the flip flop, disabling IC2/1 and enabling IC3/2. After the number of cycles, as selected by SW2, have been counted the flip flop is again toggled. IC3/1 and IC3/2 are used to square up the pulses generated by C2 and C3 respectively.

The input signal is also coupled to the output buffer, IC5, by the analogue switch IC4/1. When this switch is closed (control signal high) the output of the buffer will be the same as the input. When switch IC4/1 is open IC4/2 will be closed and the output will be held at zero. Since these switches are controlled by the flip flop the output will be the required tone burst.

A trigger output is taken from the flip flop to synchronize an oscilloscope if required. A second output is also available from pins 4/11 of IC4 which is the reverse of the main output.

Switch SW3 forces the flip flop into either of its two possible states thus allowing continuous tone or no output to be selected as required. In the centre position the normal tone burst is obtained.

TONE BURST GENERATOR

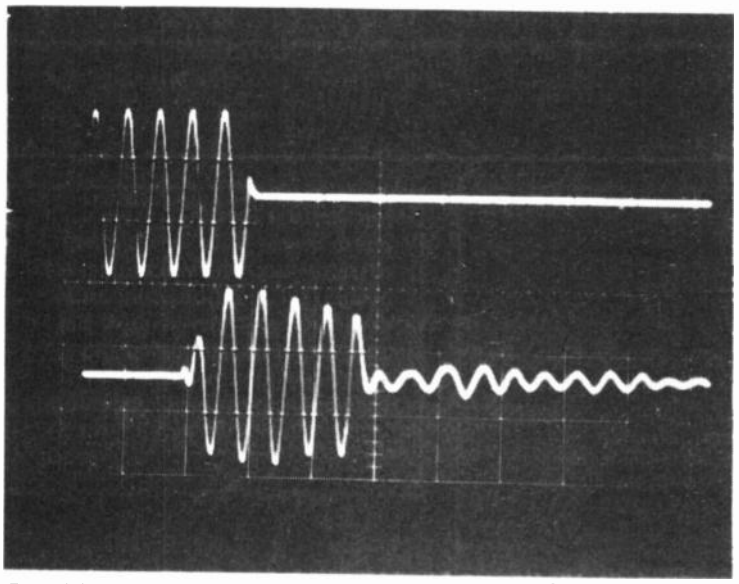


Fig.5 (a) Top trace – the input tone burst of five cycles. (original design). (b) Bottom trace – the response of a low-cost speaker at 1 kHz. Note the reduced amplitude of the first half cycle and that ringing has added another cycle at the end of the burst. The room reflection can be seen on the trace after the burst.

obtain times that remain in the same ratio regardless of input frequency. We settled for the ability to select 2, 4, 8 and 16 cycles for the duration of either period, as this compromise greatly simplifies the circuitry. We still have the switch to select tone, tone burst or off, but the OFF LEVEL control has been deleted. The latter control may quite easily be added, however, as shown in Fig. 4. . The output dc level control and the starting-point phase change have also been deleted.

Since we only need half of a CMOS 4016 IC, to give the required output, the other half may be used to give an inverse output if required, that is, the reverse output is on when the other is off and vice versa. This output is not buffered or brought out to the front panel. If it is intended to load this output with less than 47 k it is recommended that a 4066 IC be used instead which will handle loads down to 10 k. For loads of lower impedance than this, a buffer such as is on the normal output should be used.

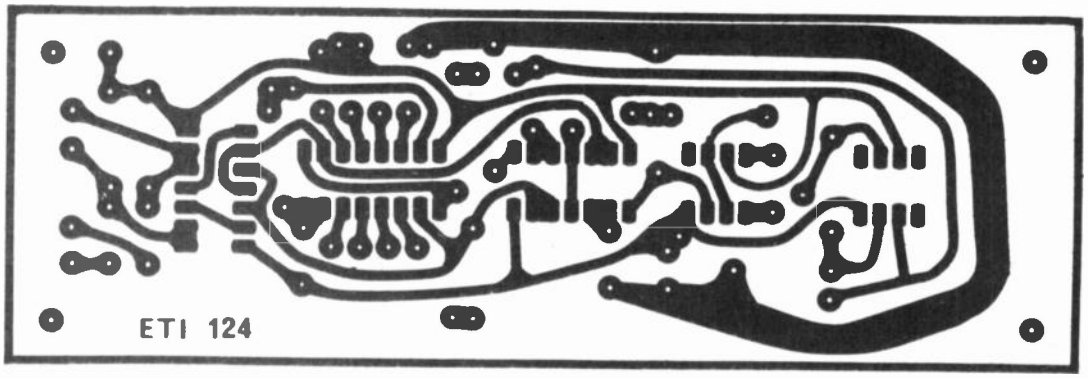


Fig.6. Printed circuit board for the Tone Burst Generator Full size. 142 x 47mm.

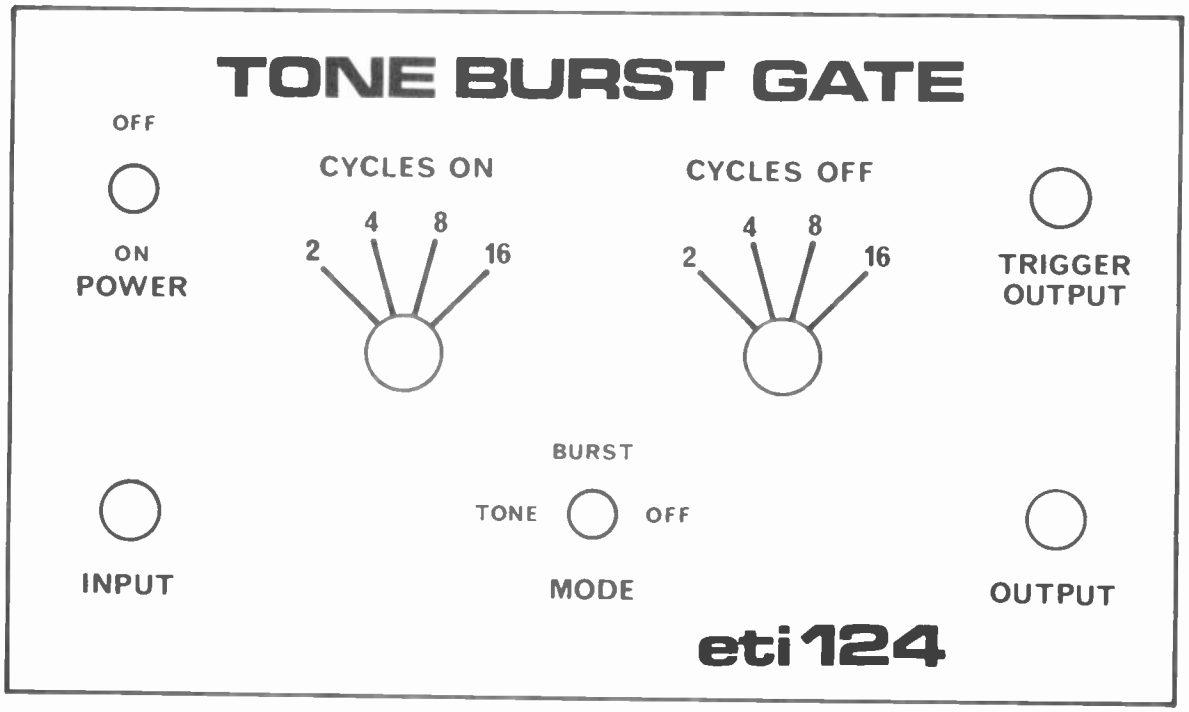


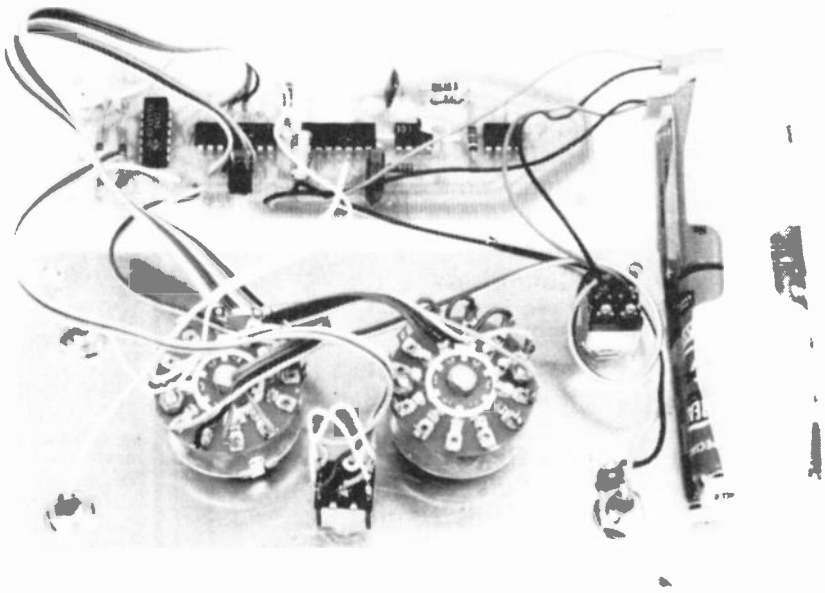
Fig.7. Front panel artwork.

CONSTRUCTION

As with any project construction is greatly simplified if a printed circuit board is used. However the layout of the unit is not critical and any other suitable method, such as Veroboard or Matrix board may be used if desired. We strongly recommend that sockets be used for the CMOS ICs, especially if a printed circuit board is not used, as these devices are quite easily damaged when soldering. The use of IC sockets also facilitates later servicing. Also remember that, unlike TTL, all unused inputs of CMOS must be connected to either the positive or negative supply rail.

The plastic box that we used measured 160 x 95 x 50 mm and is very convenient in that the printed circuit may be held in position by sliding it down behind two of the pillars to which the front panel is screwed. The front-panel overlay on the prototype was made from Scotchcal but, as the amount of lettering required is quite small, this may readily be done directly on the panel by hand or with Letraset.

Shielding of the internal wiring is not required providing that the unit is kept away from strong 50 Hz fields. If operation in the vicinity of strong fields cannot be avoided then the unit should be mounted in a diecast box.



How the unit is assembled.

USING THE UNIT

The testing of loudspeakers is very difficult indeed and much effort is still being spent to find test methods which will not only give an accurate understanding of the relative effectiveness of the design, but which will be easy to reproduce.

One of the main problems with speaker testing is that the speaker cannot easily be isolated from its environment. For example, reflections from the walls of a room modify the response, seen by a microphone, no matter where the microphone is placed in the room. If one could eliminate reflections then the situation would be improved considerably, and hence the use of anechoic (echo free) chambers for testing speakers. But such chambers are very expensive to build and consequently not readily accessible to the amateur.

A further problem is in assessing the transient power handling capability of the speaker. Speakers will handle far greater peak transient power than is indicated by their RMS power rating. This is a very important attribute of loudspeakers in handling musical transients. Any attempt to assess this with a sinewave signal may result in the destruction of the speaker due to thermal failure – apart from also being extremely noisy.

The use of a tone-burst generator minimizes both these problems. How this is achieved is better understood by examination of Fig.5. This shows on the upper trace a five cycle 1000 Hz burst that is fed to a loudspeaker. The second trace shows the same burst as picked up by a microphone in front of the speaker. We notice that the burst has been changed by the speaker and an examination of these changes can tell us a lot about the speaker. For example we notice that the first half cycle has not reached full amplitude and this indicates that the speaker would have some difficulty in reproducing high frequency transients. Next we notice that instead of five cycles there are now at least five and a half. This could mean one of two things. Either there is a speaker/room resonance or, the speaker itself is continuing to vibrate after the original excitation has ceased. Which is it? We can determine this by changing the position of the speaker to see if any change occurs in the shape of the burst, if not it is caused by the speaker itself, and if it does then it is a speaker/room resonance. A speaker that lengthens the burst unduly will sound muddy in that region. Of course the speaker must be examined over its whole range to gain a thorough assessment of performance.

It is of course possible to eliminate room reflections simply by performing the tests outside. However unless one lives in a very quiet area, background noise will introduce problems – and your neighbours are unlikely to appreciate the noise that you will generate.

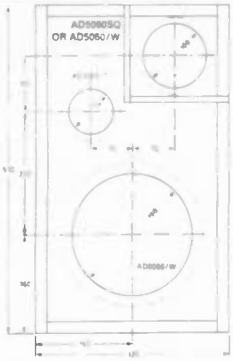
By varying the off period we can also select a ratio where the room reflection, the oscillation seen after the cessation of the burst, does not interfere with the first few cycles of the burst and the response versus frequency of the speaker may then be assessed from the amplitude of the first half cycles that are stable in amplitude. Thus it is possible to gain an appreciation of the frequency response, transient performance and quality in terms of ringing of a speaker by careful use of the tone-burst technique.

The transient power handling capability of a speaker may be assessed by selecting a fairly long off to on ratio for the burst and by feeding the burst to the speaker via a high-power amplifier. If for example an off to on ratio of 8:1 is used then the peak power will be eight times the average power. Thus the speaker may safely be driven to a peak level where a predetermined amount of distortion occurs. Take care that the amplifier is capable of providing the peak power required.

Of course a tone-burst generator may be used for a wide range of testing. We have mainly concentrated in this article on its application to the testing of loudspeakers.

The circuitry of the tone-burst generator may easily be modified for use as a 'silent switch' for A/B speaker testing. The method of doing this will be described next month. ●

PHILIPS SPEAKER KITS



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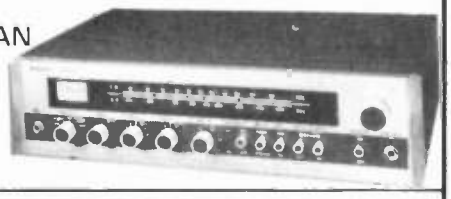

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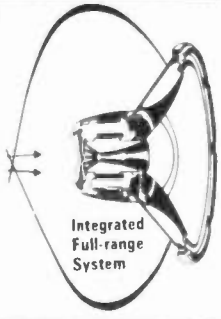

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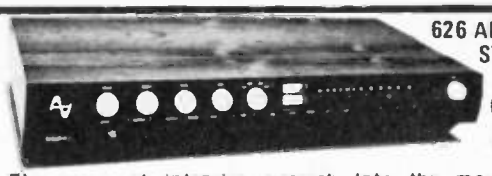

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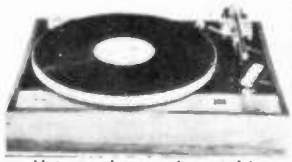

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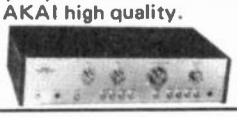

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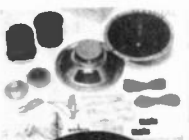

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C90 LN	2.20	2.00	1.80
C120 LN	2:95	2.80	2.65
CDC 60	2.35	2.14	1.93
CDC 90	3.10	2.90	2.60
CDC 120	3.95	3.80	3.65

MEMOREX MRX2

	1	12	24
C45	2.10	2.00	1.90
C60	2.30	2.15	2.00
C90	3.20	3.00	2.80

TDK

	1	12	24
C45 LN	1.80	1.70	1.60
C60 LN	1.95	1.85	1.75
C90 LN	2.80	2.60	2.40
C180 LN	5.45	5.30	5.05
C90 SD	3.65	3.45	3.25

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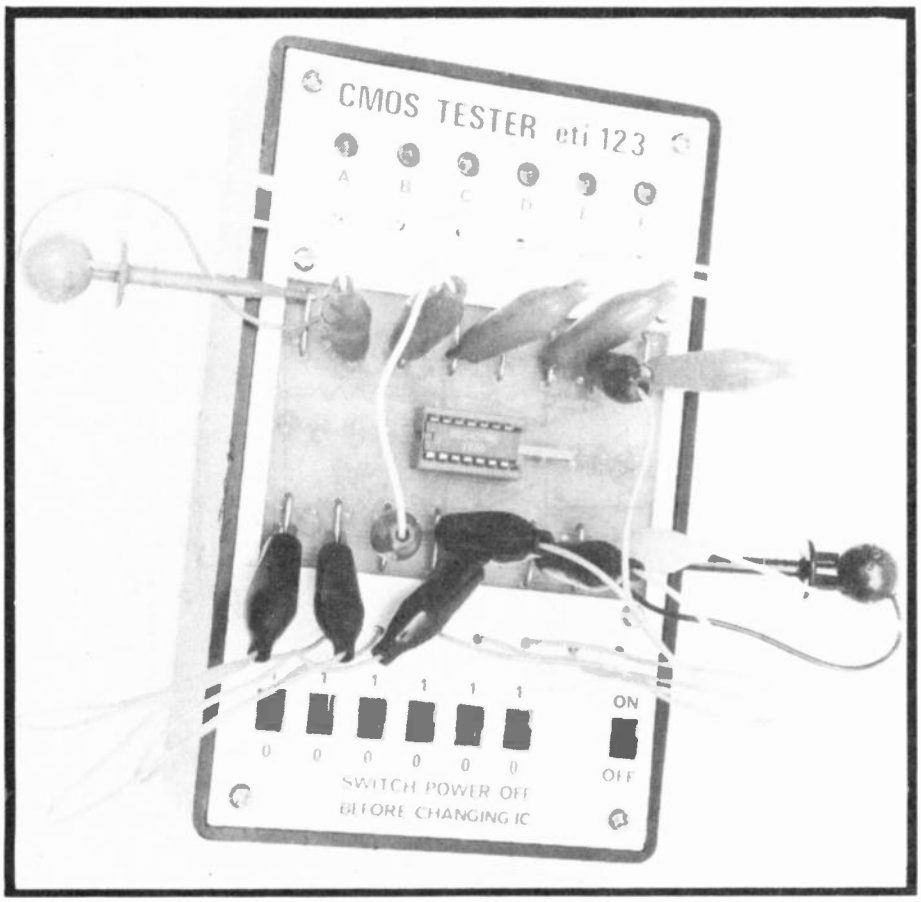


PROJECT 123

NOW THAT the use of CMOS logic is becoming widespread there is an obvious need for a simple CMOS tester suitable for the hobbyist. In last month's issue we described a sophisticated tester for both CMOS and TTL. That particular instrument is very versatile but may be too expensive for many budding experimenters and we have therefore designed this simpler instrument to cater for their needs.

A simple CMOS tester, although being inexpensive, must be capable of performing the majority of tests required for CMOS logic without causing any damage to the ICs under test or being damaged itself. It must also use only those components which are readily available to the average home constructor. The ETI 123 Tester fulfills all these requirements.

The tester circuitry draws very little current except for that drawn by the LEDs. Even the LEDs only draw current whilst a device is actually under test. For this reason we thought that the expense of a mains power supply was unwarranted and chose to use batteries instead. For those who would rather operate the unit from a mains derived supply, one capable of supplying anywhere between 5 and 12 volts at up to 40 milliamps will be suitable. Another major expense, that of providing a large number of programming switches to set up the test conditions, has been alleviated by using flying leads fitted with alligator clips to connect to the IC under test.

Several steps have been taken to prevent damage to the IC by the tester and conversely, damage to the tester by the IC. Firstly each pin of the test socket is fitted with a static discharge resistor to earth. A current limiting resistor, R 37, is in series with the supply so that the tester is protected against damage due to possible excessive current into an internal short in the test IC. This limiting resistor also ensures that current through the input-protection diodes on the IC does not exceed the specified limit of 10 mA.

Only readily available components are used in the tester and, in fact the ICs used are available from at least four different manufacturers.

To test simple gate functions, eg NAND gates, NOR gates, we need at least four switches and a logic level detector but for the more complex functions, eg multipliers, we need at least six switches and six level detectors. A clock – pulse generator is required for the testing of flip flop and other clocked devices. This pulse generator must be free of the contact bounce that is typically encountered with mechanical switches. For this reason we used a pair of CMOS NAND gates wired as an astable multivibrator to generate a continuous train of pulses. This may be used to increment counters and to shift data in shift registers. As it is a CMOS circuit it is perfectly suited to driving other CMOS devices.

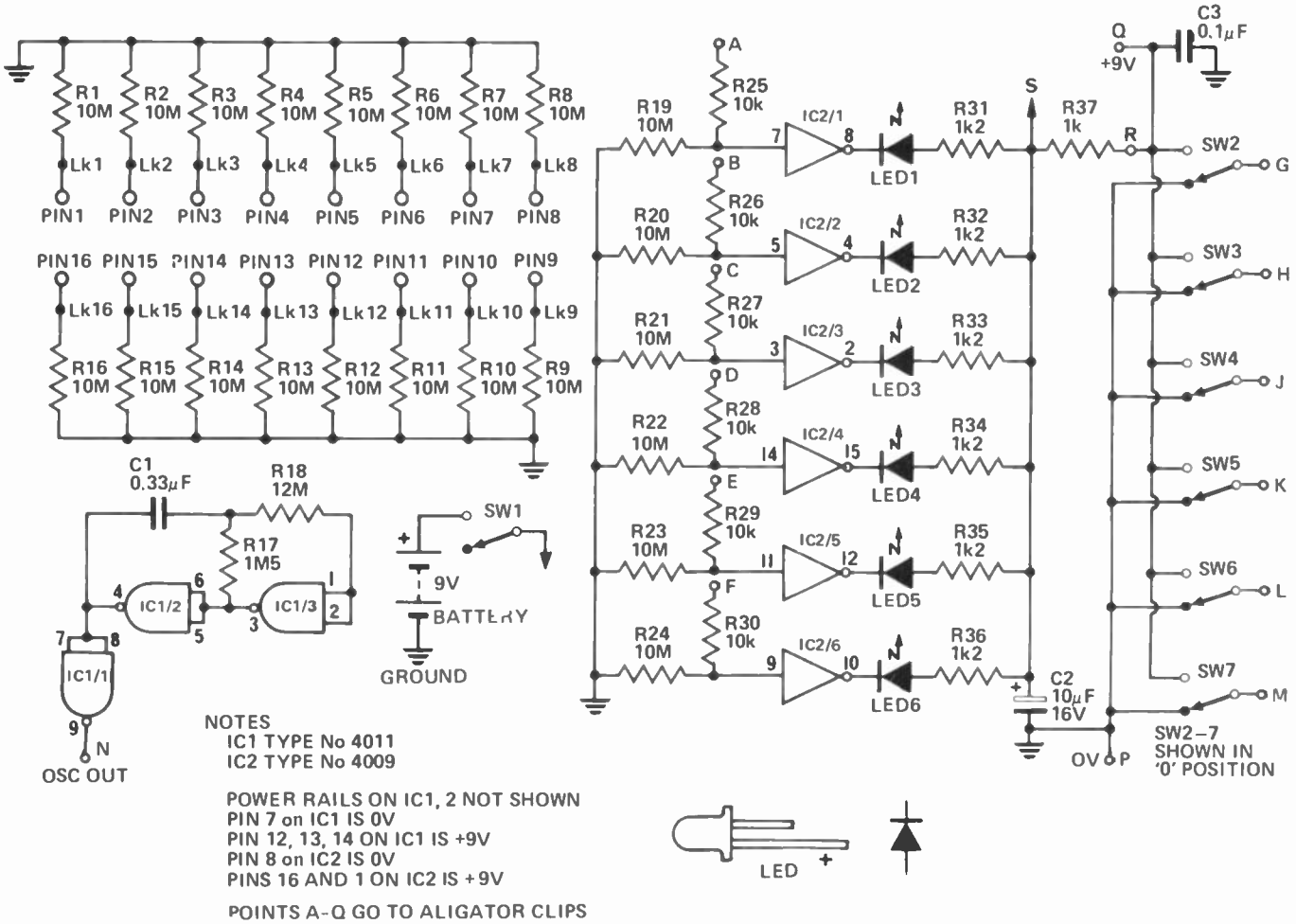
CONSTRUCTION

We recommend that the printed-circuit boards as specified be used as construction is thereby greatly simplified. The printed-circuit boards should be assembled as detailed in the component overlay diagrams. Switches SW1 to SW7 should be mounted by first glueing two strips of printed-circuit board to the front panel (copper side out). The switches may then be soldered to the copper side of the board. This procedure avoids the necessity of having 14 screw heads visible on the front panel.

The test socket is mounted on the non-copper side of board 123b. This board also carries links Lk1 to Lk16 which connect directly to the pins of the test socket. These links are also mounted on the non-copper side of the board and should be of reasonably heavy gauge tinned-copper wire, and should be installed such that sufficient room is under the link to enable test leads to be attached to them by means of alligator clips or Eazy hooks. Resistors R1 to R16 are mounted on the *copper* side of this board so that they are not visible when the board is bolted to the front panel. The top two screws, nearest to the LEDs, should be 18 to 25 mm long so that board 123a may also be mounted on them later.

On board 123a, mount and solder in position on the component side of the

SIMPLE CMOS TESTER



NOTES
IC1 TYPE No 4011
IC2 TYPE No 4009

POWER RAILS ON IC1, 2 NOT SHOWN
PIN 7 on IC1 IS 0V
PIN 12, 13, 14 ON IC1 IS +9V
PIN 8 on IC2 IS 0V
PINS 16 AND 1 ON IC2 IS +9V

POINTS A-Q GO TO ALIGATOR CLIPS

POINT Q IS +9V FOR IC UNDERTEST
POINT P IS 0V FOR IC UNDERTEST

Fig. 1. Circuit diagram of the CMOS tester.

HOW IT WORKS — ETI 123

The ETI 123 CMOS tester can be described in three separate sections. Firstly there is the test socket for the device under test. The test socket is mounted on a printed circuit board which also holds a 10 megohm static-discharge resistor to protect each pin of the IC. Each IC pin is also connected to a surface mounted link by which connections can be made to the IC.

The next major section of the tester contains detectors which monitor the voltage at each pin of the IC. Each detector consists of a CMOS inverter which derives an LED indicator. When the voltage at the input of the inverter is greater than half the supply voltage the LED will be alight. Conversely the LED will be off when the voltage at the input to the inverter is below half supply voltage. Resistors R19 to R30 protect IC2 against static charges and from the condition where a detector has no input. Resistors R31 to R36 set the operating currents for the LEDS.

The final section contains switches SW2 to SW7 and a clock oscillator. The output of the switches can be either 0 volts or +9 volts that is, a logic '0' or a logic '1'. These outputs are made available at test leads which may be connected to the IC under test as required. To protect the tester against internal shorts on the IC under test, and incorrect connections, R37 has been inserted in series with the supply rail to limit the current that may be drawn to a level which cannot cause any damage.

IC 1/2 and IC 2/3 are wired as an astable multivibrator where the frequency of oscillation is determined by the time constant of C1 and R17, whilst R18 is used to protect the input of IC 1/3 from any voltage excursions past the supply rails. IC 1/1 is used as an inverting buffer and the output of the circuit is made available at the front panel by means of a lead and alligator clip.

PARTS LIST — ETI 123

R37	Resistor	1k	¼ Watt	5%
R31-36	"	1.2k	"	"
R25-30	"	10k	"	"
R17	"	1.5M	"	"
R1-16	"	10M	"	"
R19-24	"	10M	"	"
R18	"	12M	"	"

C3 Capacitor 0.1µF polyester
C1 " 0.33µF "
C2 " 10µF 16 electrolytic
IC1 Integrated Circuit 4011 (CMOS)
IC2 " " 4009 (CMOS)
LED 1-6 Light Emitting Diode RL 4484 or similar
SW1-7 Miniature slider switch 2 pole 2 position.
IC Socket 16 pin DIL (preferably with IC removing slide)
Case 160 x 90 x 50 mm plastic box with aluminium front panel UBI
Alligator clips (15)
Battery 9 volts (6 size AA cells)

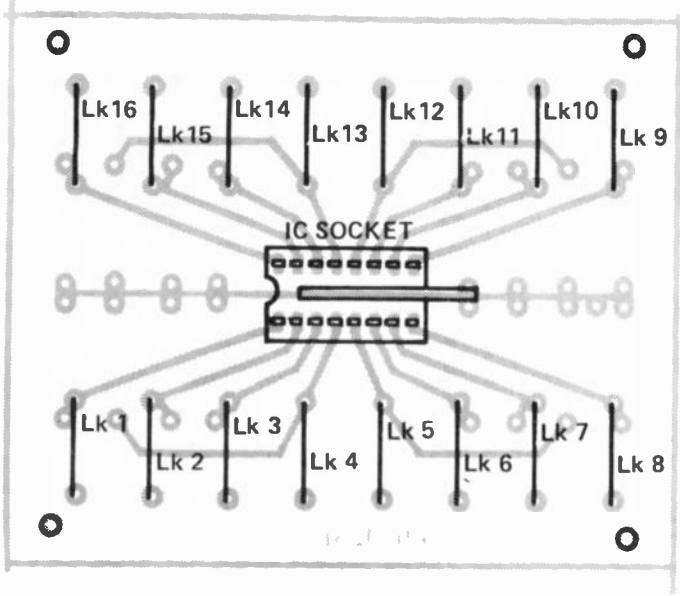


Fig. 2. Component overlay for the test-socket board ETI-123b, non-copper side.

