MAY 1975
75c*

electronics TODAY INTERNATIONAL

HI-FI

Jansen

ELECTRONIC POKER MACHINE TO BUILD

PROJECTS: RADAR BURGLAR ALARM : MUSIC SYNTHESIZER
UNDER-$2 ELECTRONIC GAME : AUDIO LOUDNESS CONTROL

Registered for posting as a periodical — Category C.

KILL THE HISS

keep the music

Until now tape hiss and other irritating noises prevented true high fidelity reproduction, so JVC invented ANRS (automatic noise reduction system) and incorporated this exclusive feature in the 1667U stereo cassette deck.

ANRS (automatic noise reduction system) as the name implies, ensures absence of tape hiss without sacrificing fidelity and musical reproduction and is claimed to be the world's best system by independent authorities.

Additionally the 1667U features the 'cronios heads' developed by JVC, that have a life ten times longer than ordinary heads. Naturally CrO_2/Normal tape selector switch, electrically governed DC motor, automatic stop mechanism and tape counter are all included.

For maximum recording ease the 1667U features two large VU meters, separate sliding volume controls and convenient push buttons. All this helps the 1667U boast of a frequency response of 30-16000Hz (±3dB) and a low wow and flutter of 0.15% RMS.

A 'must' for any serious stereo enthusiast, the 1667U stereo cassette deck, from JVC.

JVC

IF YOU'RE SERIOUS ABOUT SOUND

ANRS
Automatic Noise Reduction System

WT.GD54J.

electronics TODAY INTERNATIONAL

MAY 1975 Vol. 5, No. 5

main features

projects

reviews

news & information

COVER: Electronic Today International's electronic poker machine – page 58 – this issue.

NEXT MONTH

AMPLIFIER TECHNOLOGY

Definitive article by John Linsley Hood

CASSETTE RECORDER SPEED CONTROL

How to vary and stabilize portable recorder speed.

PRE-AMP FOR CERAMIC CARTRIDGES

BUILD ETI's BRILLIANT NEW BOOKSHELF SPEAKER

PLUS LOTS MORE!

COMING SOON- HIGH QUALITY FM STEREO-TUNER

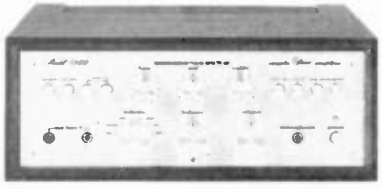
The feature articles listed above are included amongst those currently scheduled for our June issue. However, unforeseeable circumstances, such as highly topical news or developments may affect the final issue content.

Published by Modern Magazines (Holdings) Ltd, 15 Boundary St., Rushcutter's Bay, 2011. Telephone 33-4282. Cables Modmags Sydney. General Manager: Max Press; Editorial Director: Collyn Rivers; Technical Editor: Brian Chapman; Engineering Manager: Barry Wilkinson; Advertising Manager: Terry Marsden; Advertising Rep (Sydney): Grant Evans; Advertising Manager (Melbourne) Clarrie Levy.
INTERSTATE advertising — Melbourne: Clarrie Levy. Suite 23, 553 St. Kilda Rd., (51-9836). Adelaide: Ad Media Group of South Australia, 12-20 O'Connell Street, North Adelaide, S.A. 5006. (67-1129). Brisbane: David Wood, Anday Agency, 11-14 Buchanan St., West End (44-3485).
OVERSEAS — United Kingdom: Modern Magazines (Holdings) Ltd., Ludgate House, 107 Fleet Street, London EC4, U.S.A.: A.C.P. Room 2102, 444 Madison Avenue, New York 10022. Printed in 1975 by Conpress Printing Ltd., 65 O'Riordan St., Alexandria N.S.W.
Distributors: Australian Consolidated Press. (*Recommended and maximum price only).

SUPER SPECIALS

marantz.

Model 1060 Stereo Console Amplifier



The particularly nice thing about the Marantz 1060 is that it will go with just about any sized speaker system and still put out enough power to cover a room full of people. 60 watts worth of power. And more like 90 watts under typical listening conditions. At full volume or low level the distortion stays about the same. Or perhaps we should say "lack of distortion." The Model 1060 has less than 0.5% THD and IM (Total harmonic and intermodulation distortion). Typically 0.1%. And the sound quality is taken care of at both ends of the frequency spectrum. There's a high filter to eliminate record scratch and tape hiss. And a low filter to cut hum and rumble. You can select from any one of six signal sources. Other features include input for two tape recorders, as well as front panel stereo microphone input jacks. The list goes on. But for the Marantz 1060 listening is believing. You can do both.

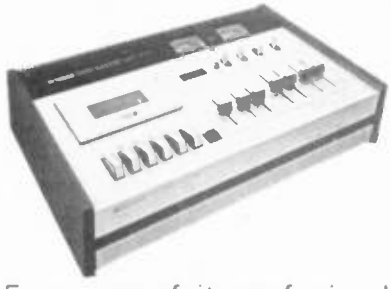
Selsound Hi-Fi Special price

$275

limit one per customer

YAMAHA

TB700 Stereo Cassette Tape Deck



Every one of its professional features reflects the highest art of a company long associated with the art of crafting fine musical instruments. Introduced at a time when interest in cassette tape recording is greater than ever, the TB-700 is a most versatile stereo component that will perform to the grand specifications of many expensive open-reel decks. In every respect, the TB-700 is a quality component, bringing the technology of the cassette tape deck to a new peak. So that you may achieve the maximum results from your personal choice of cassette tape, the TB-700 is equipped with a multiple function tape selector switch. This switch works to change over the recording bias current equalizer characteristic, and recording level of the cassette deck depending on which of the four most popular tapes — standard ferro-oxide, chrome dioxide, low-noise high-output or High Energy — is used.

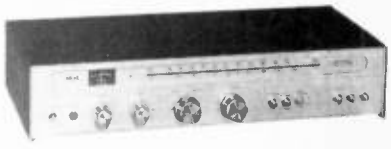
Selsound Hi-Fi Special price

$229 Save $110.00

SPECIAL INTRODUCTORY OFFER

AKAI

Tuner Amplifier AA-810



The AA-810 is an efficiently designed high quality all purpose tuner amplifier. The highly sensitive tuner section includes a Signal Strength Meter for easier FM and AM tuning and a stereo indicator lamp which lights automatically when FM broadcasting.