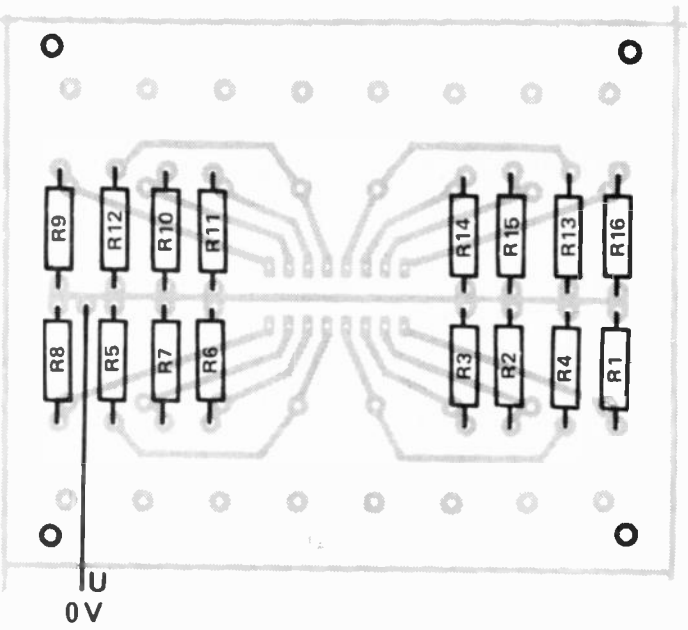


Fig. 3. Component overlay for the copper side of board ETI-123b.

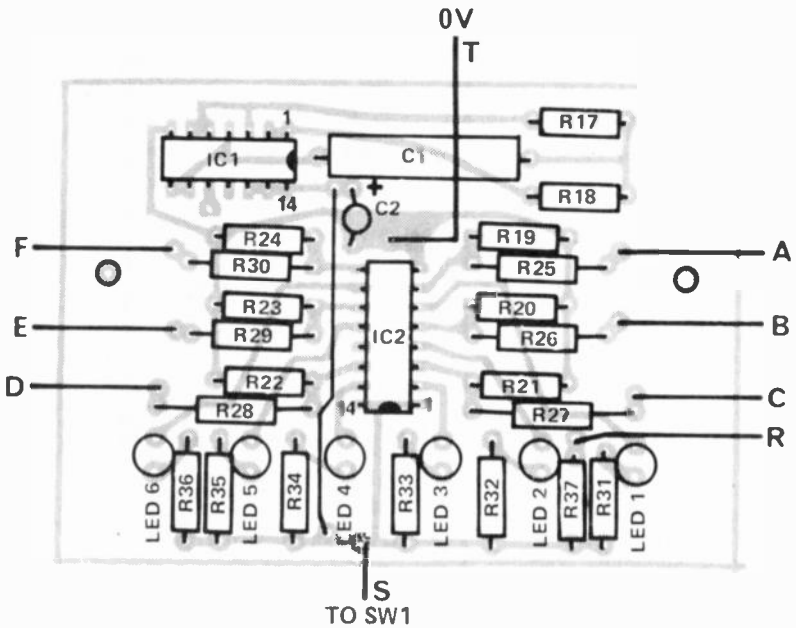


Fig. 4. Component overlay for board ETI-123a. Note that C1 may need to be mounted on reverse side, and that the LEDs should be mounted as detailed in the text.

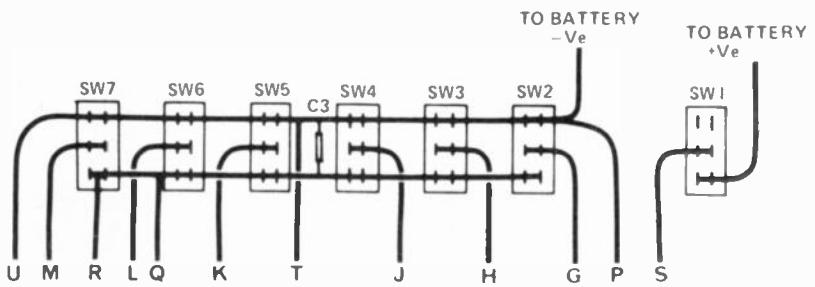


Fig. 5. Switch interconnection diagram. Note that C3 is mounted across one of the switches.

board, all components with the exception of the LEDs and capacitor C1. As C1 needs to be a polyester type it may be physically too big to be mounted on the component side without fouling the front panel and should therefore be mounted on the copper side. The LEDs should be inserted in their positions but not yet soldered. Temporarily mount the board in position such that the LEDs protrude through their correct holes in the front panel. Keeping the front panel face down, solder the LEDs into the board. Remove the board and solder 150 mm lengths of hookup wire to the points marked A to F on the overlay and pass these leads through the corresponding holes in the front panel. Do the same for the leads G, H, J, K L M P and Q from switches SW2 to SW7 using a different coloured wire to that used previously. These wires should also be passed through the appropriate holes in the front panel.

Finally solder alligator clips or Eazy hooks to the ends of all these leads and connect supply and earth leads to the 123b board. Check both boards for wiring errors or errors in component insertion before bolting board 123a in position. The battery may then be connected and the unit is ready for use.

Note that if the type UB1 box is used as in our protype the top corners of the 123a board may have to have the corners trimmed off at 45 degrees so that the board will fit in the box

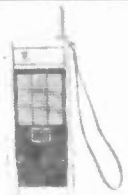
HAM RADIO SUPPLIES

MAIL ORDER SPECIALISTS

323 Elizabeth Street, Melbourne (2 doors from Little Lonsdale Street) 67-4286 67-7329
new Richmond branch now at 390 Bridge Rd., Richmond Phone 42-8136

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

- **WITH CALL SYSTEM**
- **EXTERNAL AERIAL CONNECTION**



SPECIFICATIONS, NC-310

Transistors: 13
Channel Number: 3, 27.24 OMHz Citz. Band
Transmitter Frequency Tolerance: ±0.005%
RF Input Power: 1 Watt
Tone Call Frequency: 2000 Hz
Receiver type: Superheterodyne
Receiver Sensitivity: 0.7μV at 10 dB S/N
Selectivity: 45 dB at ±10 kHz
IF Frequency: 455 kHz
Audio Output: 500 mW to External Speaker Jack
Power Supply: 8 UM-3 (penlite battery)
Current Drain: Transmitter: 120-220mA
Receiver: 20-130mA.

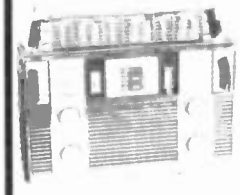
$49.00 each or $95 a pair.
Post & pack $1.50 per unit.

---

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

SPECIFICATIONS: Transmitter — Crystal Controlled: 1 Watt input power to RF stage. Operating frequency — Any 2 channels in the 11-meter Citizens Band. Receiver — Crystal-controlled superheterodyne circuit with 455 Kc IF. Antenna — Built-in 60" telescopic whip antenna. Audio Output — 0.8 Watt maximum. Power supply required — 12 volts DC (Eight 1.5 volt DC battery cells). Loudspeaker — 2¼" PM type (built-in) function as microphone on transmit.

$39.00 each or $75 a pair.
Post & pack $1.50 each unit.



BARLOW-WADLEY XCR-30

a truly portable communications receiver, based on the WADLEY LOOP principle, the same principle as applied in the DELTAHET and RACAL receivers. A truly crystal-controlled highly sensitive multiple-heterodyne portable receiver of exceptional stability with continuous, uninterrupted coverage from 500 kHz to 31MHz.
BARLOW-WADLEY XCR-30 features include: Selectable USB/LSB, CW & AM reception, frequency read-out 10kHz throughout the entire range, calibration accuracy within 5kHz, antenna resonator, tuning signal-strength meter, zero-set control, clarifier-vernier tuning, MHz & kHz tuning controls, telescopic antenna. Power source: 6 type D dry cells: provision for external DC power supply. Weight 9 lbs; size 11½ x 7½ x 4in.

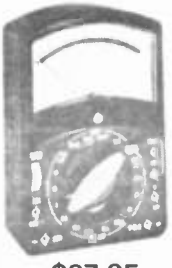
All for **$275** F.O.R.

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

NEW REDUCED PRICE THIS MONTH ONLY

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

$6.95 Post Free.



MODEL C-7077/P MULTIMETER. **Specifications:** 100,000 ohms/volt DC; 10,000 ohms/volt AC; DC volts — 5,5; 25; 50; 250; 500; 1,000. AC volts — 10; 50; 250; 500; 1,000. DC amps — 10μA; 2-5 mA; 25 mA; 500 mA. Ohms — 10 kΩ; 1 MΩ; 10 MΩ; 100 MΩ. Centre scale — 150Ω; 15 KΩ; 150 KΩ; 1-5 MΩ. Decibel — —20 to +22 dB. Dimensions — 151 x 102 x 48 mm Diode protected movement. Carrying case available Model C.

$27.95 P&P $1.50.

MODEL OL64 D/P MULTIMETER. Very ruggedly constructed this model is particularly suitable for workshops. It features special scales for measurement of capacitance and Inductance. Diode protested movement: **Specifications:** 20,000 Ohm/Volt DC. 8,000 Ohm/Volt AC. DC volts — 0.25; 1; 2.5V; 10; 50; 250; 1,000; 5.000. AC volts — 10; 50; 250; 1,000. DC amps: 50μA; 1 mA; 50 mA; 500 mA; 10 A. Ohms — 4 KΩ; 400 KΩ; 4 MΩ; 40 MΩ. Centre scale — 40Ω; 4,000Ω; 40,000Ω; 400,000Ω. Decibel: —20 to +62 dB, Dimensions: 6" x 4-1/5" x 2"; 152 x 107 x 51 mm. Capacitance: 250 pF to 0.02 uF. Inductance — 0/5000H Carrying case available Model C.

$22.50 P&P $1.50.

MODEL AS100 D/P MULTIMETER. This meter features double zener diode meter protection and 3½" full view easy to read 2 colour scale. It is fitted with polarity reversing switch and housed in a strong moulded case with carrying handle. **Specifications:** 100,000 ohm/volt DC. 10,000 ohm/volt AC. DC volts — 0.3; 12; 60; 120; 300; 600; 1,200. AC volts — 6; 30; 120; 300; 600; 1,200V. DC amps — 2 KΩ; 200 KΩ; 20 MΩ; 200 MΩ. Centre scale — 20Ω; 2,000Ω; 20,000Ω; 200,000Ω; 20 MΩ Decibel — —20 to +57 dB. Dimensions — 7-3/5" x 5-2/5" x 2-3/5" 193 x 137 x 66 mm. Carrying case available model I.

$37.50 P&P $1.50.

SCOOP PURCHASE

200-H, p.p. 75c. 90 quadrant meter. Pocket size. AC V: 10V, 50V, 100V, 500V, 1000V (10,000 ohm/V). DC/V: 5V, 25V, 50V, 250V, 500V, 2500V (20,000 ohms/V). DCA/A: 50uA, 2.5 mA, 250 mA. OHM: 60k ohm, 6M ohm. Capacitance: 100pF to 0.1 uF, .001uF to .1uF. dB: —20 dB to +22 dB. Audio Output: 10V, 50V, 120V, 1000V AC. Approx. size: 4½" x 3¼" x 1-1/8"

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

THIS MONTHS SPECIAL

SOLID STATE
19 TRANSISTOR MULTI-BAND RADIO — 9 RANGES

AM, SW, FM, VHF, AIR, PB
BATTERY/OPERATED
COLOUR CODED 9 BAND DIAL

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

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

CHRISTMAS SPECIAL

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

$24.95 P&P $2.00.
Manual tuning model
$15.50 Post & Pack $2.00.

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

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

NEW PRICE $49.50
P&P $2.50

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

SIMPLE CMOS TESTER

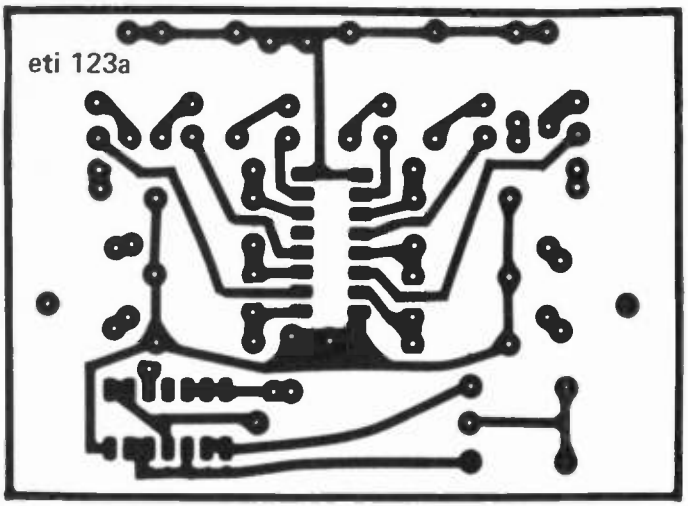


Fig. 6. Printed-circuit board layout – ETI 123a. Full size 88 x 63 mm.

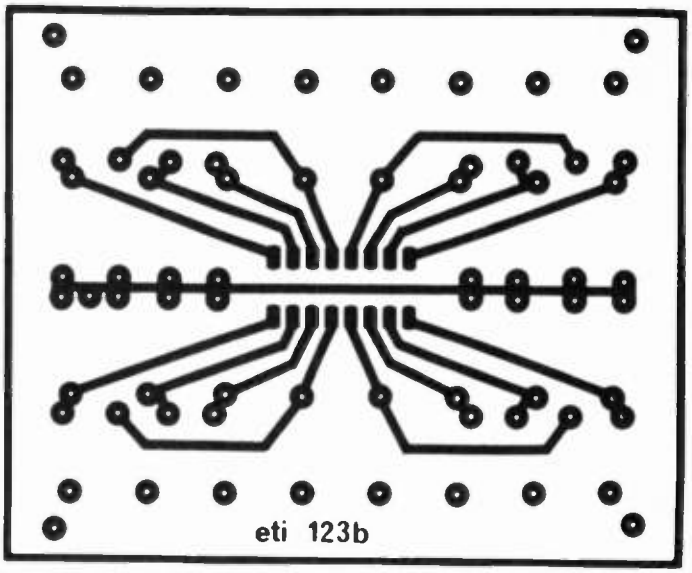


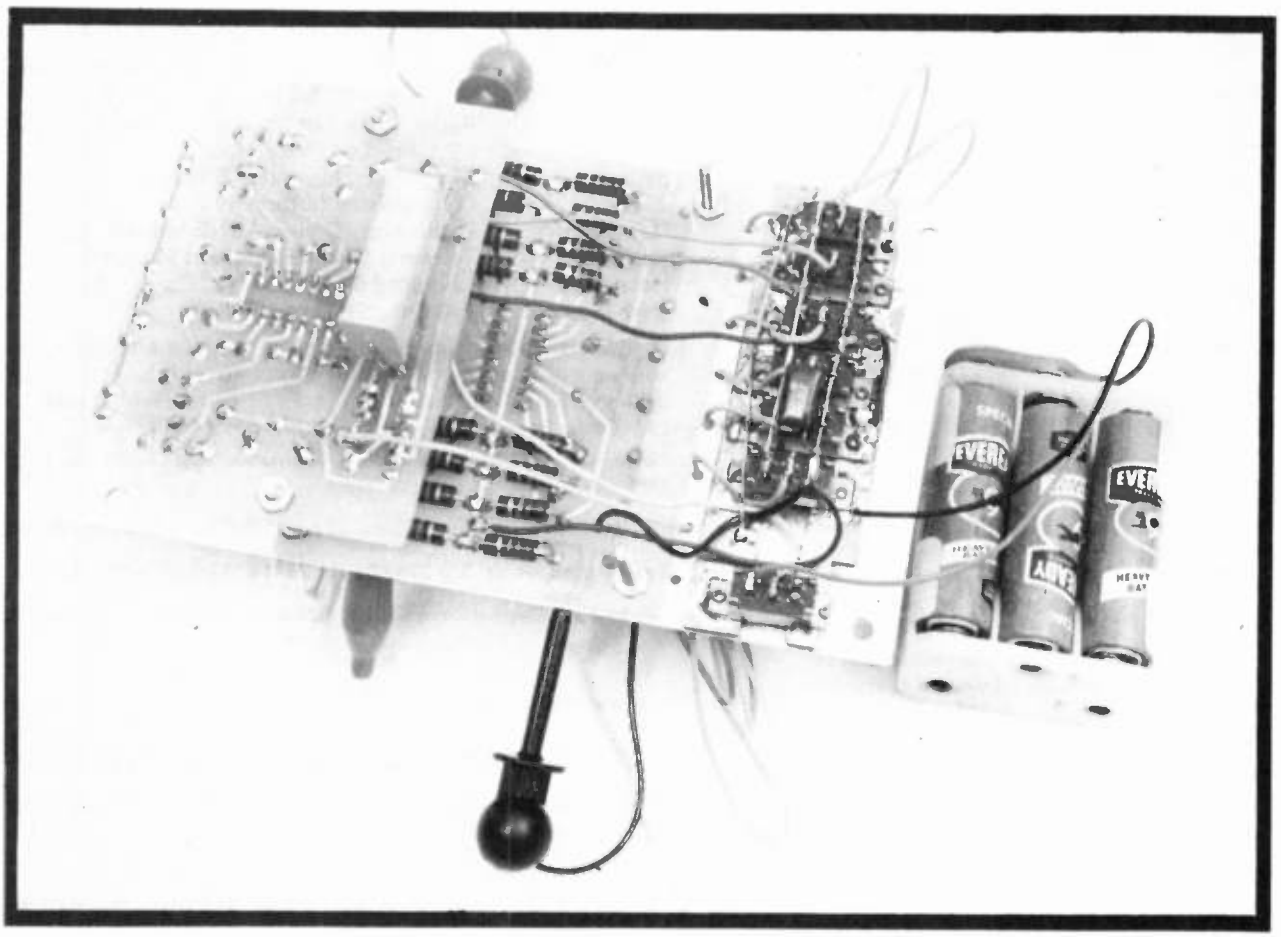
Fig. 7. Printed-circuit board layout – ETI 123b. Full size 88 x 71 mm.

without fouling the mounting pillars for the front panel.

OPERATION

Before testing or inserting any IC make sure that the power is switched off. Set up the operating conditions for the IC to be tested either by consulting the manufacturers data or by duplicating the conditions under which the IC will be used in the circuit.

Next insert the IC to be tested into the test socket and connect the power supply leads to the links for appropriate pins of the IC. Double check these connections to make absolutely sure that these connections are correct. Reversed power connections will destroy the IC. Switch on the tester and use the input switches to systematically apply all the possible input conditions to the IC whilst noting that the output conditions of the IC are as they are supposed to be. ●

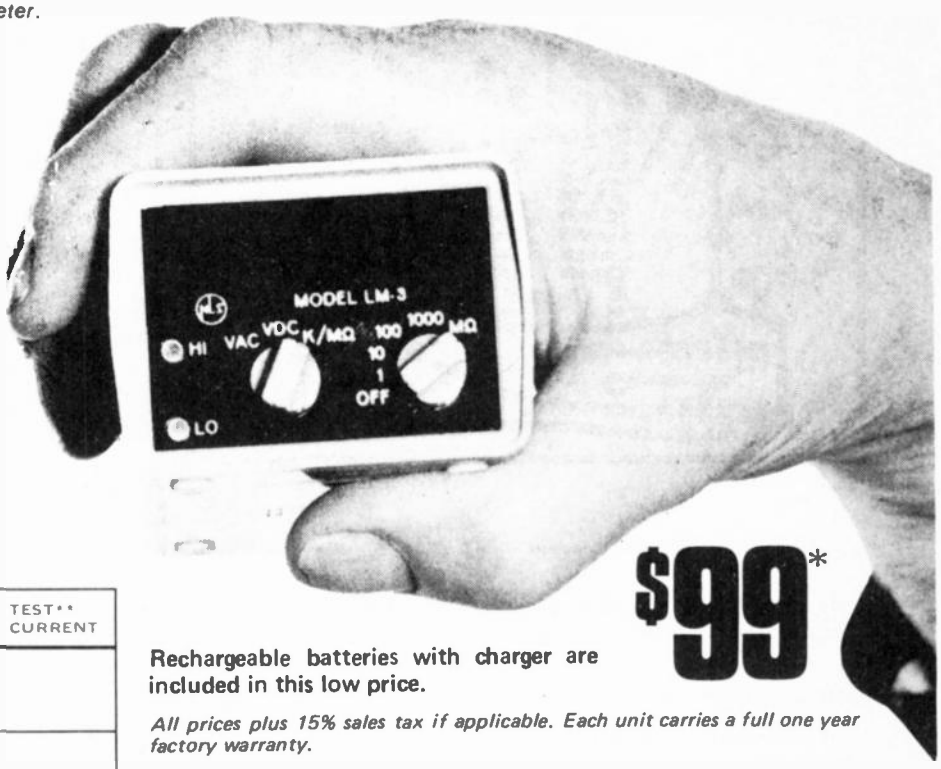


Internal view of the tester. Note how the top board is mounted (see text).

Non-Linear Systems, Inc. LM-3 DIGITAL VOLTSMETER

Originator of the digital voltmeter.

Full three digits.
Less than 2" high.
Automatic zeroing.
Automatic polarity.
Battery powered.
MOS/LSI construction.
Low, low price.
Drop-proof.



$99*

Rechargeable batteries with charger are included in this low price.

All prices plus 15% sales tax if applicable. Each unit carries a full one year factory warranty.

SPECIFICATIONS

ACCURACY (LM-3)	RESOLUTION (LM-3)	INPUT RESISTANCE	TEST** CURRENT
± (0.1% F.S. + 1% Rdg.)	1 mV 10 mV 100 mV 1 V	10 MΩ	
±(0.3% F.S. + .8% Rdg.) 50/400 Hz ± (0.3% F.S. + 10% Rdg.) 400/5000 Hz	1 mV 10 mV 100 mV 1 V	10 MΩ, 20 pF	
± (0.1% F.S. + 1% Rdg.)	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ		1 mA 100 μA 10 μA 1 μA 100 nA

* 1000 VDC or peak AC maximum any range.
** 5 VDC maximum test voltage in k/MΩ mode.

Range Selection:	Manual
Polarity Selection:	Automatic
Decimal:	Positioned by range switch
Zero Stability:	Automatic Zero
Overload Indication:	1000, with the numeral "1" flashing, is displayed for all inputs exceeding full scale.
Operating Temperature Range:	0° to 45°C
Overload Protection in KΩ Mode	Up to 120 VDC or RMS AC may be applied (not to exceed 30 seconds).
Size:	1.9"H x 2.7"W x 4.0"D
Weight:	9.2 ounces (with batteries)
Power: Battery Operation:	3.6 V (nominal at approximately 200 mA, <1W (less than 3W when batteries are being charged).

OPTIONAL FEATURES

A High Voltage Probe — To 30 KV (1000:1 Reduction) $26.00
B Leather Carrying Case — Belt and Neck Strap $11.00
C Carrying Handle/Tilt Stand $2.40
D Current Shunts — 100μA, 1mA, 10mA, 100mA & 1A range . $4.10 ea.

The LM-3 is now available throughout Australia at the following local distributors, radio shops, hobbies & electrical stores:

Melbourne:	Radio Parts (all stores), Lawrence & Hanson, I.E.I. Pty Ltd.
Sydney:	Dick Smith, Lawrence & Hanson.
Adelaide:	Compar Distributors Pty Ltd.
Newcastle:	Digitronics, Division of Edmonds, Moir & Co.
Geelong:	Teleparts (also new store at Morwell).
Hobart:	Lawrence & Hanson.
New Zealand:	Pye Ltd., Systems Division.

If there is not yet an LM-3 stockist in your city you can send your cheque or money order direct to N.L.S. for immediate delivery. (In which case if you are not completely satisfied your LM-3 may be returned within 10 days for a full refund.)

Please include 15% Sales Tax if applicable. Plus $2.00 for freight & handling.

Send me ..... LM-3's @ $99.00 each

Options as above .. A @ $26.00 ..... B @ $11.00 ..... C @ $2.40 .....

D @ $4.10 ea Current Shunts ..... 100μa ..... 1ma ..... 10ma .....

100ma ..... 1 amp

Enclosed Cheque/Money Order for ..... Payable to

Non-Linear Systems (Australia)

P.O. Box 122, Glen Waverley, Victoria 3150. Australia
Telephone: (03) 232-4506/232-7535

Non Linear Systems 23 Years of Progress

The Amazing NLS Story

Non-Linear Systems has designed, built and delivered digital instruments to well over 10,000 different customers in over 50 countries since developing the first digital voltmeter in 1952. As the originator of the voltmeter, Non-Linear Systems quickly became a company of startling success and rapid growth. Noted for originality both in products and the manner of conducting business, the company for years has supplied quality, high performance instruments and systems to all types of industries and government agencies. Here in Australia for example the PMG Research Labs purchased a 4½ Digit DMM from NSL over 18 years ago. The unit is still functional today although it has now been "retired" to the Telecom electronics museum.

No company has more years of experience in digital instruments. The traditional innovators at NLS have been hard at work developing a new approach to supplant the old. This approach utilizes state-of-the-art electronic circuits, packaged so as to provide digital instruments that are the smallest, most reliable, most rugged and lowest cost possible. NSL instruments are not only "burned in" in a hot room, but are also tormented on a shake table before final check-out and calibration. Consequently, our returned equipment rate is the lowest in the industry. Our PM-4 has passed full EMI tests and is used in Aerospace CSE and airborne equipment.

Digital multimeters have been used by laboratores and aerospace industries for years, but it took the NLS LM-3 to reach the individual consumer. The LM-3 digital multimeter has been correctly labeled the "Volksmeter". It is a full three-digit multimeter, only 1.9" high by 2.7" wide by 4" deep, the size of two packs of cigarettes and weighs only 9 ounces. It fits easily into a tool case, or if you desire, there is an optional leather carrying case for the meter and its input leads which allows you to carry it on your belt or around your neck, leaving both hands free.

The LM-3 comes complete with rechargeable batteries and charger. The price, size and performance make it a new tool for field service people in all kinds of industries.

All of NLS' new instrument line uses the best; for example, printed circuit boards are all epoxy-glass, no phenolic and low voltage coefficient resistors are used.

LM4

An example of this value engineering is the LM-4 digital Multimeter. It is a full four-digit meter with 0.02% accuracy — comparable to expensive laboratory-type digital voltmeters. Yet it sells for only $180.00 plus tax. It is packaged in the same size case as the LM-3 and utilizes the finest quality components. It has all of the features of the LM-3 but being a 4-digit meter has higher accuracy and higher resolution by a factor of 10.

If your favourite local radio electronics store does not yet have the NLS line, contact NLS (Aust.) for the nearest location or place your order direct.

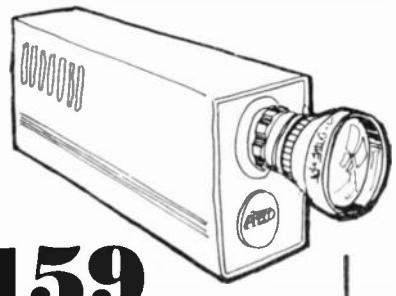
ELECTRONIC AGENCIES

BIG SAVINGS on CCTV...

115-117 Parramatta Rd. (Cnr Lloyd George Ave.,)
CONCORD NSW 2137
TELEPHONE (02) 747 6472

Trading Hours: 12:00 to 6:00 pm. Mon-Fri 8:30 to 1:00 pm Sat
NOTE: Add Postage rated 10% order value. C.O.D.'s send $2.00 prepayment.

APECO CAMERAS



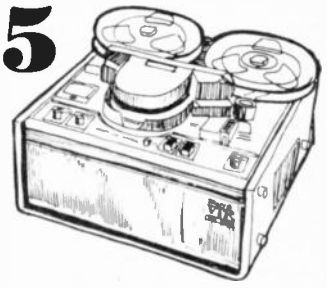
$159

Complete with high quality universal lens — no extras needed. Works with any ordinary TV set; automatically adjusts to suit different light conditions and uses standard interchangeable lenses. Ideal for experimenting, Professional or security use. Proven. Tested and guaranteed.

CC TV ACCESSORIES

7" 2400' x ½" Sony tapes.	$22.00
Signal booster/amplifier 240v.	$89.00
Mounting brackets, from	$12.50
Close up lens (macro).	$45.00
Wide-angle lens.	$49.00
Telephoto lens 70mm.	$93.50
Zoom lens 12.5-70mm.	$42.00

VIDEO TAPERECORDER $595



Sanyo VTR-2000. Records video and audio signals on ½" tape (1hr) — features auto level controls for easy operation. Record from home TV or camera, play back on home TV. Completely portable (29lbs).

CONCORD TV CAMERA

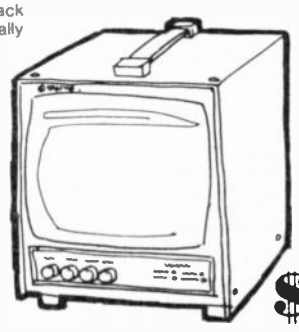
With in-built monitor/viewfinder. Lets you see what the camera sees — great when you have to follow a moving target as in sport, etc. Use as playback monitor with Video Tape Recorder etc. Normally $650.

$425

Garrard MINI-CHANGER

3 Speed 240v compact record changer. Plays all records, with ceramic cartridge. BRAND NEW AND FULLY GUARANTEED.

$21



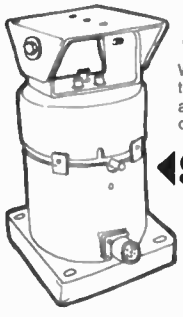
$219

AC-DC 9" MONITOR

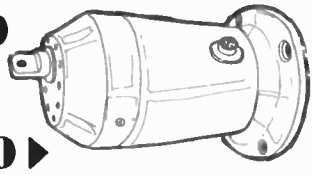
240v AC or 12v DC operation — may be connected directly to TV camera or VTR; simplified controls and light weight make for easy portable use.

AUTOMATIC SCANNERS

With remote controller. Easily adjustable from 45 deg. to 360 deg.; sweeps desired area and reverses automatically. Remote controller permits manual operation from a distance.



◀**$190**

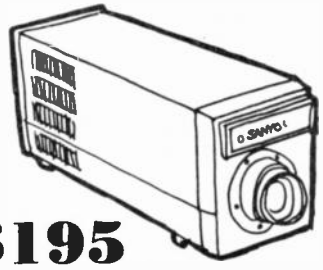


$140▶

PANEL METERS

Large 5" size — Best quality high accuracy meters with various scales For 100UA, 200UA, 500UA, 12MA.

$7.50



$195

SANYO has a complete line up of CCTV Cameras and VTR's. The model VC1120 (illustrated) provides for RF or VIDEO output and automatically adjusts to a wide range of light conditions. Uses std. interchangeable lens — 240v operation.

WE'VE GOT MORE SPEAKERS

(1) Woofer-Tweeter. Package Deal. 8" 3" 20W RMS 8 ohms, by MSP.

$14.50 ea.

(2) Plessey 12" 2 way package deal C12P/&X-20 30W RMS 8 ohms.

$24.95 ea.

(3) Imported 8" De-luxe 2 way. 8" 2" 25W RMS 8 ohms.

$16.50 ea.

(4) MSP 3 Way 8" Package Deal. 8" 5" 3" 20W RMS 8 ohms.

$18.50 ea.

(5) Plessey 12" 3 Way package deal. C12P KC5NR X-30. 30W RMS 8 ohms.

$34.90 ea.

(6) Imported 10" De-luxe 3 Way. 10" 4" 2" 30W RMS 8 ohms.

$25.50 ea.

(7) De-luxe Dome System 3 Way. Imported 8" dome mid/tweeter 20W

$33.00 ea.

(8) De-luxe Dome System 3 Way. Imported 12" plus dome mid, tweeter 30W.

$48.50

(9) Imported 12" 3 Way system. 12" 6" 3" (x2) 30W RMS 8 ohms.

$34.90

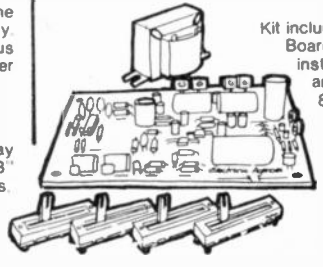
All kits include cross over components and wiring diagrams.

PA, CB or ham BASE STATION MICROPHONE KIT

50 ohms impedance (10K with transformer $6.50) and includes press-to-talk switch DPDT, spring return.

$13.50

STEREO 30 $30



Kit includes transformer, labelled and numbered P.C. Board, all Resistors and Capacitors, 4 pages instructions. Amazing offer for "hi-fi-ers" — Stereo amplifier kit, giving 15W RMS in 4 ohms, 10W RMS in 8 ohms (per channel) with 5 mV magnetic cartridge input VOLUME, BALANCE, BASS and TREBLE controls supplied — latest integrated circuit pre-amp and driver stages, complementary "flat-pack" output transistors — all on one P.C. Board for easy assembly. Hi-Fi performance with 20Hz to 50kHz response, low distortion and low hum level ensure compatibility and the best turntables and speakers. Complete Kit $30 plus post.

MAGNEPLANAR MG 2167 LOUDSPEAKERS

PRODUCT TEST

Would you believe a tweeter five and a half feet long!

WHEN THE BOX containing the Magneplanars was delivered, the first man carrying one end of the box came through the door and, after what seemed an eternity, his assistant followed with the other end. The box containing the two speakers was over five metres long, about 700 mm wide and about 200 mm deep! We were so intrigued that we all stopped work to examine them.

When opened, the carton revealed two objects that looked more like room dividers than loudspeakers.

The speakers are basically wooden frames with dimensions of 1730 x 570 x 45 mm (excluding the stands) with an attractive fawn coloured decorative cloth at the front and rear, between which are placed two perforated panels covering the "dynamic" elements.

These elements consist of three separate sections of Mylar diaphragm across the back of which is glued a continuous zig-zag of wire fixed on the angle.

A series of polarised plastic magnets are placed on the internally perforated frame. These provide the dynamic portion of the system (described as the planar magnet field). The magnets are similar to the plastic magnets in refrigerator doors.

The manufacturer's descriptive literature is meagre, but does nevertheless make some interesting claims, these include:

- Purely resistive impedance for ideal amplifier loading.
- Puts out some sound front and back (bi-polar radiator).
- No cavity or cabinet wall resonance to colour sound.
- Superior transient response throughout entire audio range due to low mass of diaphragm.
- Distortion level far below other loudspeakers because of complete control of diaphragm.

Recommended retail price approx $700.

Agent: **International Dynamics (Agencies) Pty Ltd.**
23 Elma Rd,
North Cheltenham, Vic. 3192.
Tel: 95-1280.

- Can be placed to look more like part of furnishings than a loudspeaker.
- Fifty six in. long, 1½ in. wide tweeter section provides horizontal sound dispersion previously unattainable.
- Fantastic power handling capability.
- Large radiating area provides width and height and depth of sound only equalled by live performances.
- The bi-polar radiation of Magneplanars provides a means of optimizing stereophonic and quadraphonic sound imaging.

Although one or two of these claims seem to us to be of questionable relevance, most can certainly be substantiated. Certainly the concept of a dynamic speaker with an effective width of about 4 mm, and a total radiating area of close to one square metre, is a technical breakthrough if ever there was one.

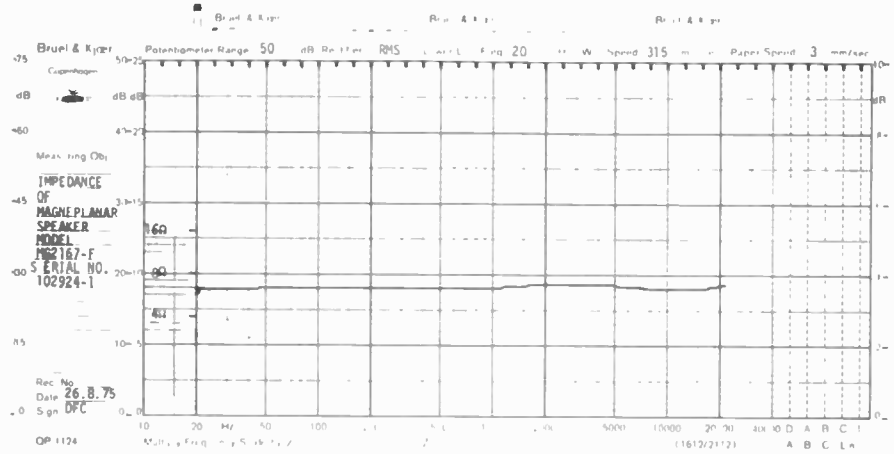
The units are so thin in cross-sections that it's hard to believe they are not electrostatically operated. In fact we were convinced for a whole day that they were giant 'electrets', and it was not until we ran an impedance curve that the matter was settled once and for all. The curve is reproduced in this review — it's the smoothest impedance curve we have ever seen, it's not only a specification writer's delight, but possibly a joy to every amplifier as well . . . but not quite, as we will see.

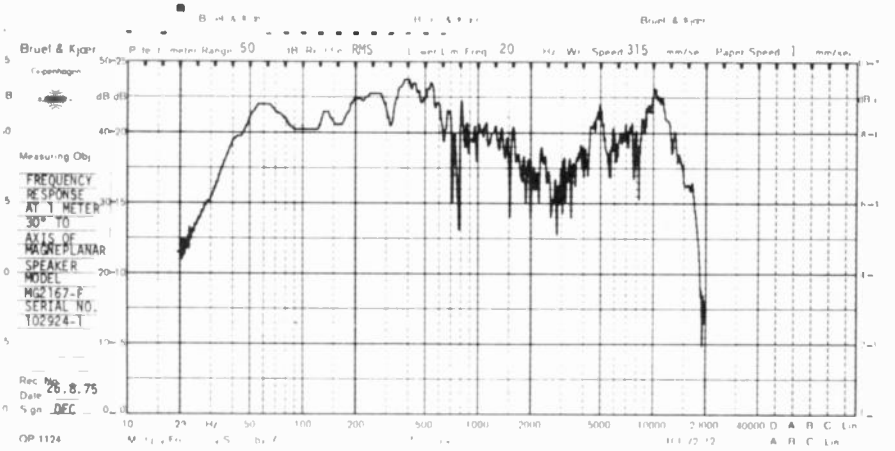
Magneplanar's agents told us that "these speakers like a big amplifier". amplifier".

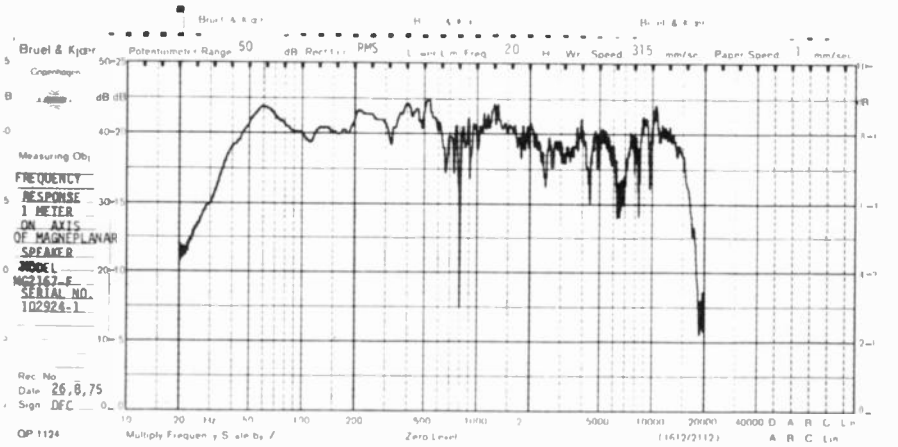
This turned out to be valuable advice. The Magneplanars do need about 200 watts per channel to bring out their best. With a lesser capability, one quickly gets into the amplifier's clipping region and severe distortion consequently ensues. The minimum amplifier power that should be used is around 70 watts per channel. The upper power limit is also the optimum for good performance, i.e. 200 watts/channel.

We mounted the speakers on their stands (correctly positioned out from the wall to provide optimum sound reinforcement) subjectively to evaluate their appearance and performance. The stands tilt the speaker panels back at about five degrees to the vertical — aesthetically more pleasing than having them stand absolutely vertically.

Immediately noticeable was that







their response was clean and their directionality and high frequency performance better than we had expected, although we soon found that we had to switch from our 70 watt amplifier to a 150 watt amplifier because of the Magneplanar's low efficiency (14 watts for 90 dB at two metres).

MEASURED PERFORMANCE

The on-axis frequency response was exceptionally smooth up to 700 Hz and, whilst still good to 15 kHz, interactions between separate elements of the high frequency array were apparent. The response at 30° to the main axis was also good to at least 15 kHz showing only a moderate drop of 2-6 dB between 2 kHz and 5 kHz. The deep notch at 800 Hz was a cancellation null from the low frequency elements, not apparently from a cross-over network.

Overall though, frequency response was particularly flat from 50 Hz to 15 kHz and would be hard to better.

The Magneplanars have separate sections for combined bass-mid range and a separate tweeter section, with simple L.C. cross-overs operating at 2.5 kHz, mounted near the bottom of the speakers. The tweeters just have to be the world's largest. They're over 5½ feet long!

We would have liked to have examined the cross-over networks more closely. They seem remarkably small for the power handling involved. Unfortunately we could find no way

AUDIO PROJECTS

Volume 1

-FROM ELECTRONICS TODAY INTERNATIONAL

AMPLIFIERS

SPEAKER SYSTEMS

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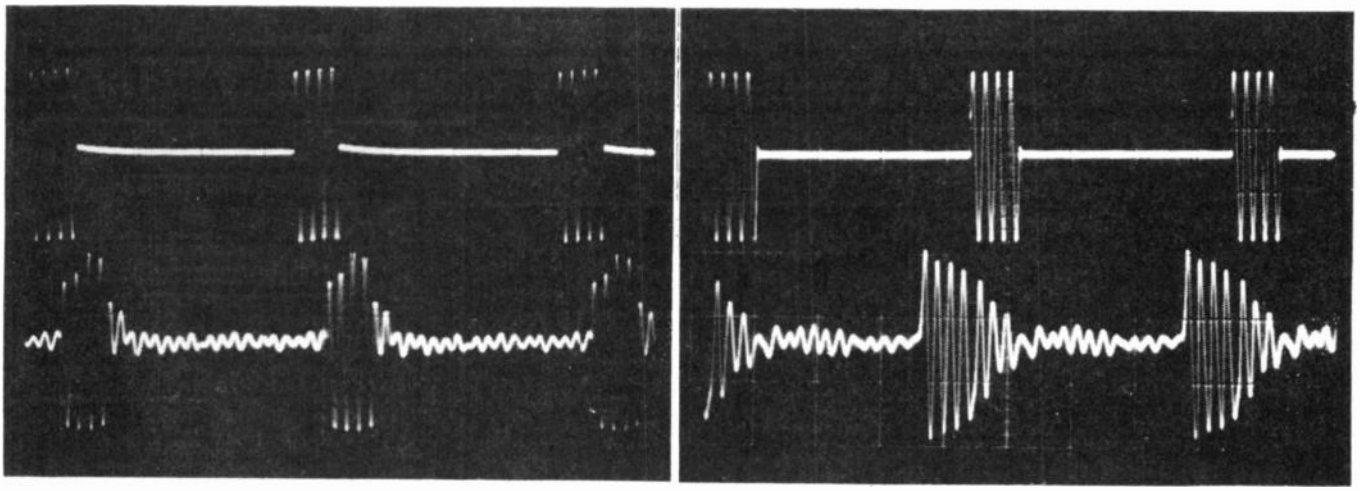
MAGNEPLANER MG 2167 LOUDSPEAKERS



Tone burst testing. LEFT: 1 kHz at 96 dB – 1 metre. RIGHT 6.3 kHz

of obtaining access without destroying the speakers.

Distortion tests showed that at our standard listening level of 96 dB, the level of distortion was acceptable but a little higher than we would have expected. The distortion level of 2 per cent at 100 Hz can be detected – that of 1 per cent at 6.3 kHz is detectable by some musically trained people.

Our tone burst generator showed that the transient response of the Magneplanars is good below about 3 kHz (see 1 kHz response which is relatively clear), but no better than most other good speakers at 6.3 kHz. The tone burst response is a good indication of transient performance, frequency coloration and, more particularly, of the purity of reproduction of the speakers. Magneplanar claim "superior transient response throughout the entire audio range". Whilst the transient performance is *good* for much of the frequency range, the claim "entire" cannot be really substantiated.

SUBJECTIVE IMPRESSIONS

Magneplanar speakers are BIG – in a smallish house, you would have to use them as room dividers to fit them in. In addition, it is essential that they be placed away from the wall if adequate performance is to be obtained.

Subjectively, the Magneplanars are most rewarding. We played a lot of music through and, for most of it the results were quite pleasing. Organ music and deep rock do not reproduce well in the frequency region below 50 Hz but this is not really surprising.

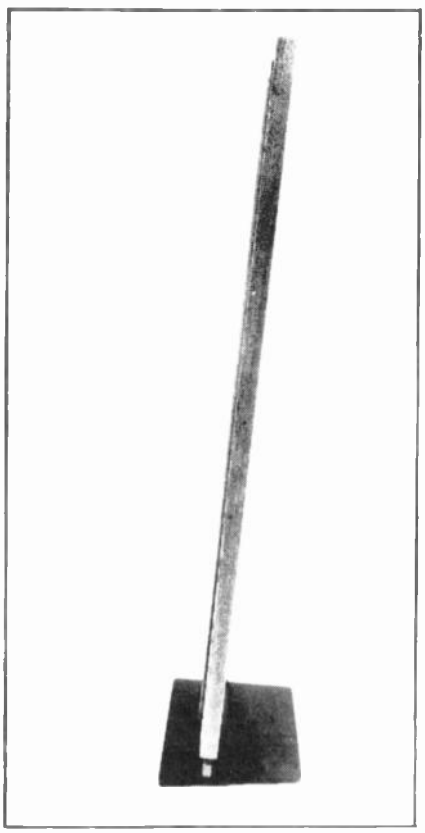
Frequency doubling can occur below 100 Hz if an under-powered amplifier is used – or if the speakers are used at too *high* a power level. But apart from these problems, and some slight coloration on human voice, the Magneplanars provided a smooth and relatively clean reproduction which the average listener will almost certainly enjoy.

We played a repertoire of test records and found that, with the exception of some guitar pieces, organ works and tympani, performance was good.

It's difficult to summorize this review. The Magneplanars are certainly *different* – to the extent that they become a conversation piece as well as musical reproducers. They sound good too!

MEASURED PERFORMANCE OF MAGNEPLANER LOUDSPEAKER MODEL MG2167-F SERIAL NUMBER 102924-1

Frequency Response:	30 Hz to 15 kHz ± 5 dB
Total Harmonic Distortion for 90 dB at two metres on axis:	100 Hz – 2.1 per cent; 1 kHz – 0.8 per cent; 6.3 kHz – 10 per cent
Music Power Rating:	Greater than 160 watts.
Sensitivity (for 90 dB at two metres on axis):	14 watts
Measured Impedance:	100 Hz – 6.0 ohms; 1 kHz – 6.0 ohms; 6.3 kHz – 6.1 ohms.
Dimensions :	1730 x 570 x 45 mm (excluding stand).
Weight:	18.5 kg each.



Magneplaner side on – it really is less than two inches (45 mm) thick!

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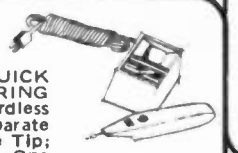

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BC 177	28c	23c
BC 178	28c	23c
BC 179	28c	23c
BC 547	25c	20c
BC 548	25c	20c
BC 557	25c	20c
BC 635	50c	45c
BC 636	50c	45c
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2N 3055	90c	80c
2N 3638	45c	40c
2N3638A	55c	45c
DIODES		
EM 401	10c	8c
EM 402	10c	8c
EM 404	10c	8c
EM 406	15c	13c
EM 408	16c	14c
EM 401	17c	15c
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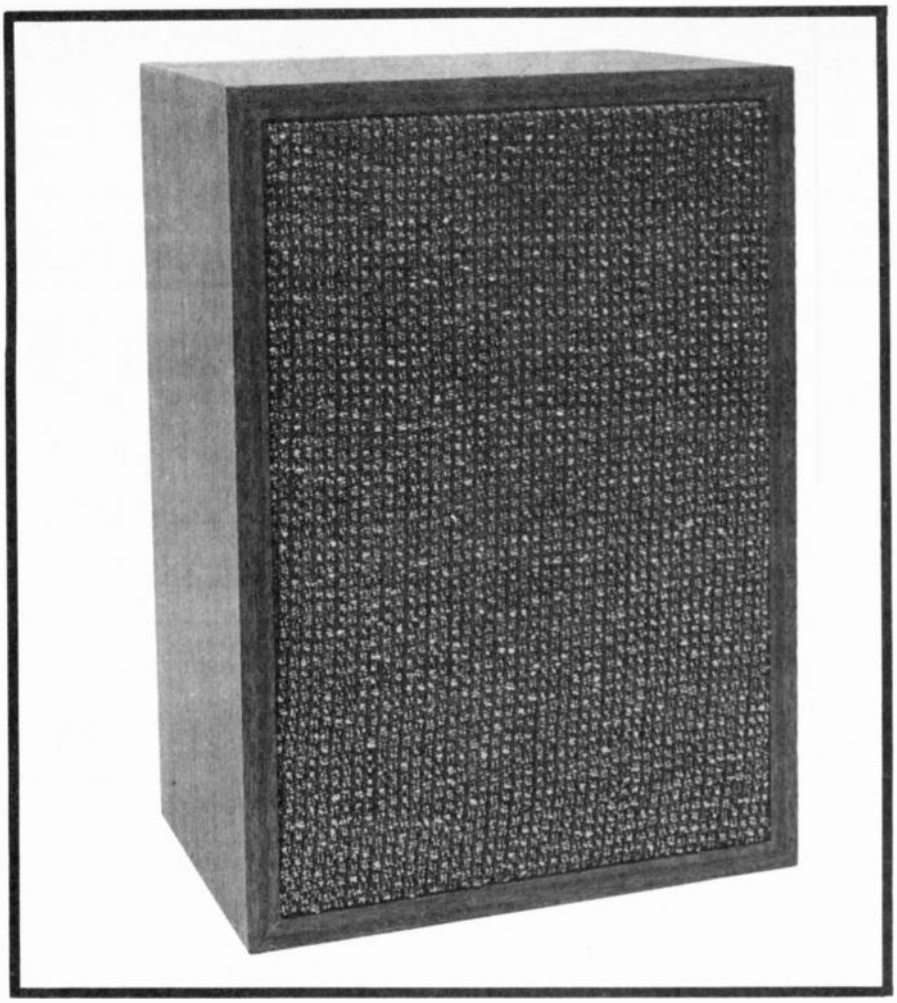


PROJECT 437

SIMPLE SPEAKER

An inexpensive unit with big sound.

EVEN if funds are very limited it is still possible for the beginner to build himself a pair of speakers that have a reasonable sound as well as good appearance.

The enclosures described are suitable for use with 150 or 175 mm speakers of the wide range type We used the Philips AD 7061/W8, which is quite inexpensive, but almost any other wide-range speaker having similar dimensions will do.

Most small speakers, such as this, have a response that falls off at both the treble and bass ends of the range. The response may be improved considerably by adding a compensating network which attenuates the mid-range somewhat. Although such a network reduces the sensitivity of the speakers the quality of the sound is greatly improved. Loss of sensitivity means that the maximum sound output from the speakers is reduced, but on no account should the power rating of the speakers be exceeded in order to restore the same maximum level. The Philips speaker used has a power rating of 10 watts and, when fitted with the compensation network and driven from a 10 watt amplifier, the level of sound available will be found to be entirely adequate for the average lounge room.

CONSTRUCTION

The box is constructed from 13 mm particle board with simple butt joints. The dimensions shown in Fig. 1 are internal dimensions and allowance should be made for the thickness of the timber used. The box should be glued and screwed together with the front panel temporarily in position so that the box is held square. When the glue has thoroughly set sand the corners of the box to obtain a smooth surface and then cover the box with wood-grained contact paper. Allow sufficient width of contact paper so that it may be folded around the edges of the box onto the inner surface of the box. This will prevent the paper peeling off later as the edges will be preventing from lifting by the front and rear panels. Mount the speaker to the rear of the front panel and then cover the panel with speaker cloth or with any other material that is reasonably transparent to sound. Fit the front-panel assembly into position and then secure it by using thin nails through the front panel into the cleats. The heads of the nails may be hidden by punching them below the surface with a nail or centre punch.

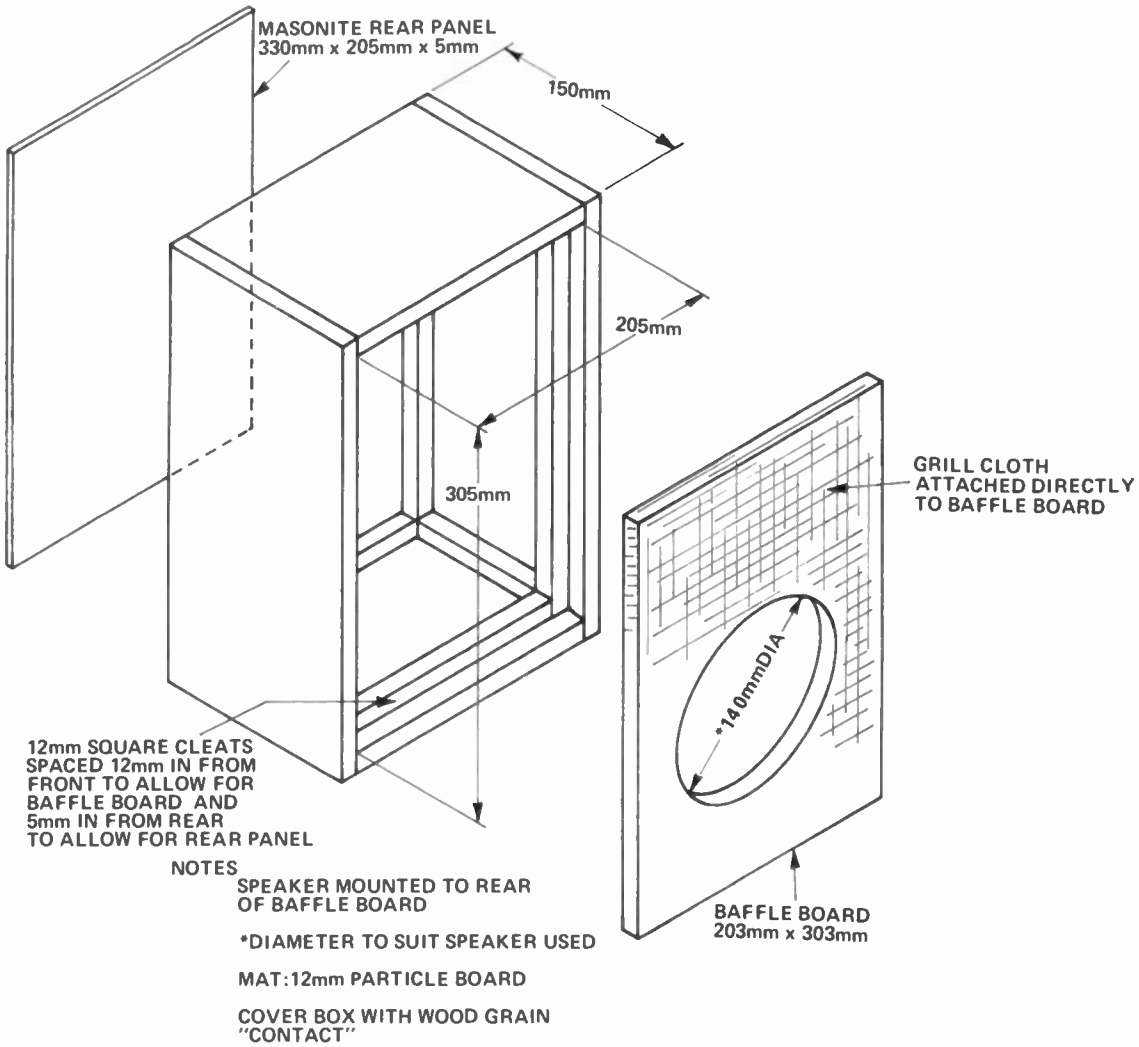
If the network is not being used then the speaker leads may be attached directly to the speaker (about two and a half metres of figure-8 flex is adequate), and passed out through a small hole in the masonite back panel. It is wise to secure the cable to the rear panel so that a pull on the cable will not damage the speaker. The rear panel may then be secured in position by four screws.

COMPENSATING NETWORK

The compensating network is mounted to the rear panel. The potentiometer is mounted directly into a hole in the panel and the choke is mounted by glueing it to the inside surface of the panel close to the position of the potentiometer. The bipolar electrolytic capacitor is mounted across the terminals of the potentiometer. The choke is also connected to the same points. The whole network is then placed in series with one of the leads to the speaker. Winding details of the choke are given in Table 1.

When listening to the speaker adjust the potentiometer for the most-level response from the speaker. Once adjusted you'll be amazed just how good this simple speaker system will sound.

Fig. 1. Dimensions of the speaker box.