Technical Specifications:
Maximum Total Harmonic Distortion — 0.8% from ¼ watt to rated output (ohms).
Frequency Response: 20 Hz to 65,000 (+ 0dB — 3dB).
Channel Separation: Better than 75dB.
Power Bandwidth (1HF): 20Hz to 40,000 Hz at 80 ohms/distortion 0.01%.

Complete antenna connections with FM local/Distance switch and a built-in AM bar antenna. FM di-pole antenna also included in standard accessories.

Selsound Hi-Fi Special price

$245

SELSOUND HI-FI

Selsound Hi-Fi
King Georges Rd.,
South Hurstville
546-7462

Selsound Hi-Fi
24 Darcy Street
Parramatta, 2150.
635-9491

Selsound Hi-Fi
2-6 Crown Lane
Wollongong
042 — 29-5110

Mail orders welcomed for these three super specials.

news digest

PHILIPS BID FOR SIGNETICS

The multi-international Philips company has made a firm bid for the US Signetics Corp 70% of whose stock is owned by Corning.

Philips have offered US$8 per share for nearly five and a half million Signetics common shares. The deal has not yet been approved by the directors of the companies involved nor by Signetics' stockholders — however industry observers confidently expect the take-over to be successful.

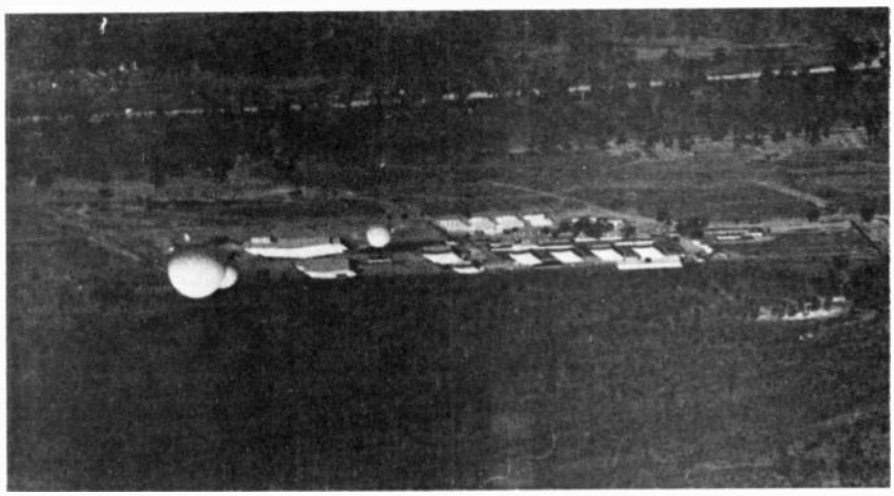
The Signetics Corporation's sales last year were just under US$121 million but resulted in a trading loss of US$3.87 million.

TELDEC VIDEO-PLAYER ON SALE AT LAST

Telefunken-Teldec's video-disc playback system is finally on sale — now.

At present distribution is limited to West Germany, but the unit is now readily available there through most audio shops and major department stores. Cost is approximately A$450. The programme discs sell for around A$3. Each disc carries a 10 minute colour programme.

At present some 50 titles are available — about 400 titles should however be available by the end of the year.



PINE GAP SURVEILLANCE BASE TO BE RETAINED

The US defence base at Pine Gap near Alice Springs is to remain. The agreement between Australia and the USA will definately be renewed when it expires at the end of 1976 — Prime Minister Whitlam told delegates to the recent Australian Labour Party Federal Conference at Terrigal, NSW.

Despite prcbing from many delegates, Mr Whitlam refused to reveal the purpose of the Pine Gap base. 'We all know what goes on there', he said. 'We can stop it whenever we like . . . it is not part of any weapons system at all'. 'I am not going to tell anybody what they do' continued Mr Whitlam, who went on to say that the base did not involve Australia in any war-like operations of any sort.

It is difficult to understand the government's continuing secrecy about Pine Gap and its functions as material has been published in several scientific journals describing in some detail the surveillance facility, its purpose and its equipment.

COMPUTER ROAD SIGNS

An engineer from Plessey Australia Pty. Ltd., carrying out tests on one of 36 advisory traffic signals on the Southern Freeway — the new toll road between Waterfall and the top of Bulli Pass, south-west of Sydney.

The signals are spaced at 1.6 km intervals on either side of the carriageway which skirts a steep coastal escarpment subject to extreme weather conditions.

They are part of a highly sophisticated computerised signalling system designed to New South Wales Department of Main Roads specifications and supplied and installed by Plessey.

The system, controlled by a Ferranti Argus 700E computer, will advise drivers of fog, speed restrictions, lane closures, and other hazards through the signals which employ an efficient fibre optic lighting system.

The project is valued at more than $700,000.

news digest

MYSTERY WALKIE TALKIE

London's Fire Brigade are currently evaluating a 'mystery' walkie-talkie system that enables firemen to communicate with each other even inside steel-framed buildings.

The 'mystery' is that no-one – including Plessey, who developed it – totally understands just how it works!

Communication within steel-framed buildings has always been a major problem, UHF and VHF radios are useless in these conditions and cable linked systems are cumbersome and prone to damage.

Plessey, under contract to the Home Office investigated the problem and found that rf energy at 3 MHz will penetrate steel-framed buildings. The frequency seems to be fairly critical and, say Plessey there must be some metal structure around for the system to work. 'It works' says a Plessey spokesman, 'but honestly we don't know why'.

Twenty-four sets of the new system – known as Figaro – have been supplied to Britain's fire brigades for evaluation. The first real-life test came during the recent Moorgate underground train disaster where it was used to communicate from the disaster site underground up to street level. The system apparently worked extraordinarily well.

RECORD-PIRATE DETECTOR

A major problem to the recording industry is the pirating of recorded material by companies who make very minor additions to existing material and then sell it as a 'sound-alike' product.

It is often very difficult to prove original ownership of such material if for instance an additional guitar track has been overlaid.

Now however a New York company, called Audicom, has developed a way of superimposing a sub-audible 200 Hz bandwidth code (centred on 2877 Hz) onto the original recording master.

The code, which may be inserted at several places on a recording, runs for about two and a half seconds at a level some 55 dB below peaks. The code consists of eight-bit frequency shifted data uniquely identifying the recording.

As it will be impossible to remove the code without also removing the overall programme material, the code will be evident on pirated as well as original material thus providing the material owner with absolute proof of copying.

Audicom has developed associated detecting equipment that monitors all broadcast material and prints out record identifying data together with the time of detection.

The system is hoped to reduce the staggering US$200 million that the industry currently claims is being lost.

TALKING CLOCK

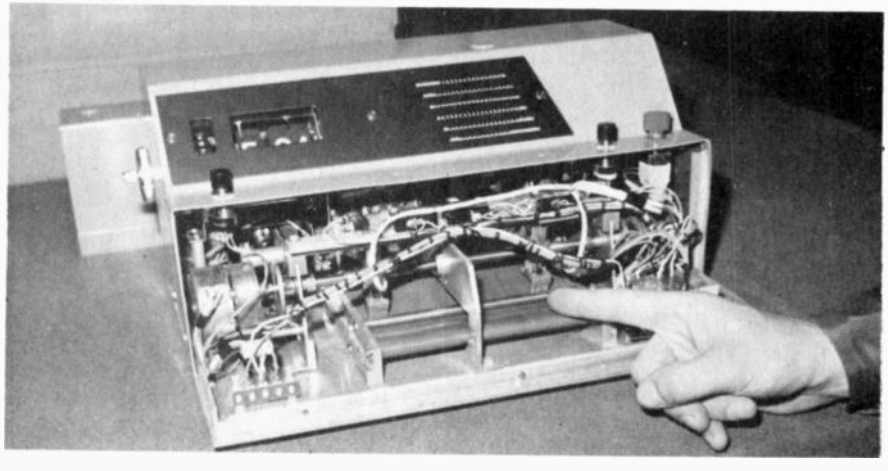
A talking clock designed by Italian inventor Carrarini Aldo give hours and minutes in a continuous sequence recorded onto a loop of magnetic tape.

The unit can be programmed to alternate spoken time announcements with train or plane arrival announcements, advertisements etc. etc.

A broad loop of magnetic tape is pre-recorded with helical tracks in adjacent width-sections with the hours and minutes. Two pick-up heads advanced by individual lead-screws move sideways across the loop to play back the recorded words in a regular sequence. When each head reaches the end of its track, a limit switch reverses its drive motor so the screw rapidly returns the head to the start of the section. This occurs once daily for the hour track, and every hour for the minute one. Thus the separated hours and minutes can be combined to compress a 24-hour day onto one compact loop.

Accuracy is maintained by synchronous motors kept in step by a photocell detecting movement of flaps on the integral digital clock.

The address of the inventor is Carrarini Aldo, Via Sante Viola 13, Tivoli, (Roma) Italy.



CABLELESS CLOSED CIRCUIT TELEVISION SYSTEM

An audio-visual television system which operates over short distances without cable linkage has been introduced by Leevers-Rich (of London, UK).

Claimed to be the only completely cableless closed circuit system on the market, it is capable of transmitting vision, sound and bi-directional speech and data over distances of up to 100 m.

The system – Lee Link 414 – uses a modulated infra-red beam and transmits visual and audio signals over short distances where cable laying would be impracticable. The complete equipment comprises two transmitting/receiving units, two control units and a video set that has a VTR socket.

Each opto-head incorporates two distinct circuits, one for transmission and one for receiving, with an integrated telescopic system for accurate alignment. For video and audio reception the receiving unit is linked to a main control which unscrambles the signals and presents them to the video set for normal presentation.

Video and audio presentation is in one direction only, but if signal or speech only is required this can be made bi-directional by the use of either a modulating/de-modulating box or the inclusion of input pulse units.

A hand set, similar to a normal telephone, is supplied as standard equipment. When used for speech or data-transmission only, the range of the system is extended up to 600 m.

Transmission without distortion is possible through glass and reduction of quality is minimal.

Australian agents are Amalgamated Wireless (A'sia) Ltd., 422 Lane Cove Road, North Ryde, NSW 2113.

(Continued on Page 11)


Art For Art's Sake.
JBL has used art to achieve art. By employing the arts of design and craftsmanship, the art of sound reproduction is heightened.
The most relevant criteria for a loudspeaker system are four: efficiency, frequency response, distortion and dispersion. In each of these, Jubal L65 is superior. But those are objective measurements when only a subjective judgement is necessary. Listening is all that's needed.
The Jubal L65 is a JBL advance into a cleaner, highly sensitive, more open sound with better bass and improved frequency response across the entire audio bandwidth. Articulation, the ability to resolve complex musical passages into individual instruments, is demonstrably better in the L65.
With the Jubal L65 reproduction is literal. Reproduction is rebirth. The art has been refined.
JBL
Sole Australian Distributors & Importers:
harman australia pty ltd
271 Harboard Road, Brookvale. Tel 939-2022
PO Box 6, Brookvale NSW 2100


INFINITY
THE WAVE OF THE FUTURE
SO TECHNICALLY ADVANCED IT SHOULD HAVE BEEN INVENTED TOMORROW

SPECIFICATIONS

Frequency Response:
30 to 21 KHz ±3 db

Crossover Frequency:
500 Hz, 5000 Hz

Nominal Impedance:
8 ohms

Maximum Amplifier Power:
200 watts/channel program

Minimum Amplifier Power:
20 watts, RMS/channel

Dimensions:
27½" high, 20" wide, 14" deep

The reviewers of Hi Fi Newsletter had this to say about the Infinity 2000A

The Infinity people have demonstrated with the 2000A that they knew their way in the problematic and highly controversial speaker world. Their representative then deserves our highest rating, and until something better comes along it remains our standard in its price category.

Infinity is proud to announce that something better has come along — the 2000AXT. It is better because it is smoother in frequency response, has much better dispersion and has about 5 db added efficiency.

It is smoother in frequency response because we use three new drivers, each developed for its smoothness of frequency response and low distortion. It has better dispersion principally due to our patented wave transmission line tweeter. Finally, it has higher efficiency due to the application of our original research into the physics of transducers as applied to speaker systems.