MAKING THE COIL

The 2 mH choke is most easily constructed by winding it on a Philips Elcoma P26 ferrite pot core. These P26 cores have different permeabilities which are marked on the core. Any of the types listed below may be used with the appropriate number of turns. Wire gauge is not critical. Anything over 0.4 mm, up to the maximum shown in the table may be used for any type core.

Do not use a bolt to hold the two halves of the cores rogether; use the Elcoma clip and then glue the completed coil into position.

TABLE 1

CORE TYPE	NO OF TURNS	MAX WIRE GAUGE
AL1600	20	1.0 mm
μE330 or AL1000	55	0.8 mm
μE220 or AL630	70	0.63 mm
AL400	70	0.63 mm
μE150	65	0.5 mm
μE100	80	0.5 mm
AL250	90	0.5 mm
μE68	95	0.5 mm
AL160	110	0.4 mm

CORRECTION

Scientific Calculators. Page 34 October '75.

Due to a printing error we regret that a Farad calculator was inadvertently shown in place of the Qualitron 1419 originally intended. Apologies to parties concerned.

SIMPLE SPEAKER

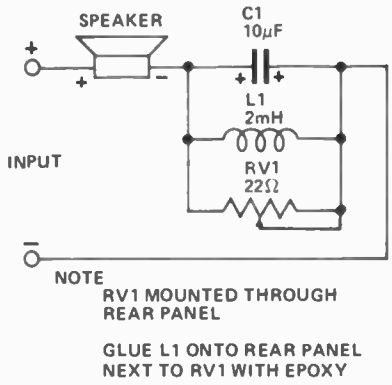
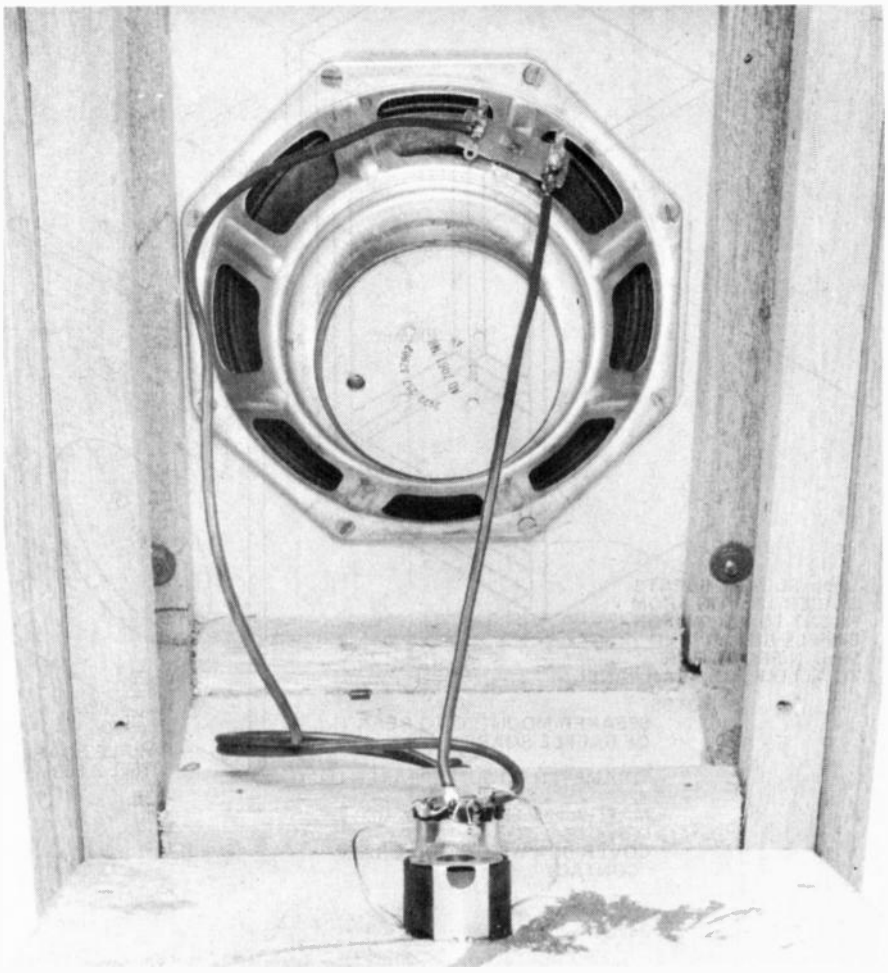


Fig. 2. How the compensation network is connected. Note that capacitor C1 is a bipolar electrolytic, and RV1 has a minimum rating of 2 watts.



Internal view of the speaker. Note the compensation network mounted to the rear panel.

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.

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

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

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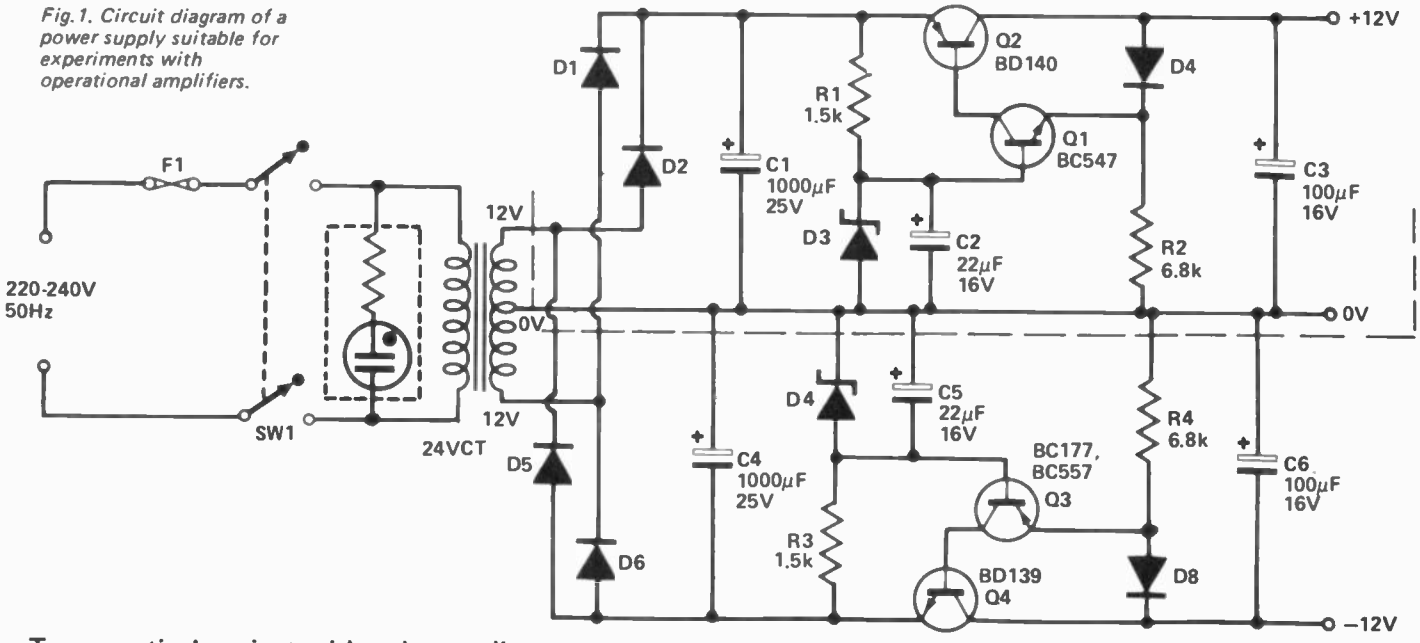

Fig. 1. Circuit diagram of a power supply suitable for experiments with operational amplifiers.

Two practical projects aid understanding

OPERATIONAL AMPLIFIERS ~PART 2

by J.T. NEILL

LAST MONTH the basic theory of operational amplifiers was given. This month we give constructional details of, firstly, a dual power supply suitable for running all the units to be described in this series, followed by the description of a sine wave audio oscillator. The oscillator is the first of a series of small projects designed to give practical experience with op-amps.

THE POWER SUPPLY

The limitation when attempting to reduce the size of any small piece of equipment is, with the present state of the art, the dimensions of the mains operated power supply required to drive it. Thus although an oscillator can be constructed with one IC and a few passive components, the companion ac power supply, by comparison, is extremely bulky. Thus it is fairly pointless to attempt to construct the power supply in such a way as to minimize its total volume. This is not really a disadvantage, however, as the power supply can be used to power other circuits and the diminutive oscillator can, of course, be powered by separate, small, batteries when that is desirable.

Small size may not be a feature of the power supply, but it does have several important characteristics, namely, *automatic* short circuit protection and good voltage stabilisation. A brief specification is given in Table 1, while the full circuit diagram appears in Fig. 1.

Consider first that part of the circuit above the dotted line.

Diodes D1 and D2 full-wave rectify the transformer output and charge C1 positively. Capacitor C1 has a sufficiently large value to filter out nearly all the 100 Hz ripple component and provide a smooth dc to the regulator.

The constant potential across the Zener diode D3 maintains the base of Q1 similarly constant. Should the mains voltage vary, or the load current alter, then the output voltage will tend to change too; however, that voltage is fed, via the diode D4, to Q1 emitter, where it is compared with the Zener voltage at Q1 base. Thus, the collector current of Q1, and hence the base current of Q2, will alter, so effectively changing the emitter-collector impedance of Q2 in such a way as to correct for the original variation. The voltage drop across D4, D8 compensates for the drop across Q1 and Q3 thus ensuring the output voltage is the same as the zener voltage.

Such a configuration will give good load regulation but very large variations in mains voltage will not be counteracted as well as is done in some other circuit designs. This is because the Zener diode is fed from an unstabilised supply. Improvement in output voltage stability – by the order of a factor of five or so – can be achieved by modifying the circuit to drive the Zener from the output, rather than the input, of the regulator, but this would not permit the incorporation of short-circuit protection components, in an arrangement now to be described. Short circuit protection of the supply is vital in experimental work, especially on integrated circuits, where the small size and close spacing of the connecting leads printed circuit tracks can so easily result in unwanted shorts which may overload and possibly damage the power supply.

Consider what happens when the output of the voltage regulator is connected directly to the earth line. The germanium diode D4 is no longer forward biased, for its anode, connected now to earth, is not more

positive than its cathode; accordingly, D4 can be considered to be absent and the effective circuit arrangement is as in Fig. 2. The base voltage of Q1 is still fixed (by the voltage across the Zener) at 12 V with its emitter taking up a voltage about 0.7 V less. This fixed voltage appears across R2, which means that a fixed current flows through R2 and Q2 into the base of Q1 and hence, the emitter current of Q1 is fixed also. The emitter current of Q2 will be larger than its base current by a factor equal to the current gain of transistor Q2. The emitter current of Q2 is the load current however, so that it can be seen that, under short circuit conditions, a constant current of a magnitude determined by R2 flows into that short circuit.

A suitable value of R2 must be selected to obtain the desired short circuit current. Here, it is chosen so that 210 mA flows in short circuit conditions. It is under these conditions that the greatest power dissipation occurs in Q2 and accordingly it has been ensured that a continuous short circuit will not give rise to overheating of that transistor.

In point of fact, about 3.4 watts are then dissipated in Q2, a value well within the capability of the transistor type employed. It is bolted to, but insulated from, the die-cast box in which the power supply is housed, so that it is thereby provided with a very large heatsink. Accordingly, in normal use all components run with hardly any temperature rise, and even when running into a short circuit, the combination of current limiting and large heatsink ensures that the power supply is not damaged.

What has been discussed so far is a single power supply, giving an output of 12 V. The actual unit contains two such supplies, as Fig. 1 shows, of similar circuit configuration, but, in the second case, a PNP transistor is used instead of an NPN and vice versa, and with a negative supply voltage, derived from D5 and D6, fed to it. The Zener diode and its electrolytic capacitor, as well as the germanium diode, are all connected with the opposite polarity from before. Therefore, a stabilised and protected −12 volts appears at the output, relative to the centre supply terminal.

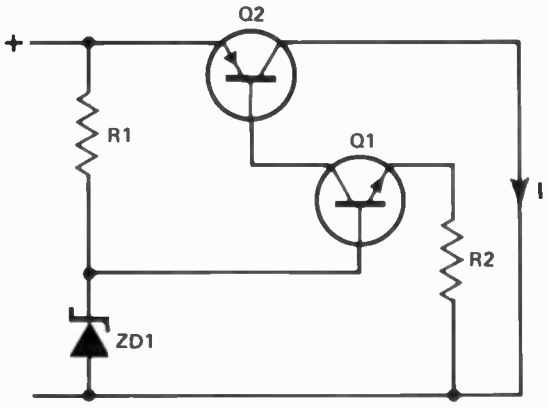

Fig.2. The equivalent circuit of the regulator when the output is short circuited.

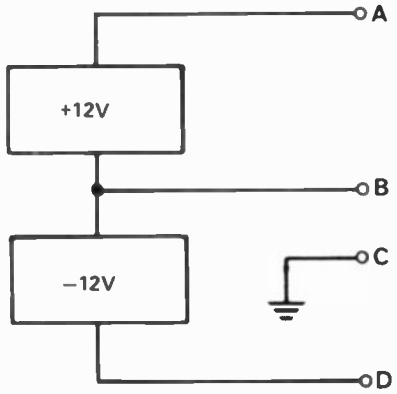

Fig.3. Power supply external connections.

As quoted in the specification, this permits the output from the power supply unit to be connected in any one of three configurations:—

1. + 12 V and −12 V relative to earth
2. + 24 V relative to earth
3. −24 V relative to earth

This is achieved by connecting the two supplies in series, with the common point brought out as an external connection. Further, this common point is not earthed, but a separate earth terminal provided. The three different modes of operation are then obtained by means of the appropriate external connections — see Fig. 3.

PARTS LIST — POWER SUPPLY

D1,2,5,6	Diode	IN4001
D3,7	"	BZ x 79 C12 or other 12 V Zener
D4,8	"	IN914
Q1	Transistor	BC547, BC107
Q2	"	BD140, BD136
Q3	"	BC177, BC557
Q4	"	BD139
R1,3	Resistor	1.5 k ¼W
R2,4	"	6.8 k ¼W
C1,4	Capacitor	1000μF 25 V electrolytic
C2,5	"	22μF 16 V electrolytic
C3,6	"	100μF 16 V electrolytic

Transformer 12 V — 0 12 V 100 mA

SW1 double-pole double throw

Die-cast box 165 x 114 x 51 mm

F1	Fuse	1 amp
Fuse holder		20 mm
Terminals (screw)		1 red, 1 black, 1 green (earth 1 other)
Neon indicator		

Veroboard, 0.15" pitch 100 x 60 mm

TABLE 1

Input	220 – 240 V 50 Hz
Output voltage	1. −12 V and +12 V
or	2. −24 V
or	3. +24 V
Output current	100 mA maximum
Protection	Automatic constant current limiting (210 mA) on short circuit
Regulation	Better than 80 mV variation, no load to full load
Hum and noise	Less than 3 mV

TABLE 2

Frequency range	120 Hz – 1.2 kHz 1.2 kHz – 12 kHz
Output level	1 V rms maximum, continuously variable
Output impedance	70 ohms
Min. load at 1 Vrms	1.5 k
Power supply needed	3 mA at +12 V 2 mA at −12 V

For use with the type of operational amplifier dealt with here, the first mode i.e. ± 12 V will usually be employed.

The rated output, of 100 mA from either side, will be found to be more than adequate for the intended use, since type 709 and 741 op. amps. draw less than 5 mA each, unloaded.

A suggested layout and constructional technique for the dual power supply is given in Fig. 4, but the layout is by no means critical and the constructor may employ any alternative method. Nevertheless, a robust housing is required and the best is probably a die-cast box – any small extra expense incurred, to obtain such a convenient and easily worked case, is well worthwhile.

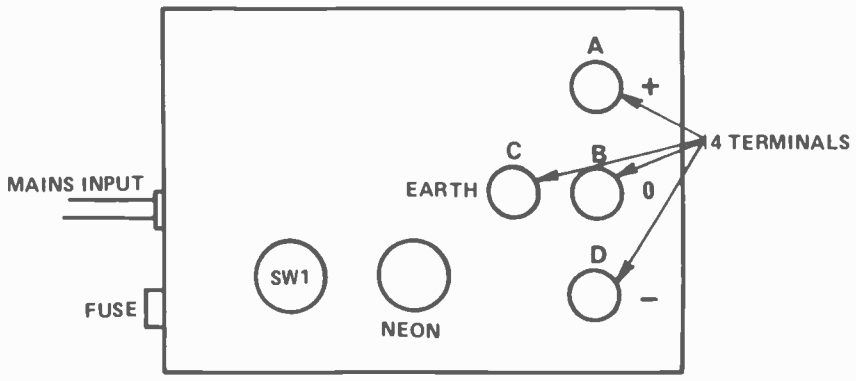

Fig. 4(a). Suggested layout of major components in the box. Note that the Veroboard should be insulated from the box by inserting cardboard between it and the box.

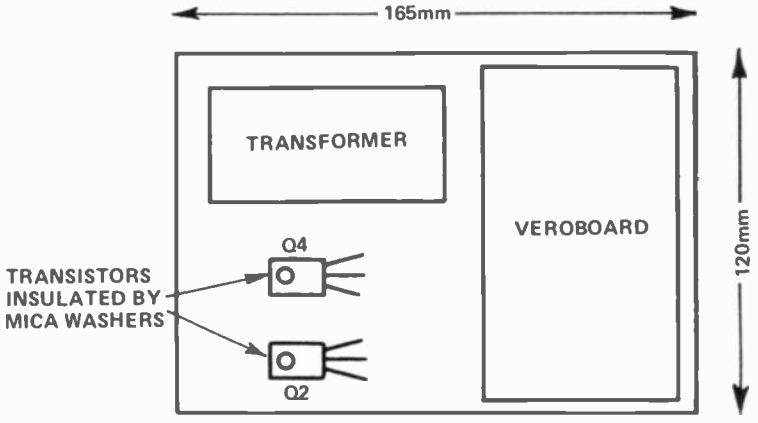

Fig. 4 (b) Suggested front panel layout.

THE OSCILLATOR

Now for the first constructional project using an operational amplifier. As mentioned earlier, this is a sine wave audio oscillator. The circuit is given in Fig. 5 and its specification in Table 2.

The oscillator makes use of the well known Wien-bridge network to set the frequency of operation. A resistor (in this case RV1a and RV1) and a *parallel* capacitor (either C1 or C2) are connected to further resistors (RV1b, RV3 and R4) in *series* with a further capacitor (either C3 or C4). It is a property of the Wien network that the junction of the two RC arms, has, at a single frequency only, a voltage in phase with, but smaller than, that applied to the whole network. Since, in the oscillator, this in-phase voltage is fed to the non-inverting terminal of the op. amp. it constitutes positive feedback, and thus oscillations will occur and be maintained at one specific frequency – a frequency determined by the values of the resistors and capacitors employed in the Wien network.

So much for the frequency of oscillation. What of its amplitude?

Consider for a moment what would happen if, with the oscillator already giving a sine wave output, the output amplitude should increase for some reason. If it continues to do so, eventually the voltage will become so large that it will be limited by the supply rails and a clipped sine wave will result. Conversely, if the amplitude of oscillation should decrease, then oscillations will eventually die away to nothing.

Such variations in amplitude can easily arise due to temperature changes etc., and will in any case occur as the frequency is altered, due to tolerances in the capacitor values and tracking errors in the twin-gang potentiometer.

Thus, some means of automatic gain control is essential in order to maintain a constant output amplitude.

It will be recalled that the signal voltage applied to the op. amp. non-inverting input was smaller than the output voltage due to the attenuation in the Wien network. To maintain oscillation the op. amp. must have a gain equal or exceeding this attentuation – which is in fact x3. The desired gain is obtained by selecting the ratio of feedback resistance to input resistance of the inverting input (RV2 + R3)/R2.

If the overall gain, including feedback, exceeds unity the circuit will produce sine wave oscillation at a frequency set by the Wien network.

Stabilisation of the gain is brought about by the action of diodes D1 and D2.

When the instantaneous output voltage is close to zero, neither diode conducts, since even a germanium diode requires 0.4 volts or so forward voltage to bias it on. Consequently, the negative feedback loop is open (giving maximum gain) and, under the action of the positive feedback via the Wien network, oscillations build up rapidly. As soon as their amplitude is sufficient to bias on either D1 or D2 (depending on the polarity of the output voltage swing), then R2, R3 and RV2 provide negative feedback, so limiting oscillations to a convenient level.

Re-inforcement of such oscillations takes place close to each zero crossing when D1 and D2 are open i.e. non-conducting; the setting of RV2 determines the final amplitude.

This method of stabilisation does give rise to a very small amount of crossover distortion, but the effect of this can be minimised by setting VR2 for the largest possible sine wave without clipping. In any event, some distortion is a small price to pay for such a simple, easy-to-get-working sine wave oscillator and, further, it is a *low* level of distortion – come class B audio amplifiers are worse!

Range switching is confined to a choice of two ranges, in the interest of simplicity and cheapness, but more ranges could easily be provided if the constructor is so inclined.

OPERATIONAL AMPLIFIERS

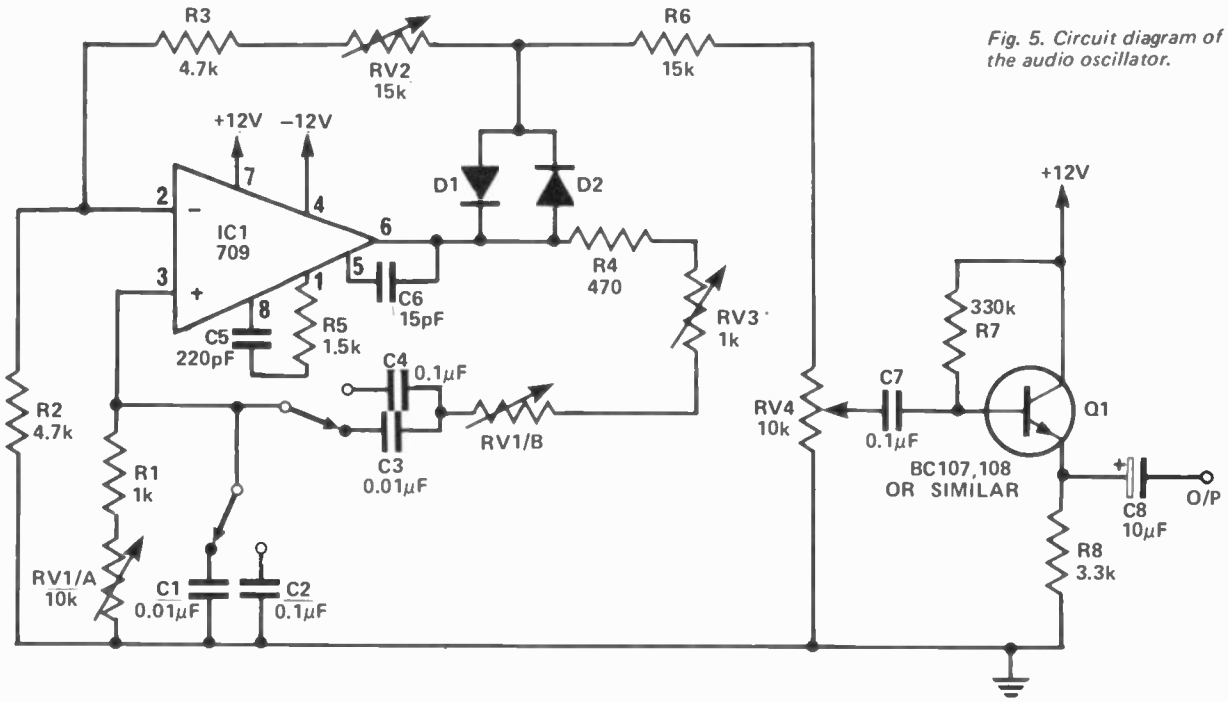

Fig. 5. Circuit diagram of the audio oscillator.

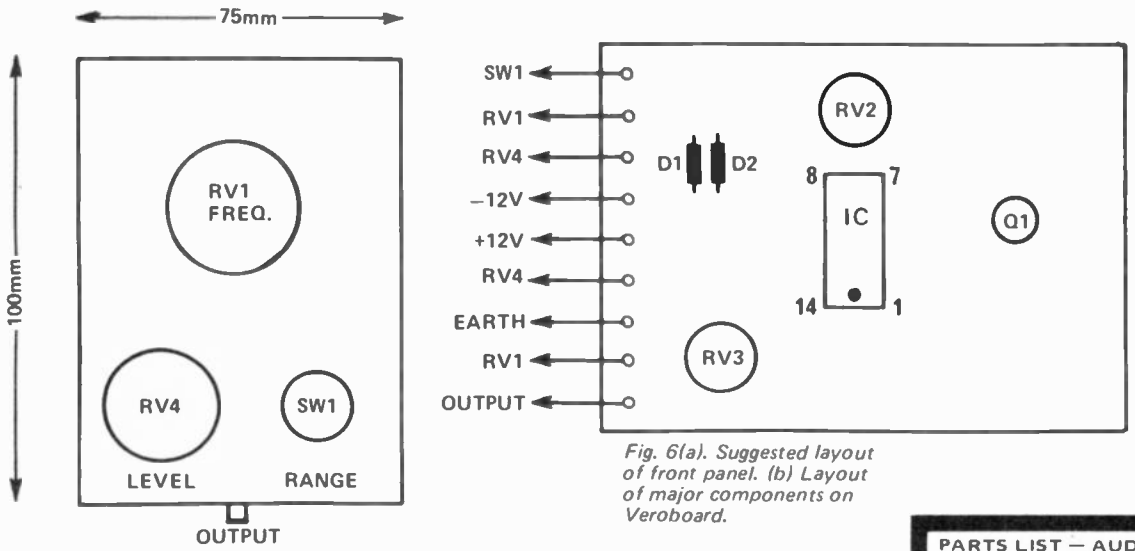

Fig. 6(a). Suggested layout of front panel. (b) Layout of major components on Veroboard.

The frequency ranges mentioned in the specification are a little unusual, in that most audio generators provide ranges starting and ending at 1 kHz, 10 kHz and so on. However, in the present case, the selection of easily available components having standard values produced the ranges shown and these were, in fact, found to be convenient in practice.

A simple emitter-follower output stage completes the unit, with a logarithmic potentiometer as a level control, enabling the output to be set from 1 V rms down to 10 mV rms or so.

Suitable compensation components R5, C5 and C6 are required for the type 709 op. amp. A layout found suitable for the oscillator is given in Fig. 6. Notice that this calls for a box of only 100 x 75 x 30 mm, which, whilst making the oscillator quite small and neat, does not result in cramping of the layout, which is straightforward and easily followed.

With wiring up completed and thoroughly checked, switch on and, if possible, monitor the output on an oscilloscope. No 'scope? Then a pair of headphones, of reasonably high impedance, can be used instead. Set RV4 about half way, S1 to "low" and RV1 about half way. If there is no output, adjust RV2; clockwise rotation should give increased output.

With an ac meter, measure the signal level at the junction of D1, D2 and RV2. Adjust RV2 for 3 volts rms. This will ensure the highest output level (thus reducing the effect of crossover distortion) consistent with sine wave

PARTS LIST — AUDIO OSCILLATOR

IC1	Integrated Circuit	709
Q1	Transistor	BC107,108 or similar
D1,D2	Diode	OA95
R1	Resistor	1k 1/8W or 1/4W
R2,R3	"	4.7k
R4	"	470 1/8W
R5	"	1.5k "
R6	"	15k "
R7	"	330k "
R8	"	3.3k "
C1,C3	Capacitor	0.01μF polyester
C2,C4,C7	"	0.1μF polyester
C5	"	220pF "
C6	"	15pF "
C8	"	10μF electrolytic 16V
RV1	Potentiometer	10k + 10k ganged
VR2,RV2	"	5k pre-set (horizontal)
VR3,RV3	"	1k pre-set (horizontal)
VR4,RV4	"	10k logarithmic
S1	Switch	DPDT
Aluminium box		100 x 75 x 40 mm
Veroboard, 0.1" pitch 80 x 62 mm		
8 pin IC holder		
3.5 mm jack		

OPERATIONAL AMPLIFIERS

operation (no clipping). This should provide about one volt rms at the output.

It was found on the prototype that changing to higher frequency range gave a slightly reduced output — doubtless due to the use of 10% tolerance capacitors in the Wien network. Closer tolerance capacitors are, of course, more expensive but the amplitude difference may be overcome by adding small capacitors to either C1 and C3 or C2 and C4 whichever reduces the amplitude difference.

Variation of output level as RV1 is rotated, due to tracking errors between RV1 sections, can be minimised by adjustment of RV3. To do this, set RV1 close to its high frequency end. Adjust RV3 to give about the same level of output as with RV1 at mid-travel. If the twin gang potentiometer RV1 is particularly poor in its tracking an alteration to the value of R4 may be called for.