The Infinity 2000AXT has the advantage of being used with various medium priced receivers as well as the super power amplifiers of today.

THE TWEETER SECTION

The wave transmission line tweeter is probably Infinity's most stunning achievement. It's neither a cone nor a piston drive, not an electrostatic, not a ribbon and not an ionic device. In fact, it really doesn't appear in any textbooks on acoustics.

This Walsh tweeter, acting as a vertical, pulsating cylinder, is a purely coherent source of sound radiation — directly analogous to the light emitted by a laser beam. Therefore, it is transient perfect — a feat which no other speaker has achieved.

The drive mechanism of the tweeter is a voice coil in a very intense magnetic field. This drive mechanism was selected for its simplicity and inherent reliability, although any drive system could be used inasmuch as the cone is only plucked at the base.

Sound velocities much higher than the speed of sound in air are propagated up the metallic cone. Sound is emitted on various parts of the cone corresponding to the temporal and spatial scheme of Figure 1. Thus, each bit of audio information fed into the device is emitted intact at the same instant of time. This is true around the entire device so that 360° coherent radiation is a reality.

THE MIDRANGE SECTION

The midrange speaker is a very high efficiency 4.5" cone utilizing a large Alnico V magnet, the cone of which is treated for five times the stiffness to mass ratio of conventional speakers. The sound quality of this device is big and open with excellent transient response due to its low time delay distortion.

THE BASS SECTION

The bass driver is a 12" woofer with a full *one inch* movement capability. Its cone is treated twice — once to increase the stiffness to mass ratio by a factor of three, while the second treatment ensures proper cone damping to complement the added stiffness. The woofer is loaded into the "Infinity transmission line" enclosure for superb bass transients. It accurately reproduces the very lowest fundamental bass frequencies with excellent transient response and very low harmonic distortion.

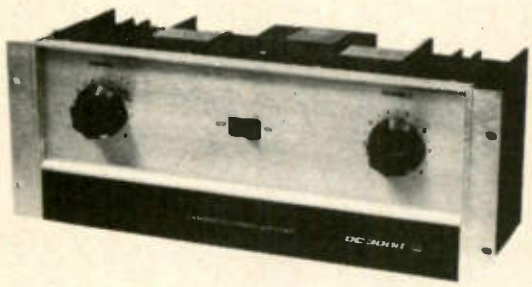
The infinity fine family of speakers available from

INSTROL — CNR PITT & KING STREETS, SYDNEY; 91a YORK STREET, SYDNEY; 375 LONSDALE STREET, MELBOURNE • **MIRANDA HI-FI** — SHOP 67 MIRANDA FAIR, 525-7800 • **QUANTUM ELECTRONICS** — HOBART • **TRUSCOTTS** — ADELAIDE

amcron

BY CROWN INTERNATIONAL

WHY is the AMCRON DC300/A often regarded as 'THE REFERENCE STANDARD'?



Because the DC300/A is the first totally redesigned amplifier since the original DC300. Most competitors are still using the six year old circuit designs pioneered by Amcron. Frankly, the DC300/A provides superior performance because of better design.

POWER YOU CAN COUNT ON

One of the DC300A's most outstanding features is that it has double the number of output transistors. Each channel has eight 150-watt devices for 1200 watts of power dissipation per channel. The DC300/A is rated at 190 W/CH at 8 ohms, 340 W/CH at 4 ohms, 500 W/CH at 2.5 ohms, or plug-in two parts for 600 watts continuous mono power at 8 ohms.

SUPERIOR OUTPUT PROTECTION

The DC300/A output protection circuitry is a radically new design which completely eliminates DC fuses and mode switches and further reduces service problems. It is superior in every way to the old VI limiting cricuit pioneered by Amcron and now used by most other high power amplifiers, since it introduces no flyback pulses, spikes or thumps into the output signal, whether operating as a single or dual-channel amplifier.

Gone to is the need the baby amp by carefully juggling load configurations. The DC300/A can drive any speaker load-in fact, down to 1 ohm.

LOWEST DISTORTION AND NOISE

The DC300/A's new IC front end sets new records for low distortion and noise. At the rated output, IM and harmonic is less than .05%, typically less than .025%, and hum and noise is −110 dB below the rated output, typically −120 dB.s,

WHAT DO THE CRITICS SAY:

Hirsch-Houck Labs. stated:

The Amcron DC300/A almost defies comment. No load we could apply – including short circuits and large capacitors – had any significant effect on its operating characteristics. Most engineers would probably be impressed, as we were, by the incredibly low distortion of this amplifier. The absence of "crossover distortion" was apparent in the very low power IM measurements, which reached a maximum of a mere 0.014% at just about 3 milliwatts output. It is, in short, a most impressive amplifier, one that has no flaws or functional weaknesses that we could detect.

The Absolute Sound Magazine stated:

"The AR's (AR-3) with the DC300/A acquired a smoother more musical high end than I had thought possible with these speakers. By comparison, the (other brand 700 watt amplifier) actually sounded grossly distorted. I can only postulate that Amcron has had more success in eliminating crossover notch distortion . . . there is no contest: The DC300/A is the best amplifier I have yet heard.

When you buy a DC300/A, you are buying more than just an amp. You are buying the Amcron company – a professional audio equipment manufacturer with a 26 year reputation for solid quality and lasting value. There are thousands of Amcron amps. in the field still working to their original specifications, and still outperforming most new amps.

The Amcron DC300/A! Still only $860.00 R.R.P.

AUSTRALIAN DISTRIBUTORS: BJD Electronics Pty. Ltd. 202 Pelham St., Carlton, 3053 Vic. Ph. 347-8255
65 Parramatta Rd., Five Dock 2046 NSW, Ph. 799-3156

news digest

(Continued from Page 6)

PORTABLE PRINTING CALCULATOR USES WIDE TAPE

A new portable calculator soon to be announced by Texas Instruments prints out thermally onto heat sensitive paper tape 50 mm (2") wide.

WARNING ON REQUIRED TUNING RANGE OF VHF FM RECEIVERS

The following letter has been received from the Australian Broadcasting Control Board.