Calibration of the frequency scale is always a problem with any home constructed audio equipment such as this oscillator. Comparison with other audio signals is one method, either by ear, oscilloscope or frequency counter.

Ideally comparison with another oscillator will allow the frequency scale to be marked up accurately.

Regarding alternative components: a 741 in place of a 709 will function well, except for some slew rate limiting at the higher frequencies, leading to distortion. If a 741 is used delete C5, C6 and R5. A type 301 may also be used; in this case C5, C6 and R5 are deleted as before and a 10 pF capacitor is fitted between pins one and 8. Almost any silicon NPN transistor will be satisfactory for Q1, but some alteration in R7 value may be necessary. Silicon diodes for D1 and D2 give rise to much greater levels of crossover distortion, due to their greater forward voltage drop.

This little oscillator will be found to give a sufficiently pure sine wave to assist in the testing of almost any audio equipment, its restricted frequency range being no great drawback for that work.

A truly portable oscillator can be made by replacing the dual 12 volts batteries by two small nine volt batteries. If this is done, however, some re-adjustment of RV2 and a reduction in the value of R6 to give a sine wave free from clipping, will be required.

to be continued . . .

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Our CA3130 gets many of its winning ways from four very capable relatives. Four RCA op amps that can fill special requirements you may have. If you need programmable linear gain control, check the CA3080. For high crossover frequency plus high slew rate, there's the CA3100T. For high output current and easy programmability, the CA3094E. For low power supply drain, the CA3078T.

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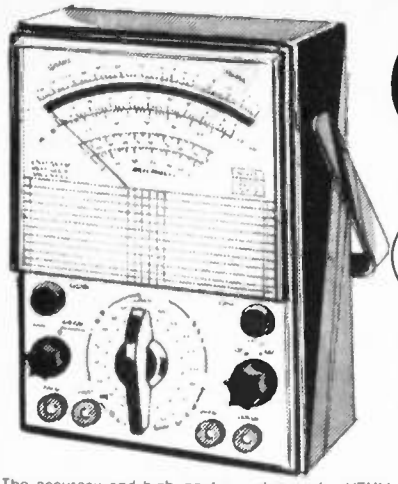
Beyond the table, here's more typical data about the CA3130:

Input Impedance: 1.5 TΩ ($1.5 \times 10^{12}\ \Omega$).
Input Current: 5 pA.
Input Offset Current: 0.5 pA.
Input Offset Voltage: 0.8 mV (CA3130B).
Settling Time: 1.2 μsec.
An output voltage swing to within 10 mV of either supply rail.
Strobing terminals.
Package: 10 lead T05.

	CA3080E	CA3100T	CA3094E	CA3078T	CA3130
Gateable plus programmable gain control	>60 dB				Gateable
Unity gain crossover frequency, MHz		40			15
Slew Rate, V/μsec		25			10
Output, mA (peak)			300		22
Power consumption, mW				.0015	2.5
Single supply voltage required, V				1.5	5.0



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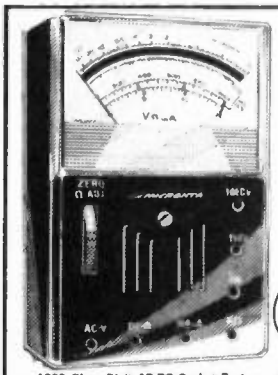

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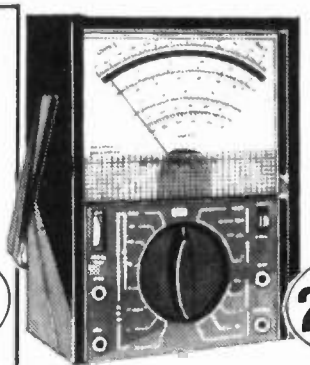

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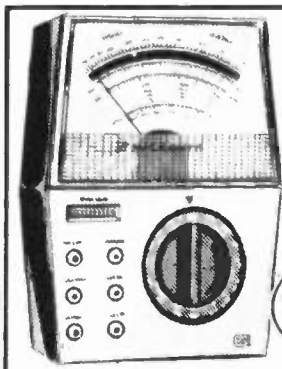
30,000 Ohms/Volt — 27 Ranges. A super-sensitive VOM for high accuracy measurements. Color-coded 4" meter, four banana jacks including output jack, polarity-reverse switch, thumbwheel zero adjust, combined carry handle/stand. Ranges: DC Volts, 0-0.3-1-3-10-30-100-300-1000 at 30,000 ohms/volt; AC Volts, 0-10-30-100-300-1000 at 10,000 ohms/volt; DC Current, 0-100 µA, 3-30-300 mA, 10 amps; Resistance, Rx1, Rx10, Rx1000, Rx10,000 (10 center scale); Decibels, -10 to +62 in 5 ranges. Accuracy, ±3% AC, ±4% DC. Size, 6¼x4½x1¾". With leads, battery, instructions. **22-203**



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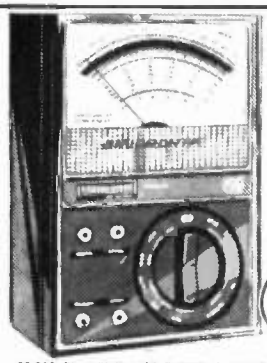
20,000 Ohms/Volt — 25 Ranges. A sensitive, full-range VOM with single-knob range selector, big 4" meter with mirrored and color coded scales. Has 6 pin jack connections including an output jack. Ranges: DC Volts, 0-0.6-3-15-60-300-600-1200 at 20,000 ohms/volt; AC Volts, 0-15-60-150-600-1200 at 10,000 ohms/volt; DC Current, 0-60 µA, 3-30-300 mA; Resistance: Rx1, Rx10, Rx100, Rx1000 (24 center scale); Decibels, -20 to +63 in 5 ranges. Accuracy is ±3% DC and ±4% AC. Size, 5½x3½x1½". With leads, battery, instructions. **22-202**



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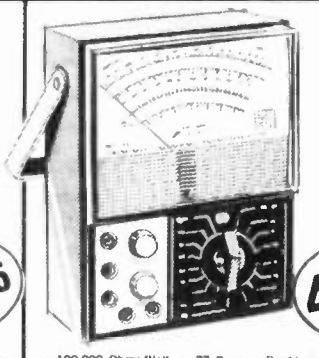
20,000 Ohms/Volt — 18 Ranges. A low-priced VOM with "expensive" features. Single-knob range selector with separate "off" position, 3" meter with easy-to-read color-coded scales, four pin jack connections including an output jack. Ranges: DC Volts, 0-5-25-125-500-1000 at 20,000 ohms/volt; AC Volts, 0-10-50-250-1000 at 10,000 ohms/volts; DC Current, 0-50 µA, 0-250 mA; Resistance, Rx1, Rx10, Rx1000 (24 center scale); Decibels, -20 to +62 in four ranges. Accuracy is ±3% on DC ranges and ±4% on AC ranges. Large thumbwheel for easy zero adjust. Size, 5⅛x3½x1⅞". With leads, battery, instructions. **22-201**



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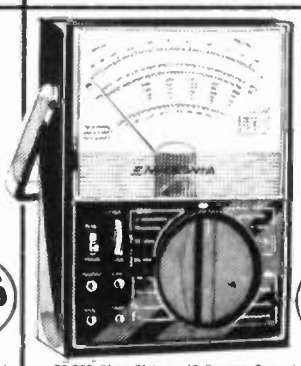
100,000 Ohms/Volt — 27 Ranges. Double jeweled D'Arsonval 5" meter, mirrored scale, reverse polarity switch, overload protected meter. Carry handle tilt stand. DC Volts: 0-0.5-2.5-10-250-1000 at 100k ohms/volt. AC Volts: 0-5-10-50-250-1000 at 10k ohms/volt. DC Current: 0-10 µA, 500 µA, 5-50-500 mA, 10 A. Resistance: Rx1, Rx10, Rx1000, Rx10,000, Rx100,000 (2 center scale). dB: -20 to +62 in 5 ranges. Accuracy: ±3% DC, ±4% AC. 8¼x5½x3¼". With leads, batteries, instructions. **22-205**



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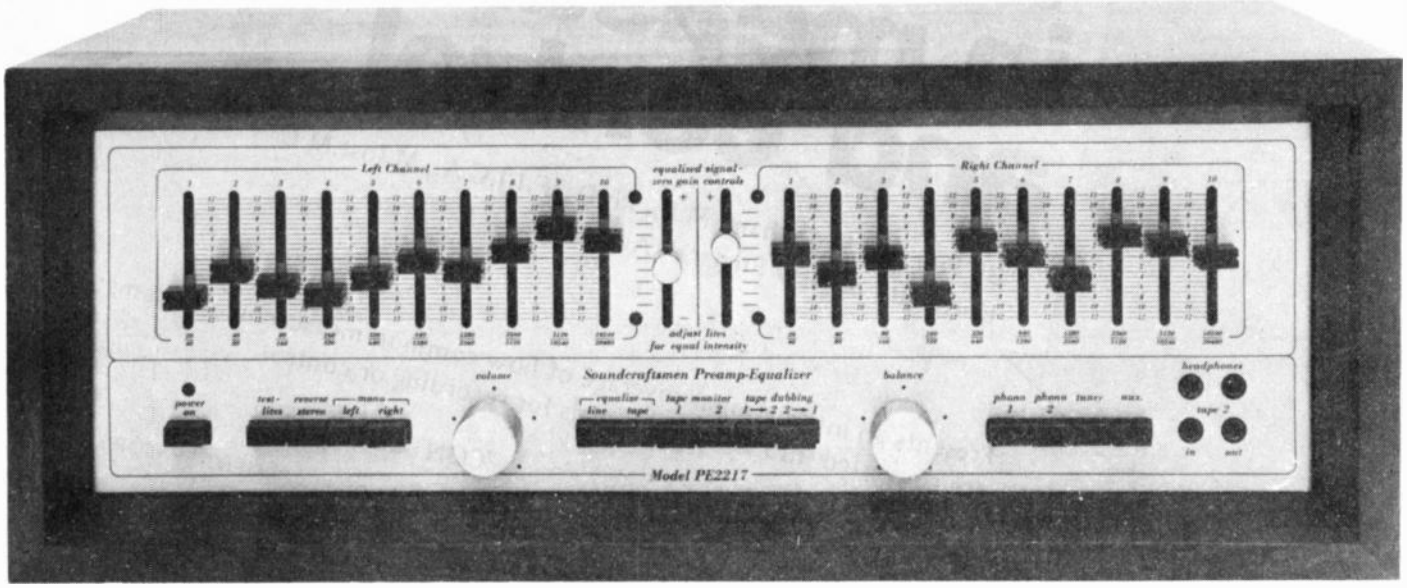

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SPECIFICATIONS

FREQUENCY RESPONSE — Hi-level inputs: ± ¼ dB, 5 Hz to 100 kHz
FREQUENCY RESPONSE — Phono inputs: ± ½ dB, 20 Hz to 20 kHz (Typ. ± ¼ dB)
HARMONIC DISTORTION: less than .05% at 1 volt, (Typ. 01% at 1 volt)
IM DISTORTION: less than .05% at 1 volt, (Typ. .01% at 1 volt)
SIGNAL-TO-NOISE — Hi-level inputs: 1– dB below full output
SIGNAL-TO-NOISE — Phono inputs: 84 dB below a 10mv input
SIGNAL-TO-NOISE — Equalizer section: 90 dB below a volt input
GAIN — Phono: 57 dB
GAIN — Hi-Level: 15 dB
INPUT IMPEDANCE — Phono: 47,000 ohms
INPUT IMPEDANCE — Hi-level: 50,000 ohms
OUTPUT IMPEDANCE: 600 ohms
MAXIMUM OUTPUT: 5 volts into hi impedance, 2.5 volts into 600 ohms

EQUALIZER LEVEL: Zero-gain controls for left and right channels, continuously variable, for unity-gain compensation form – 12 dB to + 6 dB.
EQUALIZER RANGE: 12 d8 boost and 12 dB cut, each octave centered at 30, 60, 120, 240, 480, 960, 1920, 3840, 7680 and 15,360 Hz.
MAXIMUM OUTPUT SIGNAL: Variable master volume control allows adjustment of optimum output to match amplifier capability up to 5 volts.
CIRCUIT BOARDS: Military grade G-10 glass epoxy
RESISTORS: Low-noise selected carbon-film
POWER SUPPLY: Separate supply for phono and equalizer
DIMENSIONS: Walnut-grained case 7¼" high x 20" wide x 11¼" deep. Genuine oiled-walnut cabinet available, $49.00 extra. Front panel size 5¼" x 18". Rack-mount panel size 5¼" x 19", $20.00 extra.
WARRANTY: 2 years parts and labor
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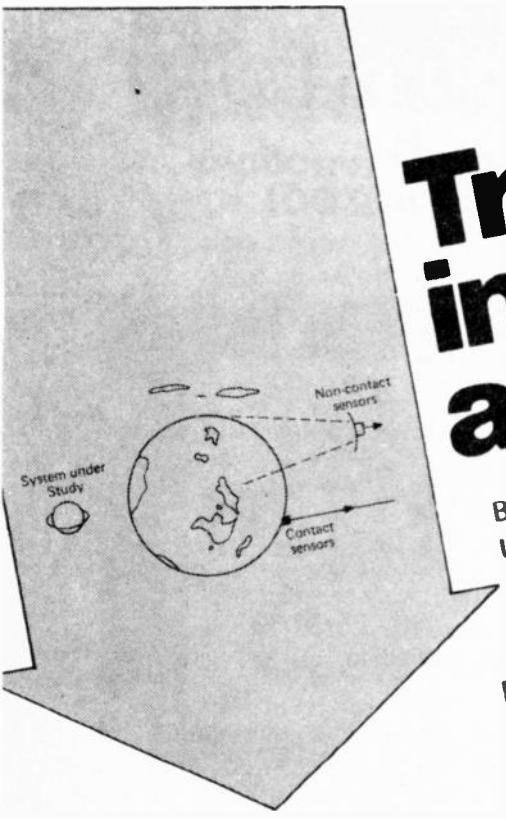

Transducers in measurement and control

By Peter H. Sydenham, M.E., Ph.D., F.I.I.C.A., M.Inst.M.C,
University of New England, Australia.

Presents an international coverage of how common measurement parameters are converted into electrical signals for recording or control.

Dr. Sydenham, a specialist author in instrumentation, originally prepared this work as an invited series of monthly articles for the magazine "Electronics Today International". Continued requests from tertiary institution teachers, both in Australia and in Britain have resulted in the series being reprinted as an inexpensive reference and teaching text. Research workers, hardware system designers, students in engineering and the sciences, scientific instrument manufacturers and their agents, and managerial level technical executives should find this extensive cover of value.

Profusely illustrated with several hundred diagrams and photographs, it explains how the commonly encountered measurement variables are converted into electrical signals in order to make records or achieve control. Each chapter contains a reading list: an index has been added.

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PART 24

ELECTRONICS —it's easy!

Digital sub-systems — counters and shift registers.

IN THE preceding articles of this series we have described the basic building blocks of digital systems. To summarize, there are the various gates, the flip-flop, the monostable, the Schmidtt trigger, the inverter and the square-wave clock source — a surprisingly few basic elements from which all the countless different forms of digital equipment are constructed. We are now in a position to examine how digital signal systems are put together using these basic building blocks.

DIGITAL NUMBERS INTO DIGITAL SIGNALS — COUNTER SUB-SYSTEMS

Not long ago digital systems were invariably built up from individual blocks where each of the above functions could be clearly identified in the system. But not so now. Many of the blocks now marketed as basic building elements are complex systems in themselves. The most extreme example is probably the micro-processor system (it provides the bulk logic requirement of a powerful computing system) which is now available as a 'throwaway' element for around $100 or less. It would take to the end of this course to begin to appreciate the complete system — operation of such a building block!

We have already become involved in small systems — the exclusive OR and the half-adder of Part 22, for instance. The next step to take is to form sub-systems with the fundamental blocks that provide us with the facility to form and manipulate digital numbers, because many (but not all) digital systems operate with numbers either to provide means of calculation, or to provide a display of numbers. Thus we need to know something of digital counters and the somewhat similar units known as registers.

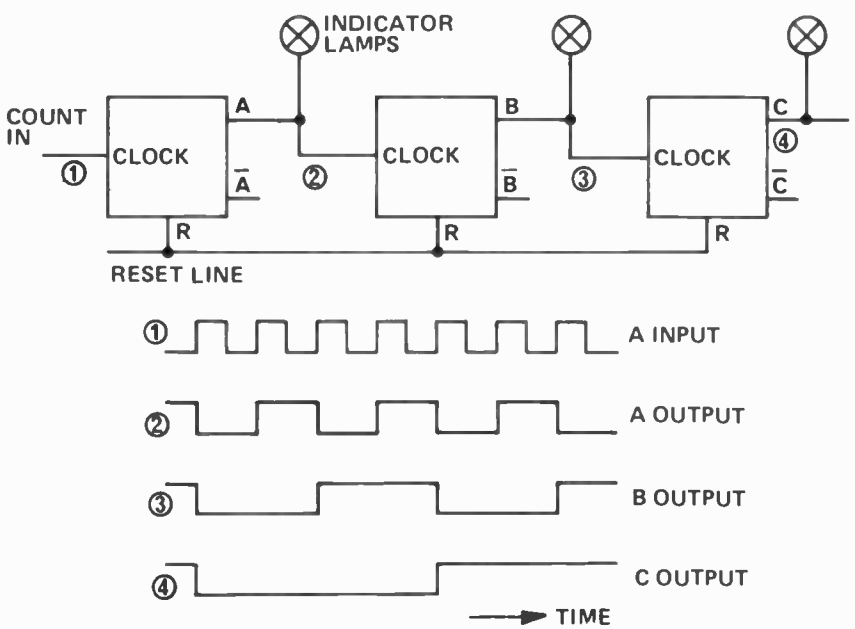
We saw in the previous part how the flip-flop provides a counting action by virtue of its ability to switch states for each pulse appearing at its input. However nowadays it is a level change rather than a complete pulse which causes the transition.

BINARY COUNTING

Cascaded flip-flops, such as shown in Fig. 1, form the simplest type of counting system. Each time the input changes state, the A flip-flop toggles back and forth delivering a state change to flip-flop B for each second input change — and each fourth change to C and eighth change to D and so on.

At any instant (where the input is presumed stationary, at least for the interrogation period) the outputs A, B, C, etc. will either be at a 0 or 1, as shown in the truth table. For example, a count of five (decimal) will be registered at 101 for CBA respectively. Note that the truth table appears to be written back to front — the reason is simply that we write numbers (by convention) with the most significant digit to the left hand of the number and this corresponds with the furthest right-hand flip-flop, its position on the schematic arising from the drawing convention used for the signal-flow through information systems. Thus a stream of input pulses with time are converted into a multi-element digital number. This form of input is often referred to as a "crazy-digital" number system when applied to systems incorporating measuring sensors. Such sensors generate pulses not having any clearly obvious relationship with time — examples are digital-position sensors wherein a pulse is generated for each unit displacement occurring.

Clearly, if the state of A, B, C, etc. is to represent a number the count must start from some clearly defined initial condition for each stage — often, but by no means always, stages are reset to 000 — by applying a level to the reset R line. In some applications the number must begin at



INPUT	C	B	A
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1
8 = 0	0	0	0

TRUTH TABLE

Fig. 1. The asynchronous or ripple-through binary counter is the simplest to implement with flip-flops.

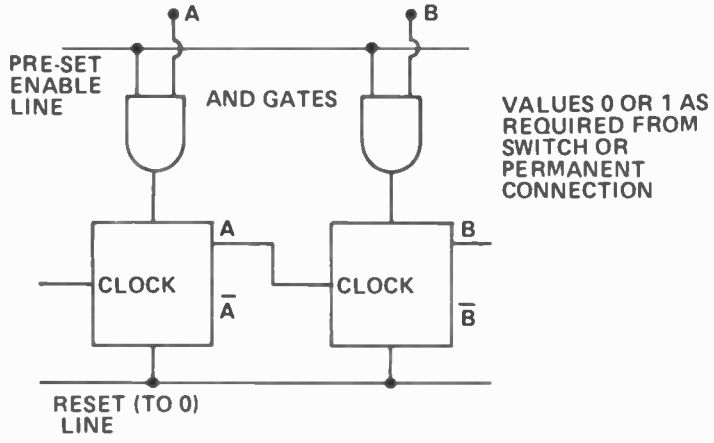


Fig. 2. Counting stages require their initial conditions be set — either to Os or to desired values.

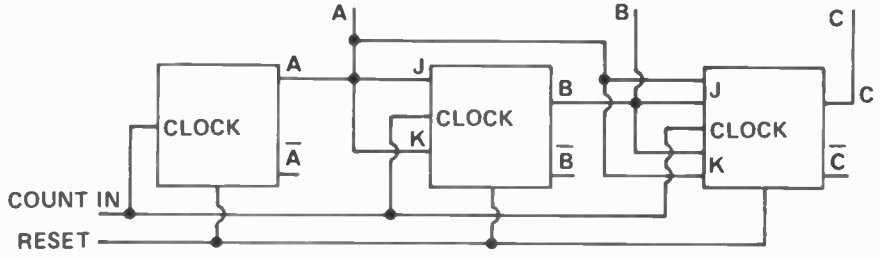


Fig. 3. Synchronous binary up-counting with JK flip-flops.

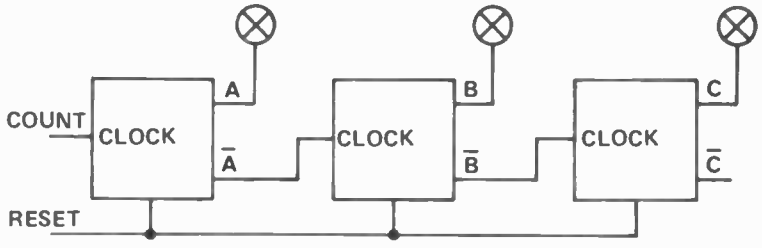


Fig. 4. Reverse counting is simple — use complement outputs instead to trigger the next stage. (a) Ripple-through count-down.

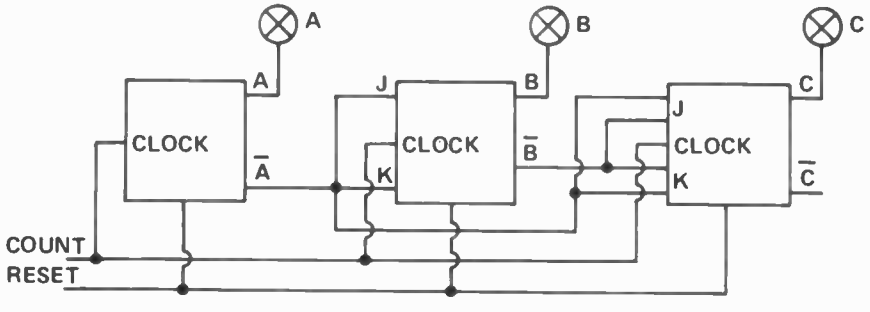


Fig. 4(b) Synchronous count-down.

a specific value. This is achieved by operating the preset lines accordingly for each stage, the value being arranged, say, by the setting of numeric dial switches usually operating through solid-state gates. Once these are set, a single command signal can preset the whole counter to that chosen number. Figure 2 shows how this is achieved using gates.

It is often desirable to display the digital value for visual interrogation. An indicator lamp (light emitting diodes LEDs are now used) driven from the A, B, C, etc., will show the positive logic binary number. Driven from $\overline{A}$, $\overline{B}$, $\overline{C}$, etc., it would show the negative logic number.

Waveforms for this form of counter (called the ripple-through type) are shown in Fig. 1. Although we refer to pulses flowing through, the waveforms are actually square-wave trains in the dynamic state, or levels in the static state, that have frequencies divided down in the ratio 1:2:4:8 etc. This 'pulse' form of expression is a hangover from the early days of digital technique (just a decade ago) where actual pulses, not levels, were used to trigger flip-flops. Each square-wave transition was differentiated by a simple RC circuit to provide a pulse of energy that triggered the next stage. Today, this method is unnecessary and is seldom used.

ASYNCHRONOUS AND SYNCHRONOUS COUNTING

Once an input pulse has occurred, it sets the chain in action, each flip-flop passing each second input pulse on, to the next stage. As each stage has a finite delay time — nanoseconds with TTL, microseconds in older forms of logic — each stage triggers at a later time than the one before it. Hence the form of action of each stage is said to be asynchronous with the others. Thus whilst the pulse is rippling through the counter the outputs are in an undefined and changing state between the previous and next correct states. The output cannot therefore be read until the whole thing has settled.

It is quite common to have binary counters with over 20 stages — at 100 ns delay in each, the maximum input pulse counting rate (if the outputs are to be used whilst it is in a counting transition mode) would be limited to 2μs between incoming pulses, that is, 500 kHz. Faster logic is available that provides around 20 ns delay but this still seriously restricts the data-transmission rate where the ripple-through design is used.

This disadvantage can be overcome by increasing the circuit complexity somewhat to form what is known as a SYNCHRONOUS counter. Each stage in the cascaded chain is fed a clock

pulse simultaneously via control gates. The control gates for each stage also receive inputs from all previous stages such that the particular stage only operates at the correct count.

By this means all stages operate synchronously and the propogation delay is reduced to that for a single stage only. Synchronous counters are essential where the outputs of all stages must be decoded in parallel, eg, where a display of the count is required. However for straight frequency division applications, where the output is taken only from the last stage, a ripple counter is normally faster than the synchronous type.

The logic-gate inputs of the JK flip-flop allow them to be connected for synchronous counting as shown in Fig. 3. It is not important to know how JK flip-flops work internally for counters are now built by cascading ICs as per application note instructions — it takes a specific type of mind to realise digital counting systems without effort! Fortunately for those of us without this ability it is rarely needed except, of course, by IC designers.

UP, DOWN AND REVERSIBLE COUNTERS

So far we have only looked at counters that increase up the binary number scale for each additional input. To make the same system count down is incredibly simple — we merely re-connect them so that the complemented outputs are fed to the next stage — see Fig. 4 — instead of using the normal output, that is, feed $\overline{A}$, B, $\overline{C}$, etc. to the count inputs. It will then count down in binary sequence. Intuitively we would expect this because of the two-state complementary nature of binary numbers. If you are worried about numbers passing through zero, try your digital arithmetic on a count-down case starting at 000.

In many applications needing counters, one-way counting is satisfactory. Examples that come to mind are nucleonic pulse-event counters, counter-timer units and counts of objects passing a given point. In some requirements, however, the need is to add or subtract pulses to provide at any time the instantaneous sum or difference between two inputs, or to give the nett value from a single measurement parameter that alternates in sign. Examples here are digital-position indicators where the direction of movement reverses, integration of reversible variables such as the flow of solid or liquid past a point the number of vehicles in a car park, and situations where the difference between two pulse-train variables is needed.

Several methods may be used to

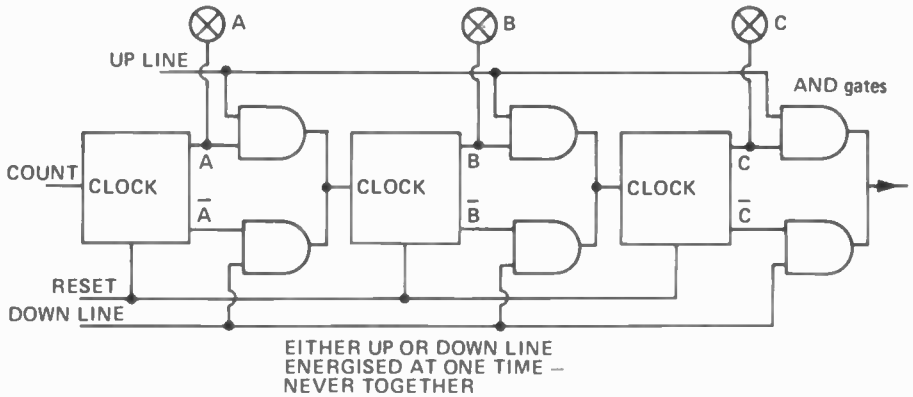


Fig. 5. Reversible counting uses fast switches to select which output of each stage feeds the next. (a) Asynchronous — line controlled.

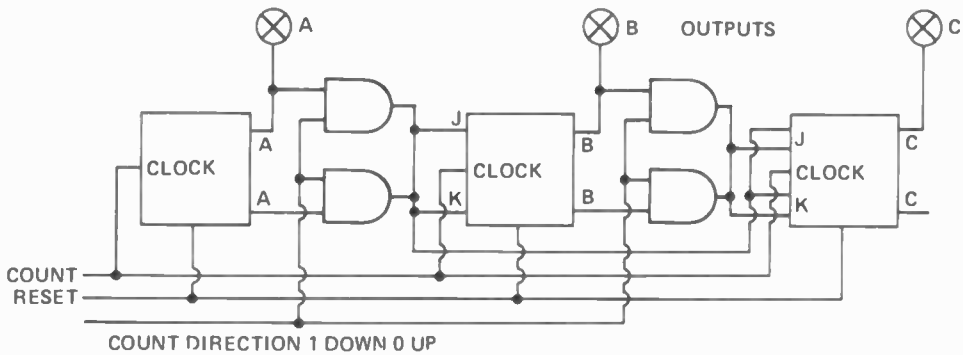


Fig. 5(b) Synchronous — line controlled.