The Australian Government has accepted in principle the recommendations of the Commission of Inquiry into FM Broadcasting to establish FM transmissions in the frequency range 88-108 MHz.

The Commission has recommended that the televised transmissions operating within this frequency range be progressively transferred to other channels, with Ch. 5 (101-108 MHz) being cleared first, followed after some years by Ch. 4 (94-101 MHz) and at a later date, if necessary, by Ch. 3 (85-92 MHz).

Action is currently being taken to transfer the Newcastle national TV station from Ch. 5 to Ch. 5A to free the band 101-108 MHz for FM transmissions in Sydney and Newcastle. It is therefore clear that the initial development of FM transmissions will be in the 92-94 MHz and 101-108 MHz ranges.

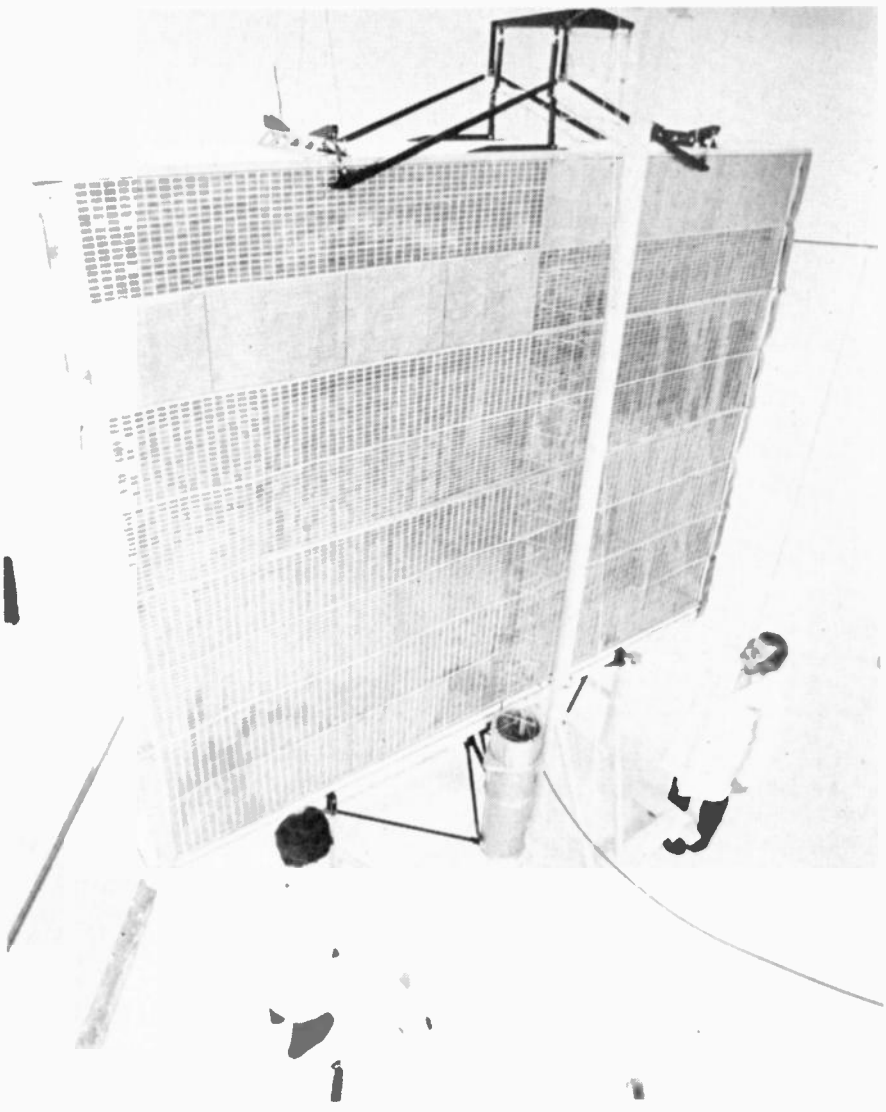
All parties within the industry who are involved in the provision of FM receivers are therefore warned that FM receivers designed for the domestic FM bands in Japan (76-90 MHz) or Western Europe (87.5-104 MHz), examples of which are reported to be on sale in some Australian states, will be unsuitable for reception of the Australian FM transmissions as now licensed or being planned, although receivers designed for the European band to 104 MHz will have limited use, in the early stages when transmissions are confined to 92-94 MHz.

Interested purchasers of FM receivers should be advised that only those covering the whole frequency range 88-108 MHz will provide adequate reception of the developing Australian FM service.

SUNPOWER TO PROPEL SPACECRAFT

An advanced lightweight 14 watts per kilogram flexible solar array that could produce electricity to propel future spacecraft is tested by Lockheed engineers. This four metre wide, three metre long section was designed and built under contract from NASA's Marshall Space Flight Center, Huntsville, Ala., by Lockheed Missiles & Space Co., Sunnyvale, Calif.

The array could be unfolded and folded in space by remote control, depending on energy requirements and the imminent danger of solar flares. The folding mast supports the array as it spirals out of the can in the middle of the solar-cell panel. On a spacecraft each array might be 4 metres wide and up to 30 metres long. A pair could supply up to 25 kilowatts of electricity to very-low-thrust ion engines that could propel spacecraft.



A screwdriver and about ½ an hour is all you need to build this 40 watt Philips speaker system.

Philips make it easy and inexpensive for you to own a professional speaker system. Assemble it yourself in about 30 minutes and you have 40 watt (RMS) capacity speakers to complement your hi-fi gear.
The AD8K40 Speaker Kit includes:

• 2 pre-cut, pre-finished wood grain cabinet enclosures with pre-painted baffle boards. • 2 mounted grill cloths with pre-painted baffle boards. • 2x8" woofers. • 2 x1" dome tweeters • 2 x 2 way crossover networks with leads and fastons fitted. • Innerbond lining • Wood screws. • Wood glue • Caulking compound.

Plus full assembly instructions. Check the column opposite this page for the dealer nearest you, or send coupon for a free brochure.

ELCOMA

To: ELCOMA, P.O. Box 50,
Lane Cove, N.S.W. 2066.
Please send me your fully illustrated brochure on the Philips AD8K40 Speaker Kit.

Name . . . . . .

Address . . . . . .

. . . . . .

Postcode 153 89

news digest

DETECTING EARTHQUAKES – EXTRA-TERRESTRIALLY

RADIO signals from outside our galaxy will soon be used to detect almost imperceptible movements in the earth's crust that may lead to the accurate prediction of earthquakes.

A team of scientists and engineers at the United States National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL), Pasadena, California, aided by geophysicists at the California Institute of Technology Seisological Laboratory, is developing an earth-fault monitoring system which combines experience gained from spacecraft navigation with current radio astronomy and geophysical research.

A 9 m antenna at JPL is the principal instrument in the earthquake research concept called *Aries* — for astronomical radio interferometric earth surveying.

A sensitive radio receiver, linked to the antenna, listens to signals from quasars as far away as a milliard light years. Listening to the same radio source will be one of the space communications stations of the NASA/JPL Deep Space Network at Goldstone, California.

The key to the Aries project is the capability of measuring the difference in arrival times of identical quasar radio signals at the two antennae, located about 200 km apart.

Over the past three years Aries techniques, based on instruments originally designed for space exploration, have been developed to produce time-difference measurements to a precision of about 0.1 nanosecond. From this type of measurement, the distance between the antennae can be determined in three dimensions, to an accuracy of centimetres.

The initial distance measurement between JPL and Goldstone will establish a reference baseline. Subsequent measurements will indicate any change in the distance between the two antennae that might be caused by shifts in the earth's crust adjacent to fault zones. A straight line between Pasadena and Goldstone intersects the great San Andreas Fault, the main channel of the earth fracture system in California and source of the State's most devastating earthquakes.

Motion associated with the fault in any or all of three dimensions can be measured. It is this motion that creates the strain that eventually is relieved through a mild, or sometimes violent, earthquake.

CALCULATOR CHIPS NOW LESS THAN $2!

Calculator chip prices continue their inexorable fall in price. Latest prices in the USA for four function eight digit MOS chips are now as low as one to two US dollars. Even the complex scientific calculator chips are down to $15 or less compared to $45 this time last year.

MOS Technology Corporation for instance are selling a single chip scientific unit for US$17.50.

WHAT HAPPENDED TO WIEGAND

In our July 1972 issue we published a story about an extraordinary ferromagnetic wire developed by John R. Wiegand.

This wire, which had a stress-hardened outer shell and a soft inner core generated pulses when placed within a moving magnetic field. A most unusual feature was that the pulse was proportional to the speed of a magnetic switching action but not proportional to speed at which the wire cut a magnetic field.

Extensive patent protection has now been obtained and licences are now being granted to interested commercial organisations.

One application for the Wiegand effect is in a new flow-meter about to be developed by the Brooks Instruments division of Emerson Electric.

Other applications currently being investigated include pulse generators for car ignition systems, electronic door locks, electronic keyboards, code readers etc.

HELP PLEASE

If anyone out there is asked to repair a Philips cassette deck that works OK except it runs at twice normal speed (!) i.e. 3¾"/sec, please telephone ETI.

The device was developed at considerable cost by Electronics Today for use as a data recorder for Modern Motor magazine's fifth wheel — it was stolen from our office last month.

Outwardly it looks like a standard machine and works normally as long as it is only used to replay recordings made on it (except that frequency response is better than usual!) — however when used with pre-recorded cassettes it naturally sounds like Donald Duck.

We really would like it back so if anyone has it in for repair — please telephone our editor on 33-4282.

news digest

ELECTRONIC CHECKBOOK CALCULATOR

A pocket calculator that will hold and display bank cheque account balances for a year or more is shortly to be announced by the US Mostek Corporation.

During the times that the calculator is 'off' data is stored in a static shift register (drawing a mere 100 micro-amps). This data is then clocked solely when access is required.

The unit is expected to retail for less than US$40 and will be built into a plastic chequebook holder.

LASER MISSILE INTERCEPTOR

The Us armed forces may soon have a laser missile interceptor. Air Force reports state that prototype deuterium fluoride lasers have been successfully tested at 'very very high' power outputs.

Power output is apparently so high that the laser beam burns straight through heavy gauge stainless nickel steel plate.

ELECTRONIC IGNITION TIMING

Electronic ignition timing may be used on Chrysler's 1976 cars. The system, which optimizes ignition timing for changes in engine speed, temperature, throttle position etc is being developed to improve fuel consumption and reduce emissions.

SINGLE CHIP 16-BIT PROCESSOR

General Instrument Corporation and Honeywell's Process Control Division have jointly developed a high performance single chip 16-bit microprocessor with unusually high memory and information handling capabilities. Details of the new MOS N-Channel Ion-Implanted microprocessor, which is not yet available for general sale, were presented at the recent IEEE COMPCON San Francisco Conference.

The architecture for the microprocessor was developed by Honeywell. The detailed circuit design and manufacturing are being carried out by General Instrument Corporation.

According to the paper presented at the conference 'the CR-1600 microprocessor device, is the first single chip 16-bit processor to achieve the performance of many of today's minicomputers'.

According to Dr. E.A. Sack, General Manager of General Instrument's Microelectronics Division, "The solid-state microprocessor initiates a new generation of electronic applications made possible by the inclusion of computing power in a single chip — previously available only in assemblies of numerous components. The cost advantages of the new capability is as significant in its way as the original conversion from discrete transistor circuitry to small scale integration. General Instrument Corporation believes that microprocessors such as CP-1600 will make possible applications of electronics hitherto not practical due to limitations of cost or size, such as incorporation of electronic controls within automobiles to meet energy and environmental requirements for gasoline efficiency."

The new CP-1600 microprocessor has applications ranging from desk calculators, peripheral controllers, process controllers, communications concentrators, POS (point-of-sale) terminals, as well as general purpose computers. The device should also lead the way to a new generation of low-priced computers, opening up the market to millions of possible users who previously could not afford existing minicomputers.

The CP-1600 is a fast and flexible microprocessor with an 87 instruction repertoire, a clock cycle time of 400 ns and a typical instruction time ranging from 1.4 to 4.8 microseconds. The new microprocessor is thus ten times faster than first generation P-Channel microprocessors and has twice the memory capacity of an 8-bit CPU. This has been achieved by the use of a new N-channel ion-implant process which is both faster than P-channel processes and yields a higher packing density.