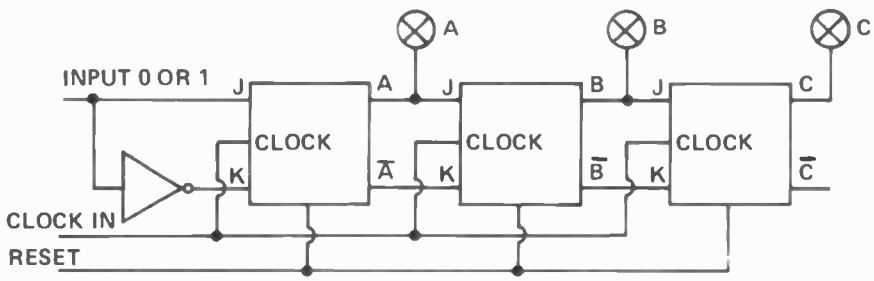


Fig. 6. The shift-register is also built from flip-flops but with different connections to counters. (a) JK type

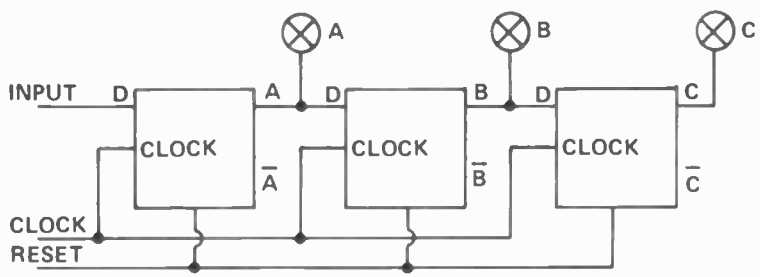


Fig. 6(b) D type.

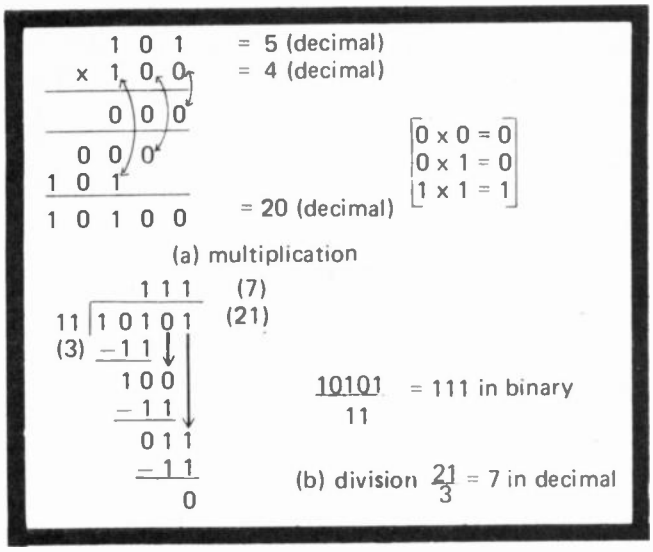


Fig. 7. Binary multiplication and division follows the same rules as decimal numbers but note how simple multiplication becomes – a process of shifting and adding 0 or 1.

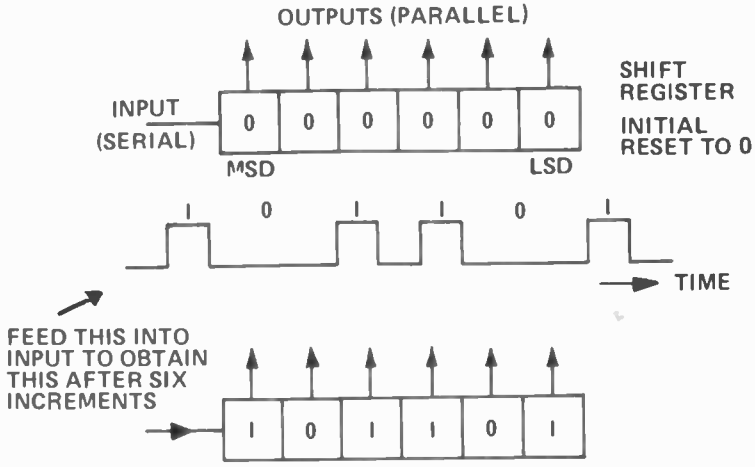


Fig. 8. Registers can provide serial to parallel word conversion, the reverse also applies.

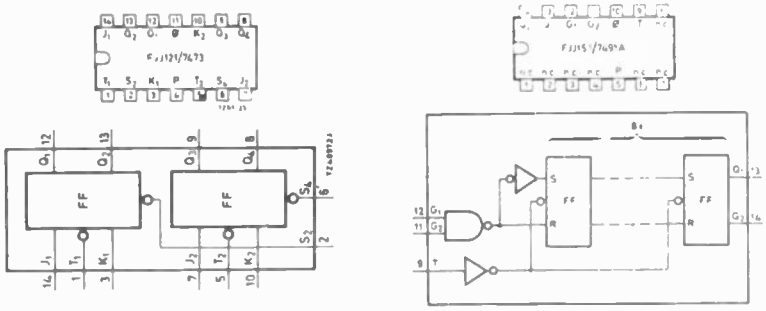


Fig. 9. Schematics of IC units. (a) Binary stages for counting or other purposes. (b) 8-bit shift register.

construct up-down or reversible counters. The most common method is to use a common pulse-count input that accepts both 'up' and 'down' pulses, the decision to add or subtract each individual pulse being decided by the simultaneous voltage levels applied to control lines. The control lines select whether the pulse is routed through the A, B, C, etc., or $\overline{A}$, $\overline{B}$, $\overline{C}$, etc. paths. Switching is accomplished using logic gates as shown in Fig. 5a and 5b – these provide adequately fast switching. In the ripple-through variety the direction-line commands must be held stationary until the counter stages have settled in order to preserve accurate counting. The delay is less pronounced in synchronous designs. Within certain limitations it is also possible to design counters that will accept a new pulse while the system is still in transition. This is done by 'holding' the pulse (by applying a delay) until the counter is ready to accept it.

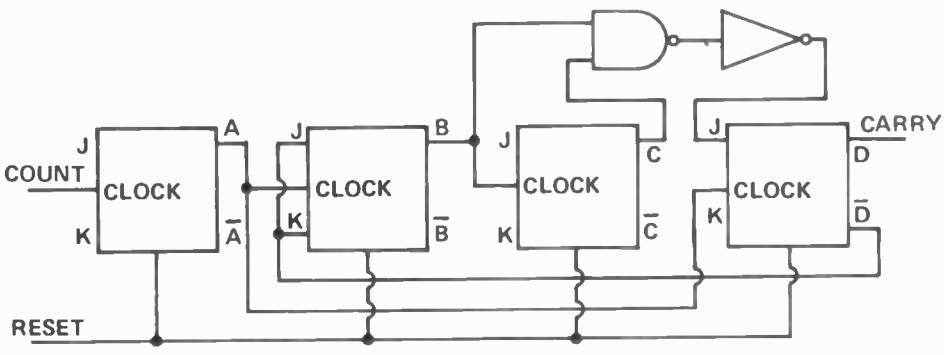


Fig. 10. Four JK flip-flops connected to count as a normal binary coded decimal NBCD stage.

SHIFT REGISTERS

Although not a counter in the same sense as above, the shift register also consists of a cascaded chain of flip-flops but with different connections. The purpose of the register is to hold a binary number but allow it to be shifted as a whole to the left (toward the most significant digit – called a forward shift register) or to the right (toward the least significant digit – the reverse shift register) one step for each input pulse.

As shown in Fig. 6, the incrementing signal, which is more usually a free-running clock signal than a one-at-any-time instruction, feeds the count inputs causing all stages to toggle in synchronism. The state of each following stage, being tied to the output of that preceding, goes to that of the one before with each clock pulse. Thus a number can be fed into one end in serial fashion and will be caused to pass through the register. The whole is cleared to zeros or reset to any desired value via the reset input line. Using D-type counters outputs A etc., go to D inputs. Whereas when using J-K counters A, etc. go to J inputs.

Registers perform three main functions in digital systems. Firstly a digital number can be delayed in time by the additive propagation time (divided by the clock frequency) of the number of stages it passes through, or stored indefinitely (provided the power is held on).

Secondly, one digital number can be successively offered up to another for digital summation of the two – a

basic step of multiplication by digital means. One number remains in position, the other increments across, the two being added at each step by the half-adder (part 22). Binary multiplication and division follow decimal number procedures but are much simpler – see Fig. 7.

A third use for shift registers is for the conversion of digital data from serial to parallel form and vice versa. For example it may require a group of eight pulses to define the position of a shaft with sufficient accuracy. The group of eight pulses is called a word and each individual pulse is called a bit. To transmit this word we would normally need eight lines. However a single line may be used if the information is transmitted one bit at a time, with synchronizing pulses to tell the receiving equipment where each word starts and ends. If the data when received is fed into a shift register serially, eight bits at a time, each word will appear in parallel at the output of the shift register, providing synchronism is maintained, where it may be decoded.

In reverse, a register can be set up to the desired number by the appropriate choice of stage inputs. Once set the register is incremented to feed out the number in serial manner to a single line.

Many forms of binary counters and registers are available in integrated-circuit packages. Figure 9a shows the schematic of a binary counter having two bits on the chip – that is it contains two flip-flops ready to be connected to count. Figure 9b is an eight-bit shift register. Both can be cascaded with like units to extend the bit capacity to virtually any length of binary word needed.

COUNTING IN OTHER THAN BINARY

In the binary counting system each bit position requires a counter element that has two stable states. In the decimal counter each digit needs 10

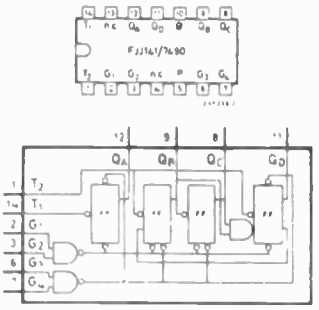


Fig. 11. Ready-made IC decade counter (SN 7490)

states to describe the individual numbers. Similarly three states are required for a ternary system, five for quinary, eight for octal and so on. Ten is not the limit – we use 12s and 60s in time and angle subdivision.

From the hardware realisation viewpoint, binary numbers are the simplest to hold because of the existence of the two-stage flip-flop. (Three state devices exist but have not gained favour). From the user's viewpoint, however, we are more familiar with decimal numbers – a few people can read and work with binary displays but more would agree that values like 1025 decimal, which when displayed in binary form required 10 bits (1000000001), is difficult to read and interpret as a magnitude.

Flip-flops ideally count in powers of two – 2, 4, 8, 16, etc. – so any other value such as three or 10 requires modification to the counting procedure.

The flip-flop chain must be made to skip the required number of unwanted states in the truth table in order to return to the zero position. It is probably evident that this implies a waste of counting capacity when states are not used. In 10s counting, four flip-flops are needed to create 10 states – the other six of the 16 possibles go unused. Similarly, with three's (called modulo-3) two flip-flops are needed wasting one of four states, and with modulo-5 counters three flip-flops are needed with three wasted states.

Although a decade counter uses only 10 out of the possible 16 states, of its four flip-flops, this is not necessarily as wasteful as it may at first appear. For example if we wish to count up to 9999 with decade counters we will need a total of four counters containing 16 flip-flops. To count to the same number with straight binary counters we need 14 flip-flops – only two less. Additionally the ease of obtaining an easily interpretable display results in a system cost that is less than if an all-binary system were to be used.

In computers, information handling capacity is at a premium and the need to display the internal numbers negligible. In such cases the octal-number system comes into its own because three flip-flops provide eight states without any waste of states, and without need for the extra components required to skip unwanted states. The octal range is 0, 1, 2, 3, 4, 5, 6, 7 and then back to 0. A number 312 (octal) is $3.8^2 + 1.8^1 + 2.8^0 = 3.64 + 1.8 + 1 = 202$ decimal. Note that the decimal number requires roughly the same number of bit positions as the octal number but to implement decimal in digital hardware would need four (compared with three for octal) flip-flops for each bit position. However, where output is needed for human use – printouts and readout in numbers – the decimal system is best.

DECIMAL COUNTING

To obtain the 10 states 0 to 9 we must begin with enough flip-flops to provide them. Decimal or decade-counting stages, therefore, need four flip-flops which count in some form of code over just 10 states. The most straight-forward realisation is to let them count through the normal binary code and to apply interconnections between stages which prevent illegitimate states occurring and, often

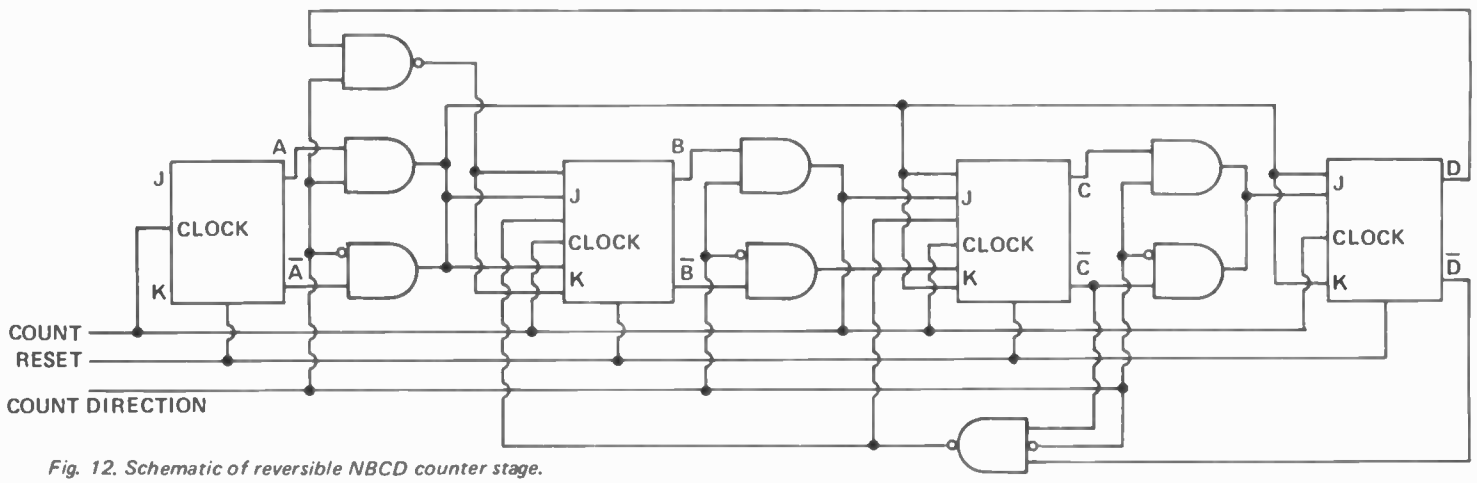


Fig. 12. Schematic of reversible NBCD counter stage.

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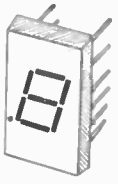

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A 7490 decade counter IC is used to give typical count rates of up to thirty MHz. A 7475 is used to store the BCD information during the counting period to ensure a non-blinking display. Stored BCD data from the 7475 is decoded using a 7447 seven-segment decoder driver. The 7447 accomplishes blanking of leading edge zeroes, and has a lamp test input which causes all seven segments of the display tube to light.

Kit includes a two-sided (with plated through holes) fibreglass printed circuit board, three IC's, DR-2010 (with decimal point) display tube, and enough Molex socket pins for the IC's.

Circuit board is .8" wide and 4 3/8" long. A single 5-volt power source powers both the IC's and the display tube.

CD-2 Kit Complete Only $10.95
Assembled and Tested $13.00

Board Only $2.50

RCA DR2010 NUMITRON

RCA DR2010 Numitron digital display tube. This incandescent five-volt seven-segment device provides a .6" high numeral which can be seen at a distance of 30 feet. The tube has a standard nine-pin base (solderable) and a left-hand decimal point. Each $4.00
SPECIAL 4 for $17.50

COUNTER DISPLAY KIT—CD-3

This kit is similar to the CD-2 except for the following:

a. Does not include the 7475 quad latch storage feature.
b. Board is the same width but is 1" shorter.
c. Five additional passive components are provided, which permit the user to program the count to any number from two to ten. Two kits may be interconnected to count to any number 2-99, three kits 2-999, etc.
d. Complete instructions are provided to pre-set the modulus for your application.

CD-3 Board Only $2.25
IC's, 7490, 7447 $2.75
RCA DR2010 tube $5.00

Complete kit includes all of the above plus 5 programming parts, instructions, and Molex pins for IC's. Only $9.25

LM309K: 5-VOLT REGULATOR

This TO-3 device is a complete regulator on a chip. The 309 is virtually blowout proof. It is designed to shut itself off with overload of current drain or over temperature operation. Input voltage (DC) can range from 10 to 30 volts, and the output will be five volts (tolerance is worse case TTL requirement) at current of up to one ampere.

Each $1.50 5 for $7.00

Babylon Electronics Inc.

Post Office Box J, Carmichael, California. 95 608 U.S.A.

The Dual 701 automatic single-play turntable with electronic direct-drive system

The Dual 701 is in every respect the finest turntable ever made. Its full measure of superiority can be appreciated best by the most serious of discerning listeners who impose the highest possible standards on their high fidelity equipment.
The specifications for wow, flutter and rumble are a triumph for its totally new kind of motor designed by Dual expressly for the 701. It is an all-electronic, low-speed, brushless, DC motor with Hall-effect feedback control, and energized by a regulated power supply. Its gapless rotating magnetic field eliminates the magnetic surges typical of all other motor designs.
There are no hysteresis or eddy-current losses, and the rotational drive is uniform and vibration-free.

Further evidence of the 701's advanced technology can be seen in the tonearm counterbalance, where two mechanical, anti-resonance filters absorb the resonant energy that would otherwise transfer spurious signals to the stylus.
The 701's many technical features set new standards for high fidelity record playback equipment, and form the nucleus of the highest quality component systems.

Dual CS 601 – Dual's first medium priced belt driven turntable

With the CS 601, Dual introduces its second fully auto matic single-play turntable. The CS 601 drive system consists of an 8-pole synchronous motor, developed especially for this new model, and a precision belt running directly from the drive shaft to a flywheel beneath the 305 mm dynamically-balanced platter.

Dual For the finest in sound: Dual

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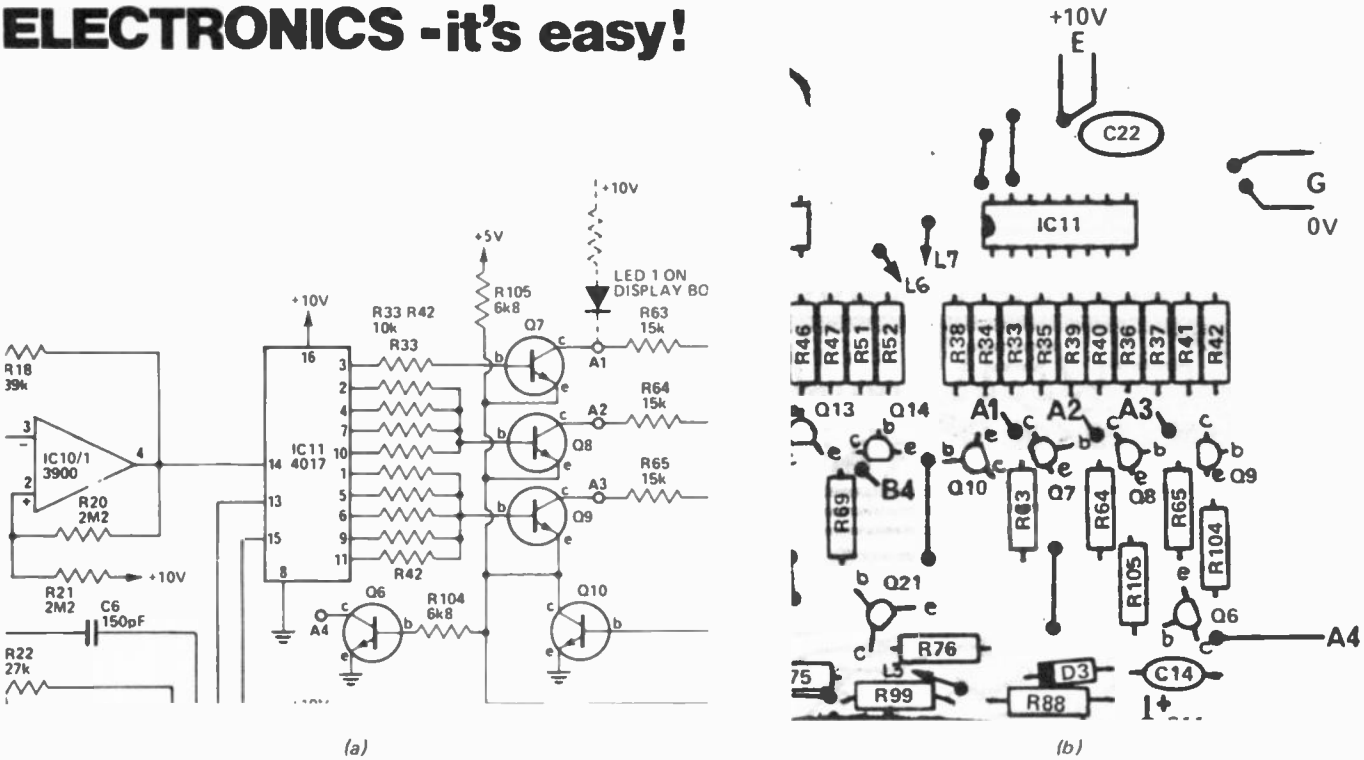

Fig. 13. In use IC counters are used as black-boxes. (a) How it appears in a circuit schematic. (b) How it appears on a circuit board.

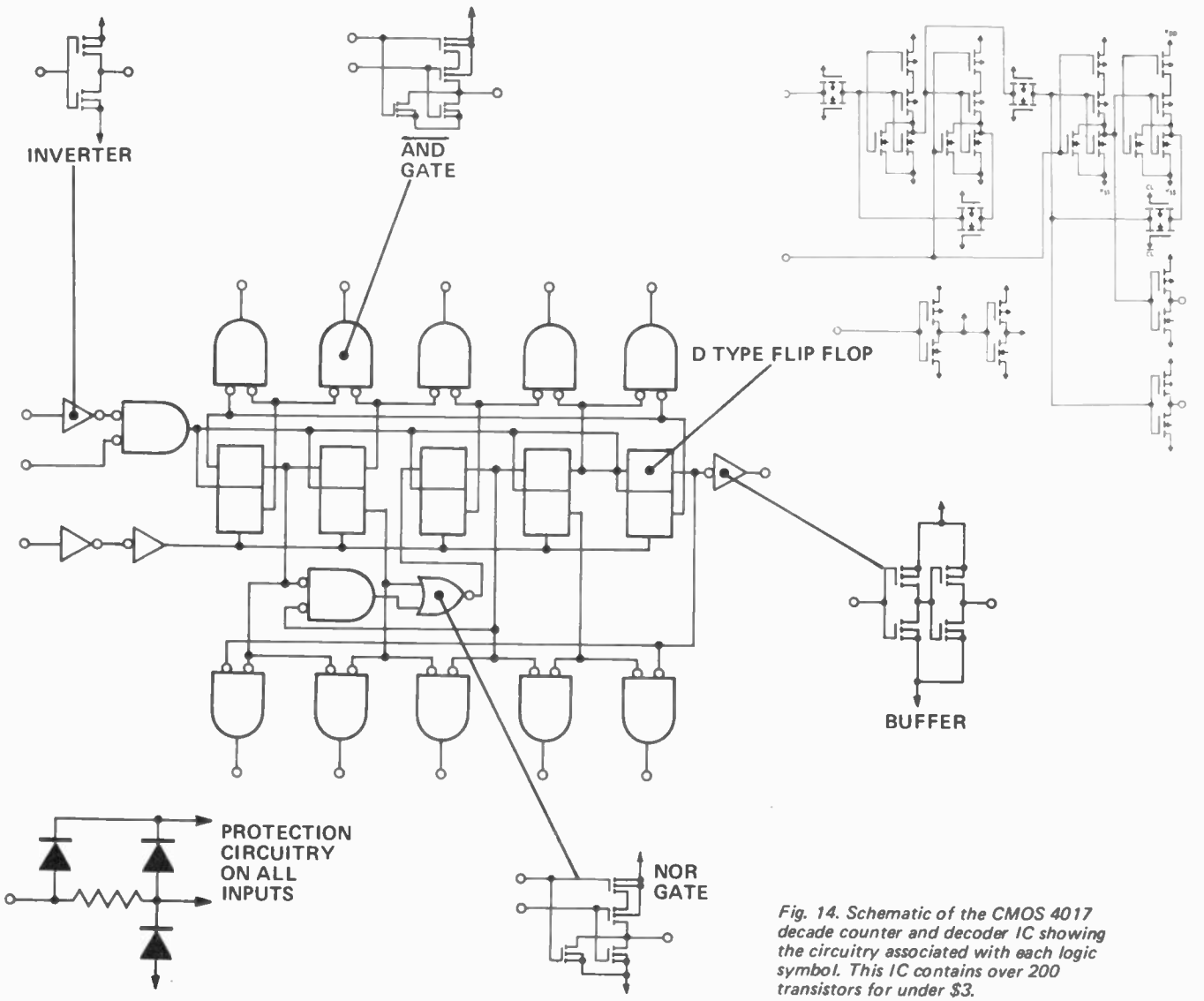

Fig. 14. Schematic of the CMOS 4017 decade counter and decoder IC showing the circuitry associated with each logic symbol. This IC contains over 200 transistors for under $3.

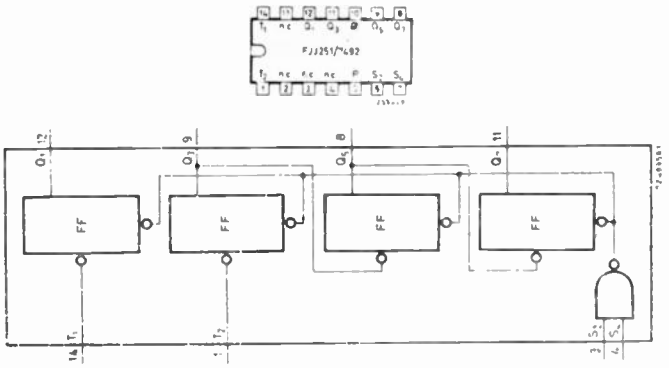

Fig. 15. Schematic of a divide by 12 counter the TTL 7492.

equally important, prevent the system locking up (as can happen in some counting systems).

Decade counters using straight binary are denoted Binary Coded Decimal – BCD. As there is no real reason why a stage should start with decimal 0 and binary 0 coinciding, it is feasible to construct a large number of different BCD counter stages using different code sequences. If the zeros do coincide it is called normal BCD (NBCD).

As we shall see in the next part, it is important to know that BCD code is used when the system needs a display in decimal. This is because the circuitry of the decoder depends upon the logic sequence of the counter as well as the requirements of the display method – more of that later.

At this stage design becomes a matter for the expert but fortunately ICs are available with the whole counter and BCD unit constructed ready to act as one decade. To obtain multiple-position decade numbers we merely cascade decade counter ICs in accordance with manufacturers' data sheets. Figure 10 shows how four JK flip-flops can be connected to provide NBCD counting. Note the need for an additional NAND gate and inverter. Comparing costs, it would usually be illogical to build a counter this way for the cost of ICs to build such a system is higher than that for a ready-made decade stage such as that shown in Figure 11.

Many applications require visual display with each decade: it is now possible to purchase an IC with count and decode functions combined in the one chip.

The question of synchronous versus asynchronous counting in decimal stages still applies. As there are, however, only four stages in each decade, the ripple-through time is not usually as vital an issue as with binary counting. However, this time must be compounded with the ripple-through time for all decades – 12 or more are common on calculators. The fastest decade system is one where all decades are synchronised, not just individual stage flip-flops. The practical catch is, however, that synchronous designs require many extra connections as the number of stages increases.

Reversible decade counters are built in a similar fashion to the binary types – using A or $\bar{A}$ etc., as needed. The problem is complicated by the need to lose states but once again few people would be called upon to design one from scratch as single –IC systems are marketed ready-made. Figure 12 shows the schematic of a reversible synchronous NBCD counter.

USING COUNTERS IN PRACTICAL CIRCUITS

Application Notes explain the connections and any special conditions to be observed in using IC counters. The electronic designer today regards the appropriate IC as a black-box with pins which are wired accordingly – what is inside is of little consequence. Figure 13a shows how an IC counter is represented in a circuit diagram and Figure 13b shows how it is wired onto a printed-circuit board. The internal complexity is seen in the circuit schematic given in Figure 14.

OTHER COUNTERS

The register becomes a counter by joining the output to the input to form a ring-counter. This system passes a pattern around the loop one step at a time for each input pulse. Hence the logical state of the elements at any time represents the number of counts accepted. This is also a convenient way to recirculate a digital word which needs constant re-use. A faster version is the twisted ring-counter.

Counters are also used frequently as frequency dividers. For example, a 1 MHz clock source passed through one BCD decade provides a source at 100 kHz; through two decade counters 10 kHz and so on. As it is more convenient to provide stable high frequencies than stable low frequencies, precise low-frequency pulse trains are best produced by this subdivision process.

As four flip-flops will provide up to 16 states they can also divide by 12 by the use of stage interconnections. Figure 14 is the schematic of a divide by 12 counter. These are used in timing systems to provide two seconds, minutes and hours units. A divide by five plus divide by two is also available in the same IC.

Just eight years ago my technician and I built one of the fastest up-down decade counters reported at the time. It used discrete components, it took several months to build, could reverse at about 400 kHz, cost about $300 in components alone, needed a shoe-box size container and a hefty power supply. Today a match-box size unit, including a battery, virtually indestructible in normal use, can be reversible at (at least) 10 MHz rates and is available 'off the shelf'. It costs a mere few dollars and is vastly more reliable. We have reached the point where the mechanicals – the knobs, dials, case and boards cost more than the electronics circuitry. At the time of writing $110 buys a 100 step programmable pocket-size calculator. We are truly in a systems, rather than components, age of electronic capability.

FURTHER READING:

An excellent inexpensive book worth purchasing is: "Digital Instruments Course – Part 1, Basic Binary Theory and Logic Circuits" – A.J. Bouwens, N.V. Philips Gloeilampenfabrieken, Eindhoven, Netherlands, 1974. (Available from Philips offices).

This gives a little more depth than this course can allocate and is recommended for those people who are involved with building digital systems routinely. ●

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Large international marketing organisation with offices in all states invites applications from experienced Television Technicians with some knowledge of colour.

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trident colour television

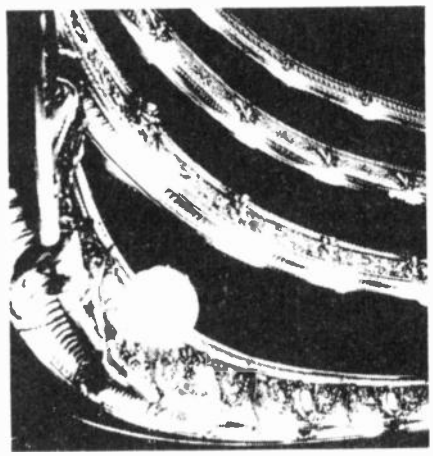
'The AR-6 is just about the finest inexpensive speaker one could hope to encounter.

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

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

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

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

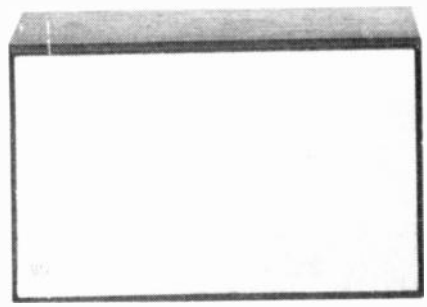


'All in all, the AR-6 acquitted itself very well in our tests. It was not quite the equal of the much more expensive AR models, whose sound it nevertheless resembles to an amazing degree, but on the other hand it out-performed a number of considerably larger and far more expensive systems we have tested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

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

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

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



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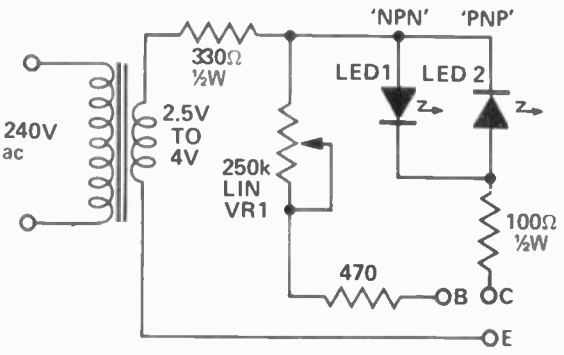
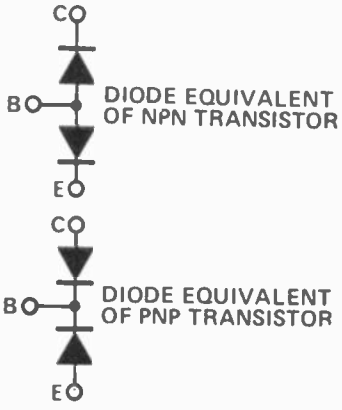
IDEAS FOR EXPERIMENTERS

GO/NO-GO DIODE/TRANSISTOR CHECKER

A diode can be checked by connecting it between C and E. If LED 1 lights the diode is OK and its anode is connected to C. If LED 2 lights its cathode is connected to C. If both lights it is a short circuit suitable only as a link!

To check transistors with known pin connections, set VR1 at maximum resistance and connect the transistor. Advance VR1 until one LED lights. If LED 1 lights it is NPN, PNP if LED 2 lights. If both light you have a three-legged link. If neither light you have a used three-legged fuse!



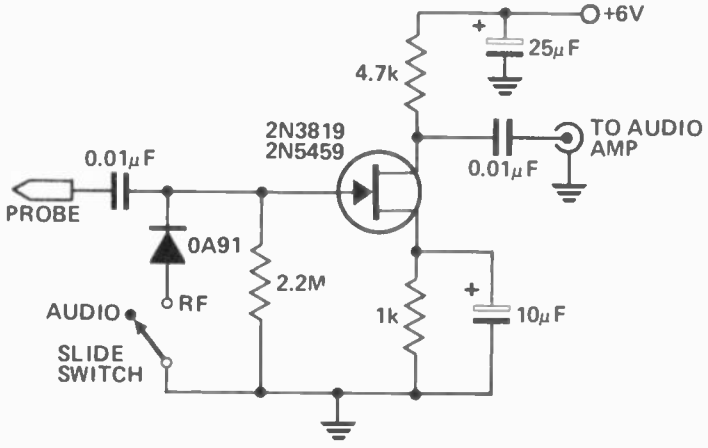


To check transistor connections, if unknown, short two of its leads together and check as for a diode making note of which lead/leads, respond as anodes. Short two other leads together and do it again. Refer to diagrams above.

AUDIO-RF SIGNAL TRACER PRE-AMP

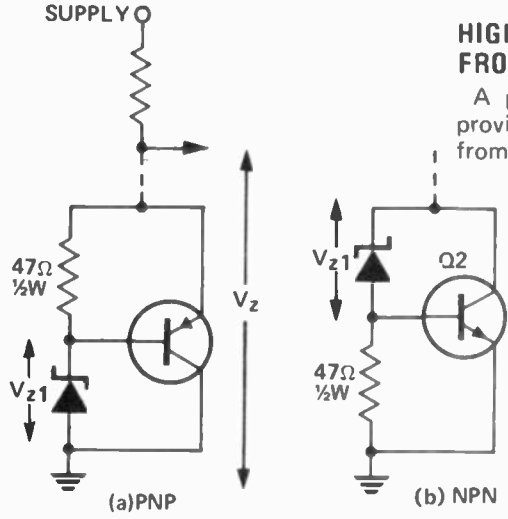
This economical signal tracer is very useful for servicing and alignment work in receivers and low power transmitters. It is easily constructed on a small piece of matrix board which can be mounted inside a commercially-available probe case or homemade probe. The slide switch can be mounted on the probe housing. A miniature toggle switch could be used as a substitute.

When switched to RF, the modulation on any signal is detected by the diode and amplified by the FET. A twin-core shielded lead can be used to connect it to an amplifier and to feed 6 volts to it.



HIGH-POWER ZENERED VOLTAGE FROM LOW POWER SOURCES

A power transistor can be used to provide a high power zenered voltage from a low wattage zener. A 400 mW zener can be used where a 10 watt zener is required or a 1 W zener can be used where a 50 to 80 watt zener is required, by using appropriate transistors for Q1 and Q2 in the above circuits.



$V_{z1} = V_z - V_{be}$

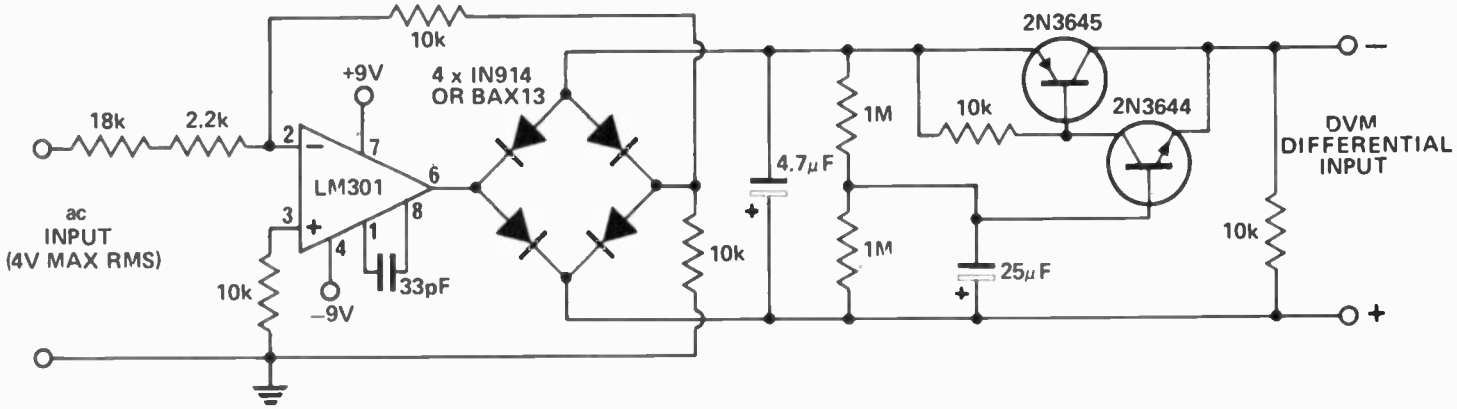
Q1, Q2 – GERMANIUM OR SILICON POWER TRANSISTOR

V_{be} – GERMANIUM = 0.3V
V_{be} – SILICON = 0.7V

Where low rating is required Q1 would be a ASZ 15 (germanium) or an AY9140 (silicon). Q2 could be a 2N3054 (silicon). For higher powers Q1 could be an ASZ18 (germanium) or a 2N2955 (silicon) and Q2 a 2N3055 (silicon) or an AY8149 (silicon).

A heatsink on the transistor is required. The circuit in (a) has the advantage that power transistors can be bolted directly on to a chassis which may serve as a heatsink.

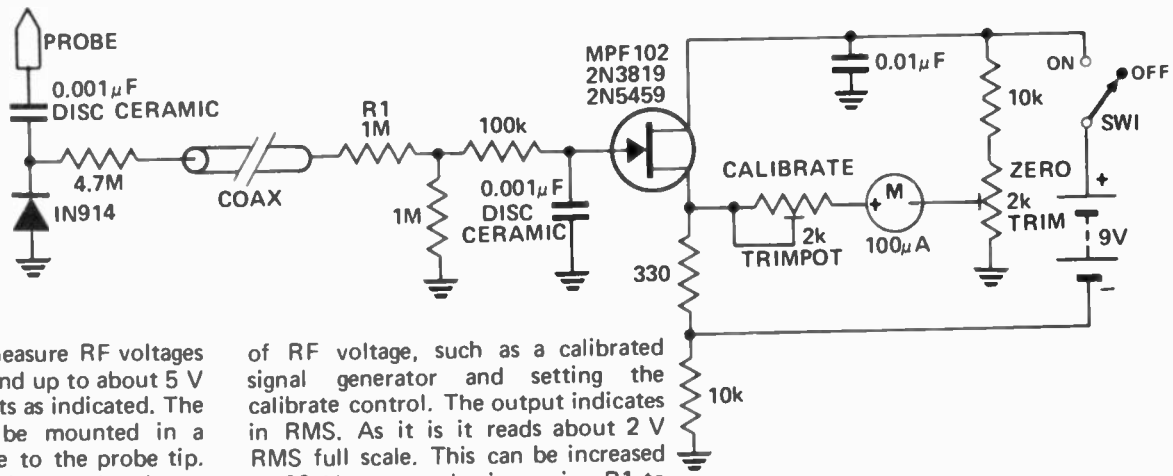
MEASURING RMS VALUE OF AC WITH A DC DVM



The above circuit may be used for measuring the RMS value of ac (sinewave) with a dc digital voltmeter. It has a frequency response to beyond 10 kHz and will measure signals as low as 400 mV. The error rises at low frequencies, somewhat below 50 Hz, to about 4% mean. The LM301 supply may be as low as ± 4V. or up to ± 15V. if desired with reduced sensitivity at the lower voltage.

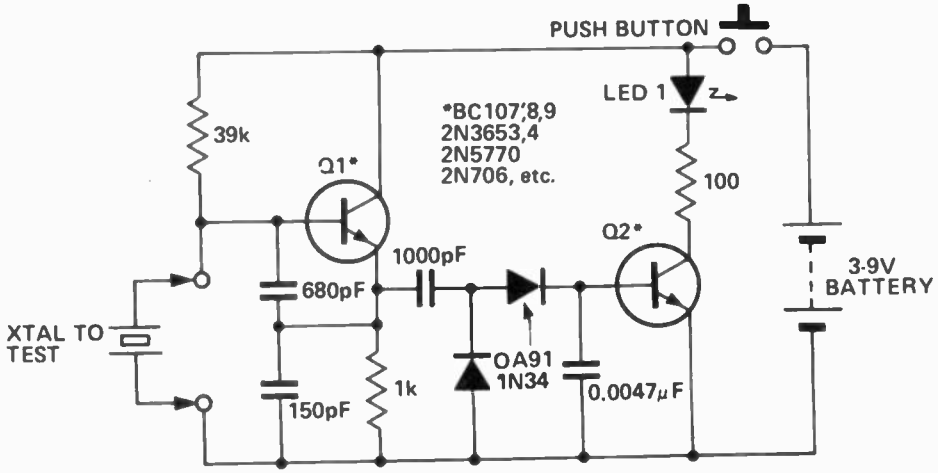
The DVM input must be floating and a differential input is required. To increase the input range a step attenuator may be used.

SENSITIVE RF VOLTMETER



This device will measure RF voltages beyond 200 MHz and up to about 5 V with the components as indicated. The diode etc should be mounted in a remote probe, close to the probe tip. Sensitivity is excellent and voltages less than 1 V peak can be easily measured. The unit can be calibrated by connecting input to a known level of RF voltage, such as a calibrated signal generator and setting the calibrate control. The output indicates in RMS. As it is it reads about 2 V RMS full scale. This can be increased to 20 V or more by increasing R1 to 20 M (two 10 M in series). The 100 μA meter could be a multimeter if desired.

CRYSTAL CHECKER



For checking fundamental HF crystals on a 'Go-No-Go' basis, the above circuit works quite well, An untuned Colpitts oscillator drives a voltage multiplier rectifier and a current amplifier. If the crystal oscillates, Q2 conducts and the LED lights. A 3 or 6 V, 40 mA globe could be substituted for the LED.

JAPANESE COMPONENT CODES

Japanese and some other imported components are marked with codes giving value, tolerance etc. as shown above. Colour coded RF chokes use the same colour code as resistors but the value is in microhenries – similar to the Philips RFC coding.

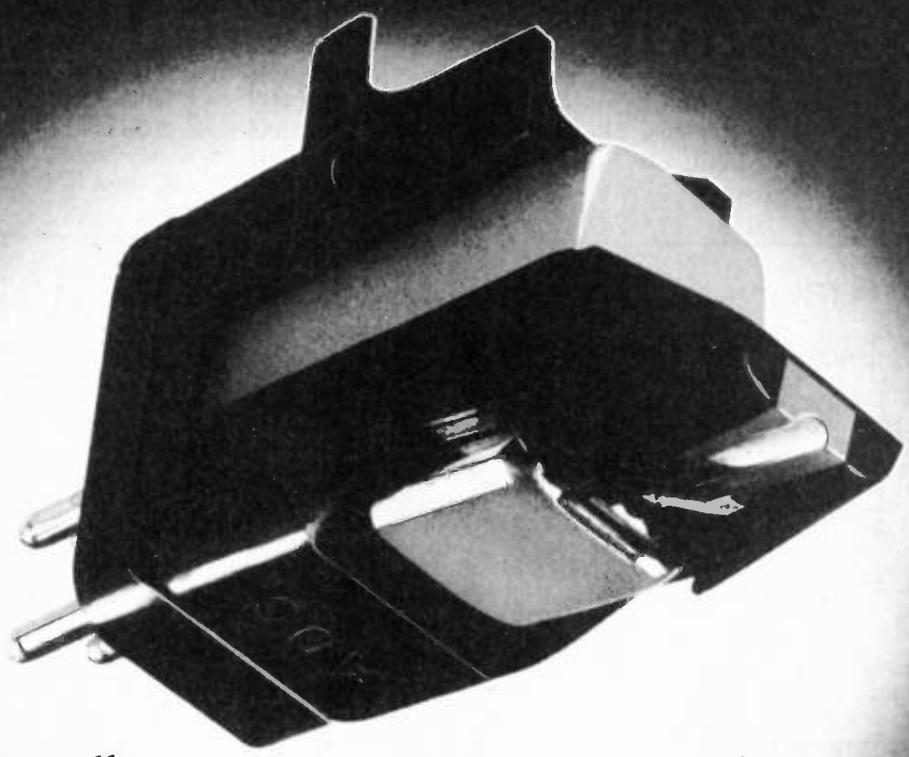
FREQUENCY RESPONSE "The CBS STR-100 test record showed less than ± 1.5dB variation up to 20,000Hz". *Stereo Review.*
"...response is within ± 2dB over the entire range". *Audio*
"Frequency response is exceptionally flat". *High Fidelity*

TRACKING "This is the only cartridge we have seen that is really capable of tracking almost all stereo discs at 0.4 grams". *Stereo Review*
"The XLM went through the usual torture test at 0.4 grams (some top models require more than a gram)". *High Fidelity*
"The XLM is capable of reprocucing anything found on a phonograph record". *Audio*

DISTORTION "Distortion readings...are almost without exception better than those for any other model we've tested". *High Fidelity*
"The XLM has remarkably low distortion in comparison with others". *Audio*
"At 0.6 grams the distortion was low (under 1.5 per cent)". *Stereo Review.*

HUM AND NOISE "The XLM could be instrumental in lowering the input noise from the first stage of a modern transistor amplifier". *Audio*
"The cartridge had very good shielding against induced hum". *Stereo Review*

PRICE "This would be a very hard cartridge to surpass at any price". *Stereo Review*
"We found it impossible to attribute superior sound to costlier competing models". *High Fidelity*
"Priced as it is, it is a real bargain in cartridges". *Audio*



"...in a class by itself."

That's the way *Stereo Review* described our ADC-XLM.

High Fidelity headlined their review, "superb new pickup from ADC" and went on to say, "...must be counted among the state of the art contenders."

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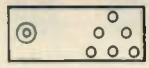

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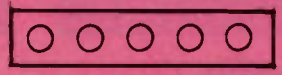

	KIT	BUILT	P&P
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25W RMS per channel ETI440	$85.00	$115.00	$4.00
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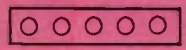
PLAYMASTER 141



Uses Texas Instruments Integrated Circuits. 5 Watts per channel. Load: 8 ohms. Input impedance: appox. 100K ohm. Response: 40 Hz to 45 kHz. Distortion: typically .3%.
KIT $19.50 + P&P $1.50. MODULE $25.00 + P&P $1.50
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Front panels: (not included in kit or module) $4.95 + P&P $1.00
PLAYMASTER 142: KIT $35.00 + P&P $2.00.

DT 1302 $19.00 + P&P $2.00
16 range multi-tester

A ruggedly, compact, precision multitester, incorporates a recessed nylon range selector switch, and OHM adjustment knob. Features an easy reading fan type scale.

SPECIFICATIONS — Sensitivity: 20,000 ohm/volt. DC Volt: 0-5-25-50-250-500-2,500. AC Volt: 0-10-50-100-500-1,000. DC Current: 0-50μA, 0-25mA, 0-250mA. OHM: 0-6k, 0-6Meg. Capacitance: 10μF — .001μF, .001μF — 1μF. Decibels: —20 — + 22 dB. Sizes: 110 x 80 x 35mm.

DT 1307 $49.00 P&P $2.00
19 range FET. multi-tester

Solid state portable FET multitester with 12 megohm DC input resistance. Separate diode protection for the meter on all ranges.

SPECIFICATIONS — Sensitivity: 36μA DC at full scale. Input: All DC voltage range 12 meg ohm. Resistance: All AC voltage range 10k ohm. DC Volt: 0-0.3-1.2-12-60-300 1200. AC Volt: 0-3-30-120-300-1200. DC Current: 0-0.6-60-600 μA, 0-600mA. OHM: 0-1k-100 K - 1M - 1000 Meg. Decibels: — 20 — + 11 dB. Size: 160 x 120 x 60 mm.

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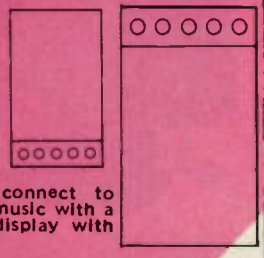

Just plug into mains, connect to speakers and watch your music with a 4 colour multiple light display with control of each channel.

SMALL $49.50, LARGE $69.50, P&P $5.00.

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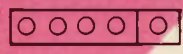
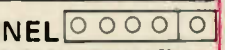


Two 2 mV inputs, two 100 mV inputs with active mixing, built and tested unit. **$29.50 plus P&P $2.50.**

FOUR CHANNEL AUDIO TO LIGHT DRIVER



Just plug into mains, connect to speaker and plug in 4 external coloured lights (not supplied) — Gives you your own Disco show1 Built and tested **$39.50 plus P&P $2.50.**

DT 1001 $7.50 + P&P $1.00
11 range pocket multi-tester

Ideal instrument for the technician and useful for the budget minded hobbyist. Features range selector switch and zero adjustment for needle. Test leads and prods included.

SPECIFICATIONS — Sensitivity: 1,000 ohm/volt. DC Volt: 0-10-50-250-1,000. AC Volt: 0-10-50-250-1,000. DC Current: 0-1-100 mA. OHM: 100k (3K at center scale). Size: 95 x 60 x 30 mm.

DT 1306 $39.00 P&P $2.50
22 range multi-tester

Deluxe, accurate and high sensitive instrument. Equipped with high sensitive ± 2% meter of 8.7μA movement. Polarity changeover switch.

SPECIFICATIONS — Sensitivity: 1 C Ω 000 ohm/volt. DC Volt: 0-0.5-2.5-10-50-250-1000. AC Volt: 0-5-10-50-250-1000. DC Current: 0-10μA-500μA 5mA-50mA-500mA-10A. OHM: 0-1.6k-16-1.6M-16M-160 Meg. Size: 215 x 150 x 85mm.

MODULES

* Fully wired & tested.
*Complete with instructions.
*Watts quoted refer to R.M.S. per channel

AM TUNER

$14.95 plus P&P $1.50. Range: 535 kHz to 1605 kHz. Aerial: Ferrite rod included Sensitivity: 80μV. Signal to noise: 20 dB at 80μV. Power supply: 9V at 4 mA.

FM/AM TUNER

$39.95 plus P&P $1.50. Range: 88 to 108 MHz. Sensitivity: 3.5μV. Signal to noise: 52 dB at 100μV. Stereo indication: 100 mA globe required. Signal strength: 200μA meter required. This module includes de-coder. AM section has same specifications as AM module. Power supply: 12V at 22 mA.

*7.5 W STEREO AMP

$19.50 plus P&P $1.20
Response: 50 Hz to 50 kHz ± 3 dB Load: 8 ohms, Input impedance: 100K ohm. Gain 39 dB. Distortion: typically <0.1%. Power supply: 24 — 32V.

*15 WATT AMP

MONO $19.50, STEREO $29.50 plus P&P $1.50.
Response: 10 Hz to 50 kHz ± 3 dB. Load: 8 ohms. Input impedance: 24 ohm. Gain: 33 dB. Distortion: typically <0.1%. Power supply: ± 16V to ± 20V.

*30 WATT AMP

MONO $29.50 plus P&P $1.50 STEREO $39.50.
Response: 10 Hz to 50 kHz ± 3 dB. Load: 8 ohms. Input impedance: 25k ohm. Gain 30 dB. Distortion: typically <0.1%. Power supply: ± 24V to ± 30V.

*See ETI August & September for semi-conductors, resistors capacitor, IC's transistors and hardware.

PRE-AMP'S

$12.50 plus P&P $1.00
Response: 25 Hz to 50 kHz — 1 dB. Output: 100 mV. Distortion: typically <0.05%. Power supply: 18-22V. Stereo magnetic cartridge pre-amp 2 mV. Input: Dual lo-impedance mic. pre-amp 0.02 mV. Input: Dual hi-impedance mic. pre-amp 2 mV. Input: Dual guitar pre-amp 30 mV. Input: Dual tape head pre-amp 0.2 mV.

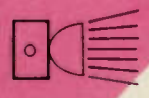
SQ DE-CODER

$12.50 plus P&P $1.00.
Uses MC1312P De-coder. Power supply: 18 — 22V.

FUNCTION GENERATOR

$19.50 plus P&P $1.00.
Uses 8038 and 709 I/C's. Gives variable and frequency sine, triangular and sqaure wave ouputs. Power supply: 18 — 22V.

ETI 1505 HI-POWER STROBE



Built and tested, simply plug in and use.

$25.50 plus P&P $2.00

KITS

	Kit	Module	P&P
ETI 533	$24.00	$29.50	$1.50
ETI 117	$16.00	$19.50	$1.00
ETI 704	$25.00	$29.50	$2.50
ETI 120	$13.95	$10.95	$1.00
ETI 121	$12.95	$ 9.95	$1.00
ETI 118	$49.50	$32.50	$1.50

SLIDE POTS

*Only in log **Only linear

	Bulk disc. price	Qyt. in pack
Single gang log (Code RSSC) Single gang linear (Code R55A) *4.7k, 10k, **22k, 47k, 100k, 220k, 470k, 1M.		
Double gang log (Code RSGC)	$.600	5
Double gang linear (Code RSGA) *10k, 22k, 47k, 100k, 220k, 470k, 1M		

NOTE: Mixed value packs of ½w, 1w, resistors, ceramics and greencaps are not available. Packs contain one value only. Other components available in any quantity subject to 20% surcharge on quantity not in standard pack. EXAMPLE: 7 double-gang slide pots: Pack of 5 = $6.00 plus 2 = $2.40. 20% surcharge on 2 = 48c. Sub-total = $8.88 plus 10% P&P (88c) TOTAL $9.76

PERSONAL SHOPPERS

HITEL HI-FI
SHOP 4, SKIPTON'S ARCADE, PENRITH,
(047) 21-0850

HITEL RECORD BAR,
SHOP C, NEPEAN ARCADE, PENRITH.
(047) 21-0850

S&P PHOTOGRAPHICS & ELECTRONICS
26 QUEEN ST NAMBOUR, 4560
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A.E. COOLING
RADIO AND TELEVISION SERVICE
6 TRIMMER ROAD,
ELIZABETH SOUTH, 5112
PHONE 08-2552249

MAIL ORDER

Add 10% for post and packing. Minimum order $5 plus P&P.

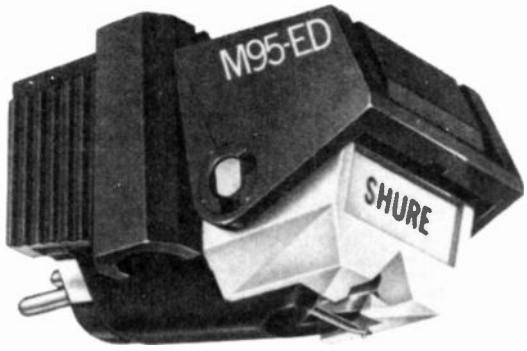
MOD-AMP

P.O. Box 180, AVALON 2107

RETAIL OUTLETS IN METROPOLITAN AND COUNTRY AREAS NOW BEING APPOINTED – ENQUIRIES WELCOME

THE NEW '#TWO'

BY ANY MEASURE OF PERFORMANCE...THE CARTRIDGE SECOND ONLY TO THE SHURE® V-15 TYPE III



NEW!