The CP-1600 easily integrates into a versatile high throughput micro-computer system. The 16-bit word enables fast and efficient processing of numeric or byte oriented data. The 16-bit address permits accessing 65 536 words in any combination of program memory, data memory, or peripheral devices.

AUDIO PROJECTS VOL. 1

Due to a printer's error, one illustration was omitted from the article on the ETI 422 Stereo Amplifier in our recently-published Audio Projects Volume 1.

We reprinted as many copies as possible, but some had already gone out to our distributors. These were put on sale with an errata slip inserted, showing the missing illustration.

We regret any inconvenience this may have caused. ●

Introducing
Ferric Oxide's finest hour...

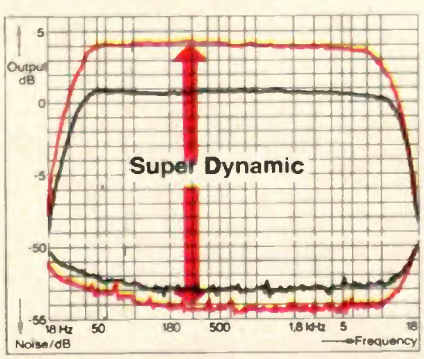
...hour and a half, and two hours

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

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BA4472

VIDEOPHONE -experimental link

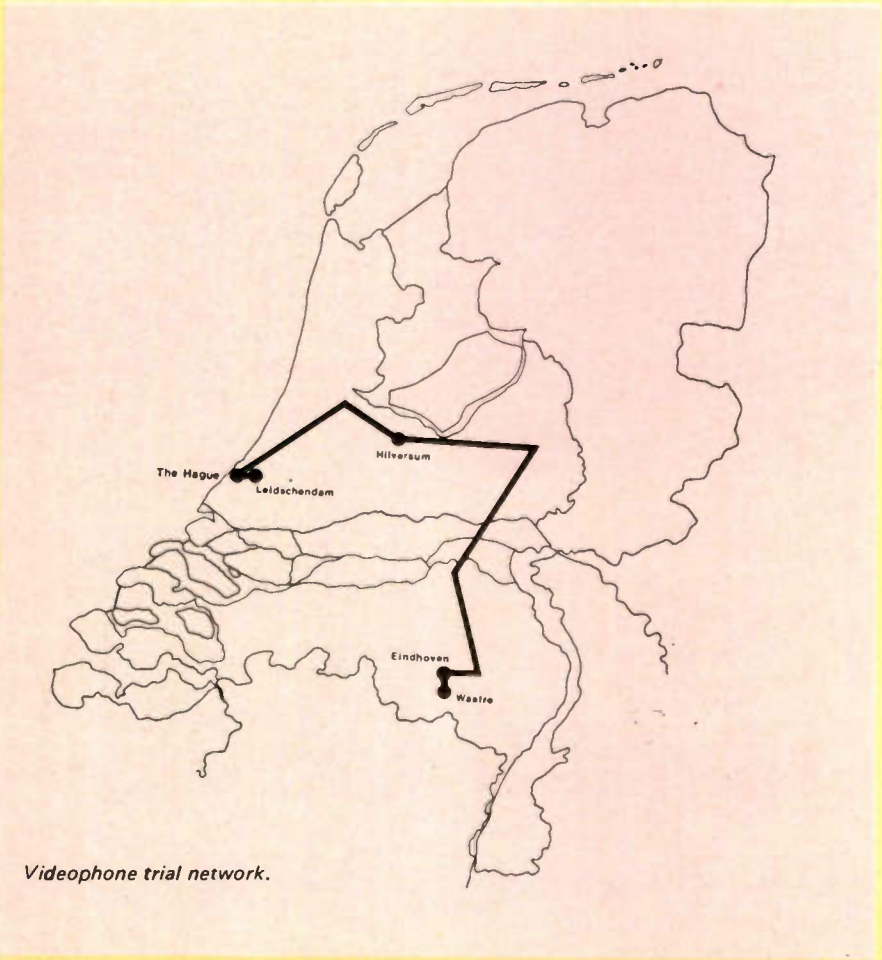
Prototype system links fifty-five subscribers through five exchanges.

IN RECENT YEARS experiments have been conducted in several countries with picture telephony, a new medium of communication which makes it possible for the parties at either end of a telephone connection to see each other and show documents or objects. Development in the Netherlands started as early as 1968 at the Philips Research Laboratories, and culminated early in 1972 with the opening of a simple local network incorporating 20 sets.

After studying the first results, the Netherlands PTT decided to set up an experimental network for joint use with Philips over a period of two years. This is expected to give sufficient opportunity for evaluating the technical, ergonomical and operational aspects. There are other points of interest such as possible changes in the communication pattern of the subscribers and more specifically the extent to which picture telephony can obviate the need to travel.

NETWORK CONFIGURATION

The experimental network finds its subscribers exclusively among those who have to be in frequent touch with each other on account of their functions. As such it interconnects various offices and laboratories at Waalre (Philips Research Laboratories, 20 subscribers), Eindhoven *(Philips' Gloeilampenfabrieken,* 10 subscribers), Hilversum *(Philips' Telecommunicatie Industrie,* 11 subscribers), The Hague (PTT Directorate General, four subscribers, and *Philips Telecommunicatie Nederlands,* one subscriber), and Leidschendam (PTT Laboratories, nine subscribers). Thus the total number of subscribers at present is 55.



Videophone trial network.