M95ED Deluxe High Trackability Cartridge

Second only to one! The Shure M95ED combines several of the high-performance design features of the Shure V-15 Type III to deliver exceptional trackability (at ¾ to 1½ gram forces). A radically new internal electromagnetic structure insures a level of total performance surpassed only by the Type III. The M95ED incorporates a new, thinner, uninterrupted pole piece developed by Shure design engineers to optimize electromagnetic characteristics—especially at higher frequencies. As a result, magnetic losses have been minimized, and frequency response remains essentially flat across the entire frequency range.

With its nude-mounted, biradial elliptical stylus tip, the M95ED has a very low effective stylus tip mass. This results in higher trackability to maintain perfect groove contact through the "hottest," most heavily modulated passages encountered on modern recordings—all at extremely light tracking forces that reduce record wear and increase stylus tip life. And, as a "plus," its exceptional trackability makes the M95ED an outstanding choice for use in four-channel encoded (matrix) systems.

AE095/FP

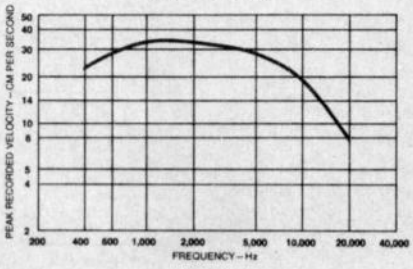
M95ED SPECIFICATIONS

Trackability at 1 gram tracking force using a Shure/SME Arm:

24 CM/SEC at 400 Hz
33 CM/SEC at 1,000 Hz
28 CM/SEC at 5,000 Hz
19 CM/SEC at 10,000 Hz

Tracking Force: ¾ to 1½ grams
Frequency Response: 20 to 20,000 Hz

TRACKABILITY CHART
(at 1 Gram)



Optimum Load

47,000 ohms resistance in parallel with 400 to 500 picofarads total capacitance per channel. (Load resistance can be as high as 100,000 ohms and total capacitance can be as low as 100 Picofarads with only minor audible change.) Total capacitance includes the capacitances of the tone arm wiring, phono cables, and the amplifier input circuit.

Output Voltage: 4.7 mV per channel at 1,000 Hz at 5 CM/SEC peak velocity

Channel Separation: Minimum 25 dB at 1,000 Hz

Channel Balance: Output from each channel within 2 dB

Stylus: N95ED Biradial elliptical with nude diamond tip

17.8 microns (.0007 inch) frontal radius

5 microns (.0002 inch) side contact radii

25 microns (.001 inch) wide between record contact points

78 rpm Stylus: N95-3 Spherical—63 microns (.0025 inch)

Inductance: 650 millihenries

D.C. Resistance: 1550 ohms

Weight: 6 grams

Mounting: Standard 12.7 mm (½ inch) mounting centers

FOR HEAVIER TRACKING TURNTABLES AND TONE ARMS

. . . Shure designed the M95EJ Custom high trackability cartridge. It uses the same newly developed pole piece as the M95ED and delivers a frequency response virtually identical in its flatness—but at slightly greater tracking forces. The M95EJ features a biradial elliptical stylus tip, and tracks at 1½ to 3 grams. An ideal cartridge choice for audiophiles who want to upgrade their record playback systems at moderate cost!

New Recommended Retail Prices: M95ED $52 — M95EJ $38

SHURE®

AUDIO ENGINEERS P/L
342 Kent Street,
SYDNEY 2000 N.S.W.

AUDIO ENGINEERS (Vic.)
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THORNBURY 3071 Vic.

RON JONES PTY. LTD.
57 Castlemaine Street,
MILTON 4064 Qld.

ATHOL M HILL P/L
1000 Hay Street,
PERTH 6000 W.A.

Buying an AM/FM stereo receiver? Just compare the rest to

ROTEL

With four models rated from 32 to 120 watts RMS, the Rotel stereo receiver range is comprehensive . . . each model offering outstanding value for money. Attractive designs are combined with technical excellence and painstaking manufacture. The result? A stereo receiver you'll be proud to demonstrate to your friends. For example, take Rotel's FM tuner sections. All feature FET front ends for extreme sensitivity and very low distortion. All feature ceramic filters and integrated circuitry for extra selectivity and reliability. Rotel's attention to detail in the FM tuner sections is indicative of Rotel's manufacturing philosophy and the overall excellence of the Rotel range. When you are listening to a Rotel demonstration, please be quite analytical. Compare other units with Rotel. Compare performance — compare the price. See how much more Rotel offers for your stereo dollar!

CHOOSE FROM FOUR OUTSTANDING ROTEL STEREO RECEIVERS . . .

RX-202	RX-402	RX-602	RX-802
32 watts RMS into 8 ohms	48 watts RMS into 8 ohms	76 watts RMS into 8 ohms	120 watts RMS into 8 ohms
20-70,000 Hz.*	10-75,000 Hz.*	10-100,000 Hz.*	10-100,000 Hz.*
AM/FM Tuners	AM/FM Tuners	AM/FM Tuners	AM/FM Tuners

**All frequency response figures are quoted plus or minus 3 dB.*

- **For technical information in detail, ask for the Interdyn Infopak RT1.**

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1DRT/1

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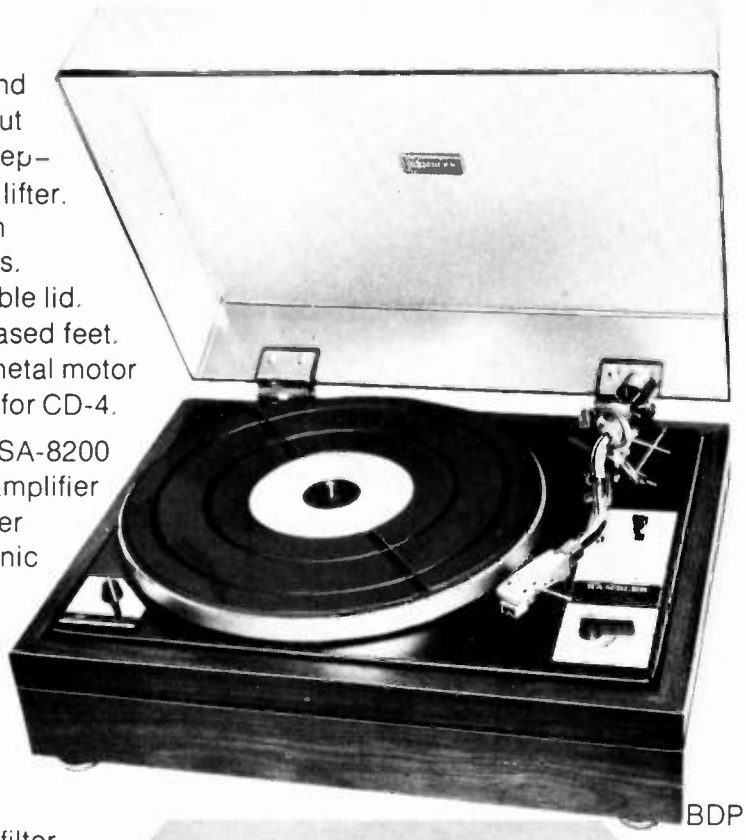
Available from:
A.C.T.: Duratone Hi Fi, Cnr Botany St & Altree Crt, Phillip 2606. Telephone: 82-1388.
N.S.W.: M & G Hoskins Pty Ltd, 400 Kent St, Sydney 2000. Telephone: 546-1464, 547-1093.
Qld: Stereo Supplies, 95 Turbot St, Brisbane 4000. Telephone: 21-3623. S.A.: Challenge Hi Fi Stereo, 96 Pirie St, Adelaide 5000. Telephone: 223-3599. TAS.: Audio Services, 9 Wilson St, Burnie 7320. Telephone: 31-4111. VIC.: Encel Electronics Pty Ltd, 431 Bridge Rd, Richmond 3121. Telephone: 42-3762. W.A.: Arena Distributors, 282 Hay St, Perth 6000. Telephone: 25-2699.

RAMBLER

Starts you off on the right track.

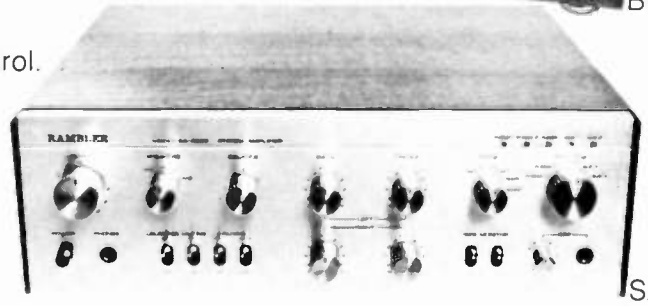
The BDP-100 Turntable and the SA-8200 amplifier are two fine examples from the Rambler Range of Hi-fidelity audio equipment.

The BDP-100 2-speed turntable is quality engineering throughout, featuring a diecast platter, belt driven from a synchronous motor. An "S"-shaped, low tracking error arm with adjustable anti-skate and lateral balance. Auto cut and return arm with indep-endent dampened arm lifter. Magnetic cartridge with diamond elliptical stylus. Spring loaded detachable lid. Shock absorbing felt based feet. Sprung, heavy gauge metal motor board and wired ready for CD-4.



BDP100

Channel it through our SA-8200 multi-purpose, stereo amplifier with its 55 watts RMS per channel output. Harmonic distortion of less than 0.2% at 45 watts RMS per channel. Inputs:— 2 phono, 2 AUX, 2 tape, tuner and mic. Separate base and treble controls on each channel. High and low filter switches and loudness control. Provision for 2 pairs of speakers. These are just some of the many value packed features in these two superb pieces of Rambler Hi-Fi equipment.



SA8200

"Rambler – The Best Thing That Has Happened to Music."

See and hear the Rambler range of sound equipment at your Rambler dealer now and compare the outstanding performance and value.

Distributed and serviced throughout Australia by Sun Electric Co. Pty. Ltd. Melbourne, Sydney, Brisbane, Perth, Adelaide, Hobart and Canberra.

MR 160

AUDIO FACTS

DISTORTION MAY HELP!

In some circumstances amplifier distortion may actually be advantageous!

This is just one of the quite surprising findings of a study made of transient intermodulation distortion by leading audio authority Gordon King.

The study at least partially explains why some amplifiers with exemplary specifications are subjectively inferior to others with lower specs. And why amplifiers with similar specs may not sound the same.

Gordon King's full report on the fascinating subject will be published in Electronics Today International very soon.

FERRI-CHROME TAPE

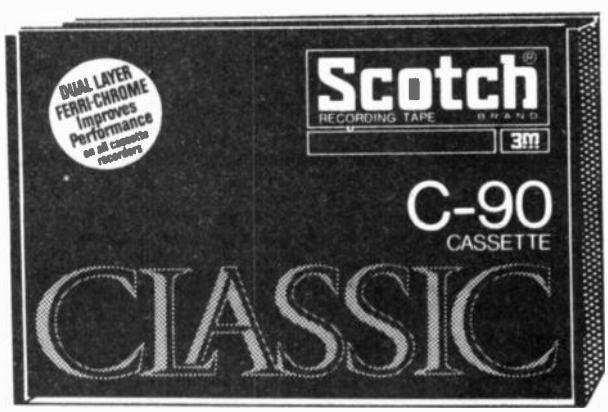
A new Scotch brand 'Classic' cassette line is claimed to offer a more brilliant high frequency response, excellent response at low frequencies, and a higher overall output than previous 3M Cassettes.

The cassettes use a dual-layer technology to combine low-noise, ferric oxide and chromium dioxide in a ferric-chrome tape.

Overall higher output, excellent low frequency response, and high frequency response, superior or equal to that of low-noise ferric oxide & "chrome" tape is claimed, when the tape is played on a machine either without a "chrome" switch or with it in a "non-chrome" setting.

According to 3M 'Scotch' CLASSIC has 10 dB increased headroom at 12.5 kHz before saturation, giving undistorted highs that are clear, crisp and natural. When compared to "chrome" tape in the "chrome" switch setting, the high-frequency performance is equal; the low-frequency performance is 5 dB superior.

"This development", says Tony Page, Marketing Manager of 3M's Magnetic Audio/Video Products Division, "permits higher recording and play back quality with cassette recorders which do not have a special switch for chromium dioxide tape". He said that recorders with a two-position switch ("normal" and "chrome") should be used in the "normal" position with the new tape and those with three-position switches should be set at the "high performance" setting.



HI-FI CONTEST

A complete AKAI hi-fi system, an AKAI cassette recorder and a number of record care kits are prizes in a contest organised jointly by AKAI and our associate publication Hi-Fi Review.

The contest is in two parts – in one part entrants rank in order of preference ten features of a typical cassette recorder. In the second part of the contest entrants write a caption to a picture. Entrants may enter either or both parts of the contest.

Details and entry forms are in the October issue of Hi-Fi Review which is on sale from October 1st onwards.

FIFTEEN TO TWENTY THOUSAND AT SYDNEY HI-FI SHOW

Sydney's recent hi-fi exhibition held at the Koala Motel attracted some fifteen to twenty thousand people according to reliable estimates.

Unlike previous years, few exhibitors were displaying or demonstrating four-channel equipment and it now seems that, even if one compatible system were to be adopted, four-channel sound is unlikely to be the market success that its protagonists had hoped. There may however be further developments next year.

Gale's very impressive looking GS 401A loudspeaker attracted a lot of interest. Its specifications are equally impressive – harmonic distortion of less than 0.5% right across the audio spectrum – response in an anechoic chamber of ± 3 dB from 70-20 000 Hz – and a seven year guarantee. We hope to review this unit soon.

BASF were showing their new range of high quality Dolby encoded pre-recorded tape cassettes.

Star of the show seemed to be Cerwin Vega's massive horn loaded bass driver. This extraordinary device is of the type used to produce the very low frequency rumble used in the film 'Earthquake'. It is capable of producing sound levels of up to 140 dB if the theatre can stand it!

A very ingenious approach to record cleaning was displayed by Colton (represented in Australia by Crest Records). Although it looks like a cross between a van der Graff generator and the Domain moving footway, it does seem to work very well. It consists of an endless moving belt that is charged electrostatically by pads which touch the moving record surface beneath. Dirt is electrostatically attracted to the moving belt and then deposited on a separate replaceable felt pad. The belt itself is driven from a small rubber wheel that presses against the record near its centre.

5% OFF ON ORDERS OVER $50.00
10% OFF ON ORDERS OVER $100.00
15% OFF ON ORDERS OVER $250.00

NOVEMBER SPECIALS

CALCULATOR CHIPS

S738 8 digit multiplexed — five function — chain operation 2 key memory — floating decimal — independent constant — interfaces with led with only digit driver — 9 V batt. oper. 24 pin **$3.95**

S739 9 digit — 4 function — chain operation — 9V battery operation — 16 sec turn-off 22 PIN DIP **$3.95**

CLOCK CHIP

5311 6 digit multiplexed — 50-60 Hz — BCD and 7 seg out — fast, slow set 12-24 Hr — 28 PIN DIP **$3.95**

TIMERS

555	Multipurpose timer 8 PIN DIP	$ .69
556A	Dual 555 14 DIP	$1.29

POCKET CALCULATOR KIT

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

CALC KIT **$12.95**
BATTERIES ONLY (DISPOSABLE) SET **$2.00**

9 DIGIT LED DISPLAY FNA 37

On multiplexed substrate, comm. cathode compatable with all 8 digit calculator chips, 7 segment right hand decimal, red with clear magnifying len .12" character, 1 to 4 MA, 1.8 V typ 2⅛" x ¼" x 1/16" high **$3.95**

TTL (DIP)

7432	$ .19	7493	$ .49
7448	.89	74107	.33
7475	.45	74121	.35
7490	.49	9601	.75

VOLTAGE REGULATORS

309K	TO-3	$1.00
340T-5V	TO-220	$1.00
340T-15V	TO-220	$1.00

MEMORIES

1103	$ 1.29
5203	12.95
5260	.99
5262	3.19

TTL

7400	$ .14	7451	.17	74154	1.25
7401	.16	7453	.17	74155	1.07
7402	.15	7454	.17	74156	1.07
7403	.16	7460	.17	74157	.99
7404	.19	7464	.35	74158	1.79
7405	.19	7465	.35	74160	1.39
7406	.35	7470	.30	74161	1.25
7407	.35	7472	.30	74162	1.49
7408	.18	7473	.35	74163	1.39
7409	.19	7474	.35	74164	1.59
7410	.16	7475	.57	74165	1.59
7411	.25	7476	.39	74166	1.49
7413	.55	7483	.79	74170	2.30
7416	.35	7485	1.10	74173	1.49
7417	.35	7486	.40	74174	1.62
7420	.16	7489	2.48	74175	1.39
7422	.26	7490	.59	74176	.89
7423	.29	7491	.97	74177	.84
7425	.27	7492	.71	74180	.90
7426	.26	7493	.60	74181	2.98
7427	.29	7494	.94	74182	.79
7430	.20	7495	.79	74184	2.29
7432	.23	7496	.79	74185	2.29
7437	.35	74100	1.30	74187	5.95
7438	.35	74105	.44	74190	1.35
7440	.17	74107	.40	74191	1.35
7441	.98	74121	.42	74192	1.25
7442	.77	74122	.45	74193	1.19
7443	.87	74123	.85	74194	1.25
7444	.87	74125	.54	74195	.89
7445	.89	74126	.63	74196	1.25
7446	.93	74141	1.04	74197	.89
7447	.89	74145	1.04	74198	1.79
7448	1.04	74150	.97	74199	1.79
7450	.17	74151	.79	74200	5.90
		74153	.99		

LOW POWER TTL

74L00	$ .25	74L51	$ .29	75L90	$1.49
74L02	.25	74L55	.31	74L91	1.45
74L03	.25	74L71	.25	74L93	1.69
74L04	.25	74L72	.39	74L95	1.69
74L06	.25	74L73	.49	74L98	2.79
74L10	.25	74L74	.49	74L164	2.79
74L20	.31	74L78	.79	74L165	2.79
74L30	.31	74L85	1.25		
74L42	1.49	74L86	.69		

HIGH SPEED TTL

74H00	$ .25	74H21	$ .25	74H55	$ .25
74H01	.25	74H22	.25	74H60	.25
74H04	.25	74H30	.25	74H61	.25
74H08	.25	74H40	.25	74H62	.25
74H10	.25	74H50	.25	74H72	.39
74H11	.25	74H52	.25	74H74	.49
74H20	.25	74H53	.25	74H76	.49

8000 SERIES

8091	$ .53	8214	$1.49	8811	$ .59
8092	.53	8220	1.49	8812	.89
8095	1.25	8240	2.19	8822	2.19
8121	.80	8520	1.16	8830	2.19
8123	1.43	8551	1.39	8831	2.19
8130	1.97	8552	2.19	8836	.25
8200	2.13	8554	2.19	8880	1.19
8210	2.79	8810	.69	8263	5.79
				8267	2.59

9000 SERIES

9002	$ .15	9309	$ .79	9601	$ .89
9301	1.01	9312	.79	9602	.79

CMOS

4000A	$ .26	4016A	.56	4050A	.59
4001A	.25	4017A	1.19	4066A	.89
4002A	.25	4020A	1.49	4068A	.44
4006A	1.35	4021A	1.19	4069A	.44
4007A	.26	4022A	1.10	4071A	.26
4008A	1.79	4023A	.25	4072A	.35
4009A	.57	4024A	.89	4073A	.39
4010A	.54	4025A	.25	4075A	.39
4011A	.29	4027A	.59	4078A	.39
4012A	.25	4028A	.98	4081A	.26
4013A	.45	4030A	.44	4082A	.35
4014A	1.49	4035A	1.27	4528A	1.60
4015A	1.49	4042A	1.47	4585A	2.10
		4049A	.59		

74C00	$ .22	74C74	$1.04	74C162	$2.91
74C02	.26	74C76	1.34	74C163	2.66
74C04	.44	74C107	1.11	74C164	2.66
74C08	.68	74C151	2.61	74C173	2.61
74C10	.35	74C154	3.15	74C195	2.66
74C20	.35	74C157	1.76	80C95	1.35
74C32	1.61	74C160	2.48	80C97	1.11
74C73	1.04	74C161	2.93		

MEMORIES

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

CALCULATOR & CLOCK CHIPS

5001	12 DIG 4 funct fix dec	$2.49
5002	Same as 5001 exc btry pwr	2.79
5005	12 DIG 4 funct w mem	2.99
MM5725	8 DIG 4 funct chain & dec	1.98
MM5736	18 pin 6 DIG 4 funct	4.45
MM5738	8 DIG 5 funct k & mem	5.35
MM5739	9 DIG 4 funct (btry sur)	5.35
MM5311	28 pin BCD 6 dig mux	4.45
MM5312	24 pin 1 pps BCD 4 dig mux	3.95
MM5113	28 pin 1 pps BCD 6 dig mux	4.45
MM5114	24 pin 6 dig mux	4.45
MM5316	40 pin alarm 4 dig	5.39

LED's

MV108	Red TO 18	$ .22
MV50	Axial leads	.18
MV5020	Jumbo Vis. Red (Red Dome)	.22
	Jumbo Vis. Red (Clear Dome)	.22
ME4	Infra red diff. dome	.54
MAN1	Red 7 seg. .270"	2.19
MAN2	Red alpha num .32"	4.19
MAN4	Red 7 seg. .190"	1.95
MAN5	Green 7 seg. .270"	1.45
MAN6	.6" high solid seg.	4.25
MAN7	Red 7 seg. .270"	1.19
MAN3	Red 7 seg. .127" straight pins	.29
MAN8	Yellow 7 seg. .270"	1.45
MAN66	.6" high spaced seg.	4.75
MCT2	Opto-iso transistor	.61

MULTIPLE DISPLAYS

NSN33	3 digit .12" red led 12 pin fits IC skt.	$1.79
HP5082 7405	5 digit .11 led magn. lens com. cath	3.49
HP5082 7414	4 digit .11 LED magn. lens comm. cath.	$3.25
FNA37	9 digit 7 seg led RH dec clr. magn. lens	4.95
SP-425-09	9 digit .25" neon direct interface with MOS/LSI, 180 VDC, 7 seg	1.79

SHIFT REGISTERS

MM5013	1024 bit accum. dynamic	mDIP	$1.75
MM5016	500/512 bit dynamic	mDIP	1.59

DTL

930	$ .15	937	.15	949	.15
932	.15	944	.15	962	.15
936	.15	946	.15	963	.15

Data sheets on request
With order add $.30 for items less than $1.00 ea.

LINEAR CIRCUITS

300	Pos V Reg (super 723)	TO-5	$ .71
301	Hi Perf Op Amp	mDIP TO-5	.29
302	Volt follower	TO-5	.53
304	Neg V Reg	TO-5	.80
305	Pos V Reg	TO-5	.71
307	Op AMP (super 741)	mDIP TO-5	.26
308	Micro Pwr Op Amp	mDIP TO-5	.89
309K	5V 1A regulator	TO-3	1.35
310	V follower Op Amp	mDIP	1.07
311	Hi perf V Comp	mDIP TO-5	.95
319	Hi Speed Dual Comp	DIP	1.11
320	Neg Reg 5,2, 12, 15	TO-3	1.19
322	Precision Timer	DIP	1.70
324	Quad Op Amp	DIP	1.52
339	Quad Comparator	DIP	1.58
340K	Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V)	TO-3	1.69
340T	Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V)	TO-220	1.49
372	AM-IF Strip detector	DIP	2.98
374	AM-FM-SSB Strip	DIP	.53
376	Pos V Reg	mDIP	2.42
377	2w Stereo amp	DIP	1.16
380	2w Audio Amp	DIP	1.11
380-8	.6w Audio Amp	mDIP	1.52
381	Lo Noise Dual preamp	DIP	1.52
382	Lo Noise Dual preamp	DIP	.71
550	Prec V Reg	DIP	.89
555	Timer	mDIP	.89
556A	Dual 555 Timer	DIP	1.45
560	Phase Locked Loop	DIP	2.48
562	Phase Locked Loop	DIP	2.48
565	Phase Locked Loop	DIP TO-5	2.38
566	Function Gen	mDIP TO-5	2.25
567	Tone Decoder	mDIP	2.66
709	Operational AMPl	TO-5 or DIP	.26
710	Hi Speed Volt Comp	DIP	.35
711	Dual Difference Compar	DIP	.26
723	V Reg	DIP	.62
739	Dual Hi Perf Op Amp	DIP	1.07
741	Comp Op AMP	mDIP TO-5	.32
747	Dual 741 Op Amp	DIP or TO-5	.71
748	Freq Adj 741	mDIP	.35
1304	FM Multpx Stereo Demod	DIP	1.07
1307	FM Multpx Stereo Demod	DIP	.74
1458	Dual Comp Op Amp	mDIP	.62
1800	Stereo multiplexer	DIP	2.48
LM2111	Dual LM 211 V Comp	DIP	1.70
1900	Quad Amplifier	DIP	.35
7524	Core Mem Sense AMPl	DIP	.71
8038	Voltage contr. osc.	DIP	4.25
8864	9 DIG Led Cath Drv	DIP	2.25
75150	Dual Line Driver	DIP	1.75
75451	Dual Peripheral Driver	mDIP	.35
75452	Dual Peripheral Driver	mDIP	.35
75453	(551) Dual Periph Driver	mDIP	.35
75491	Quad Seg Driver for LED	DIP	.71
75492	Hex Digit driver	DIP	.80

The prices as listed are in Australian dollars. Send bank cheque with order. If international postal money order is used send receipt with order. Shipment will be made via air mail — postage paid — within three days from receipt. Minimum order — $5.00.

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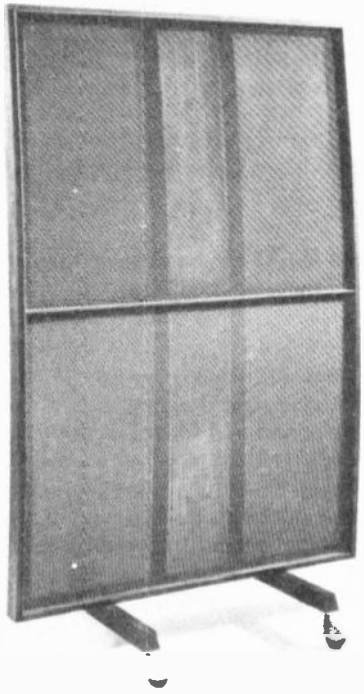

In our February 1975 issue we published an article by Dr. Farrimond showing how two Quad speakers could advantageously be coupled together.

The Radio People Ltd (Chatham Rd., Kowloon, Hong Kong) have sent us details of Double-Quad units that they have been building for a number of years.

Power packs and input transformers are mounted in the base of the system to improve mechanical stability and to provide easy connection of mains and signal cables.

AUSTRALIANS MORE SOPHISTICATED IN SOUND

Australians were rapidly becoming more sophisticated when it came to home entertainment sound equipment, the local managing director of the world's largest specialised manufacturer of high fidelity sound equipment said recently.

Mr J.L. Black, managing director of Pioneer Electronics Australia Pty Ltd, was speaking at the opening of the company's $500,000 head office complex at Braeside, by the Minister of Labour and Industry, Mr J. A. Rafferty.

Mr Black said that Australians were no longer satisfied with the old radiogram idea.

"Instead, once they have heard good quality fidelity sound they are only happy with the better type of audio equipment which reproduces it," he said.

Mr Black said that the Australian public was paying an additional 35 per cent on all quality hi-fi gear and 45 per cent on speakers, because of "blanket tariffs" which did not differentiate between the old radiogram type of equipment made in Australia and the increasingly popular sophisticated equipment made only overseas.

US $4000 LOUDSPEAKER

The Servo-Statik 1A loudspeaker system, capable of "the most distortion-free sound reproduction, the widest dynamic range, and the most linear frequency response" of any speaker ever made, according to the manufacturer, has been introduced by Infinity Systems, Inc.

The system, consisting of two rosewood frame electrostatic screens about five feet high and a bass cube with an 18" woofer and its own servo amplifier, carries a retail price tag of US$4,000!

CBS Laboratories measured the anechoic response of the original Servo-Statik 1 as 25 Hz to 20,000 Hz ± 3.5 dB, a measurement never equalled by any other speaker, claim the manufacturers. The manufacturer rates the new system's response as 25 Hz to 30,000 Hz ± 2 dB.

The bass cube of the Servo-Statik 1A incorporates an 18" woofer with a 35-pound magnetic circuit; a feedback sensor, which instantaneously corrects any slight deviations in the speaker's output; and an electronic crossover unit with high-voltage FET's.

Its dc servo amplifier supplies 150 watts rms power.

Each of the screens contains electrostatic midrange and tweeter modules with their own built-in power supplies.

Separate stereo amplifiers ar required for the midrange (100 to 250 watts rms per channel) and tweeter section (35 to 125 watts rms per channel).

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