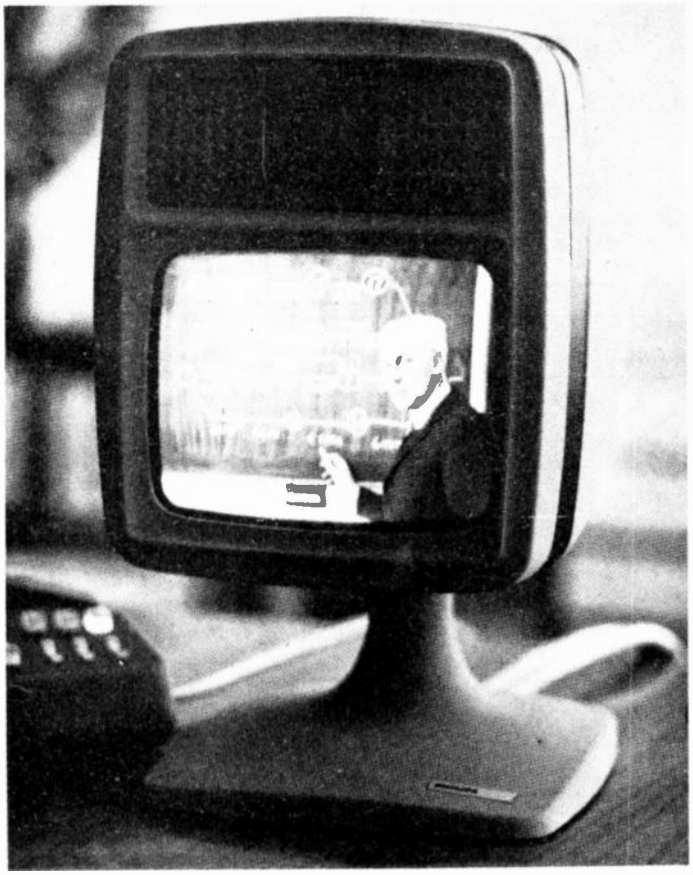
Existing equipment and facilities are used wherever possible for transmission and switching. From an operational point of view, however, the experimental network is entirely separate from the public telephone network.

The PTT provides the transmission paths via radio relays and cables; Philips Telecommunicatie Industrie supplies the equipment, such as the picture telephones, the exchanges and the repeaters. Because few subscribers are involved, the exchanges can be small; four of them are of conventional design, while the fifth (at Waalre) is an experimental computer-controlled type. Each conventional exchange is equipped with a switching matrix composed of reed relays for switching the video signal. A special modulator -demodulator developed by the PTT Laboratories permits two picture telephone conversations to be conducted simultaneously on a radio relay. For the local sections of the network transmission takes place over the conductors of existing telephone cables. The network, including the exchanges, employs a total of some 300 repeaters.

BANDWIDTH

In picture telephony it is of great economic interest that the bandwidth on trunk circuits, and hence the number of telephone channels occupied, shall be restricted to the lowest possible figure. A bandwidth of about 1 MHz proves to be adequate, permitting a moving picture of a person's head and shoulders to be transmitted with adequate resolution. Such a picture telephone signal can be transmitted by present-day telephone cables over a length of 1.5 to 2 km without any intermediate repeaters being needed.

In order to reduce the bandwidth from the 5 MHz television standard to about 1 MHz, the number of lines used in picture scanning has been reduced from 625 to 325. The number of picture spots per line has been reduced proportionally. This has resulted in a bandwidth of 1.3 MHz, which is roughly one quarter of the television standard. By way of illustration, this may be compared to a television news broadcast where the head and shoulders of the announcer occupy



Discussions among designers, developers and production specialists dealing with a new product can be held by picture telephone.

Diagrams and sketches made on a blackboard can be displayed and commented upon.

about one quarter of the picture area with the same resolution.

Future compatibility with the existing television standard being a desirable feature, the design objective has now been set at 313 picture lines, which is the closest possible approximation to half the 625 lines of the television standard.

SIGNAL STRUCTURE AND TRANSMISSION SYSTEM

The picture telephone system uses an advanced digital synchronizing technique and, in conjunction with sound, is transmitted on the "sound in sync." principle. During frame flyback a digital code word is transmitted which accurately defines the end of the past frame period and the start of a new one. During part of the line flyback a series of short pulses ensures that an HF oscillator in the receiver remains in synchronism with a similar oscillator in the transmitter. The remaining part of the line flyback time is used on a sound in sync. basis to transmit the delta-modulated sound signal, which is also in a digital form. The visual information is transmitted in the conventional way by an analogue signal. Transmission of the combined picture, sound and sync. signals take place on one pair of conductors for each direction. Thus a 4-wire connection is available for the sound signal, which means that crosstalk will not occur in the transmission path. Since, moreover, the sound information is transmitted digitally, i.e. without any loss variations, the loudspeaking telephone section with the associated speed switches is highly stable, so that the speaker at the other end can easily be interrupted.

Although digital signalling would have been quite feasible too, a separate pair of conductors is used in the experimental network for purely practical reasons. The 6-wire circuit thus obtained makes it possible, if desired, to switch the entire network to the conventional mode of picture telephone transmission with analogue synchronization and separate transmission of the sound and signalling information.

The 20 subscribers at Waalre are using the picture telephones which have been in use there for some years. For all the other subscribers Philips' Telecommunicatie Industrie has developed a picture telephone solely for use in the experimental networks, and not intended for future marketing. The picture telephone is composed of three discrete units:

- a picture set with camera, picture tube and loudspeakers;
- a control set with keys for selecting any desired picture telephone subscribers and for the control of sound and the local picture, the control set also contains the microphone;
- a terminal box accommodating the power supply and other ancillary equipment.

The picture set is placed about one metre in front of the subscriber's seat. The control box can be placed within easy reach.

The camera has an automatic lighting control system, which adapts the camera to any changes in lighting conditions. The use of a Plumbicon type camera tube permits electronic zoom and height control. Special electronic circuits ensure good gradation and contour crispness.

The picture tube has dimensions of about 190 x 140 mm. This means that the pictures are large enough to be viewed by two persons in full comfort. A polarizing filter has been fitted in front of the tube to prevent reflections, resulting in good contrast without troublesome flicker even under conditions of strong incident light.

DISPLAYING DOCUMENTS OR OBJECTS

A fold-out mirror fitted on top of the camera makes it possible to show pictures of texts, drawings or objects placed on the table. Normal typewriter text cannot be reproduced legibly on account of the system's limited resolution, but larger letters (not more than 25 to a line) can be easily read.

Widely spaced handwritten text, drawings, graphs and diagrams can be displayed and discussed, and so can small equipment units or components.

The camera may also be trained on blackboards or planning-boards to transmit the information shown on them, provided the size is adequate.

VIDEOPHONE - experimental link

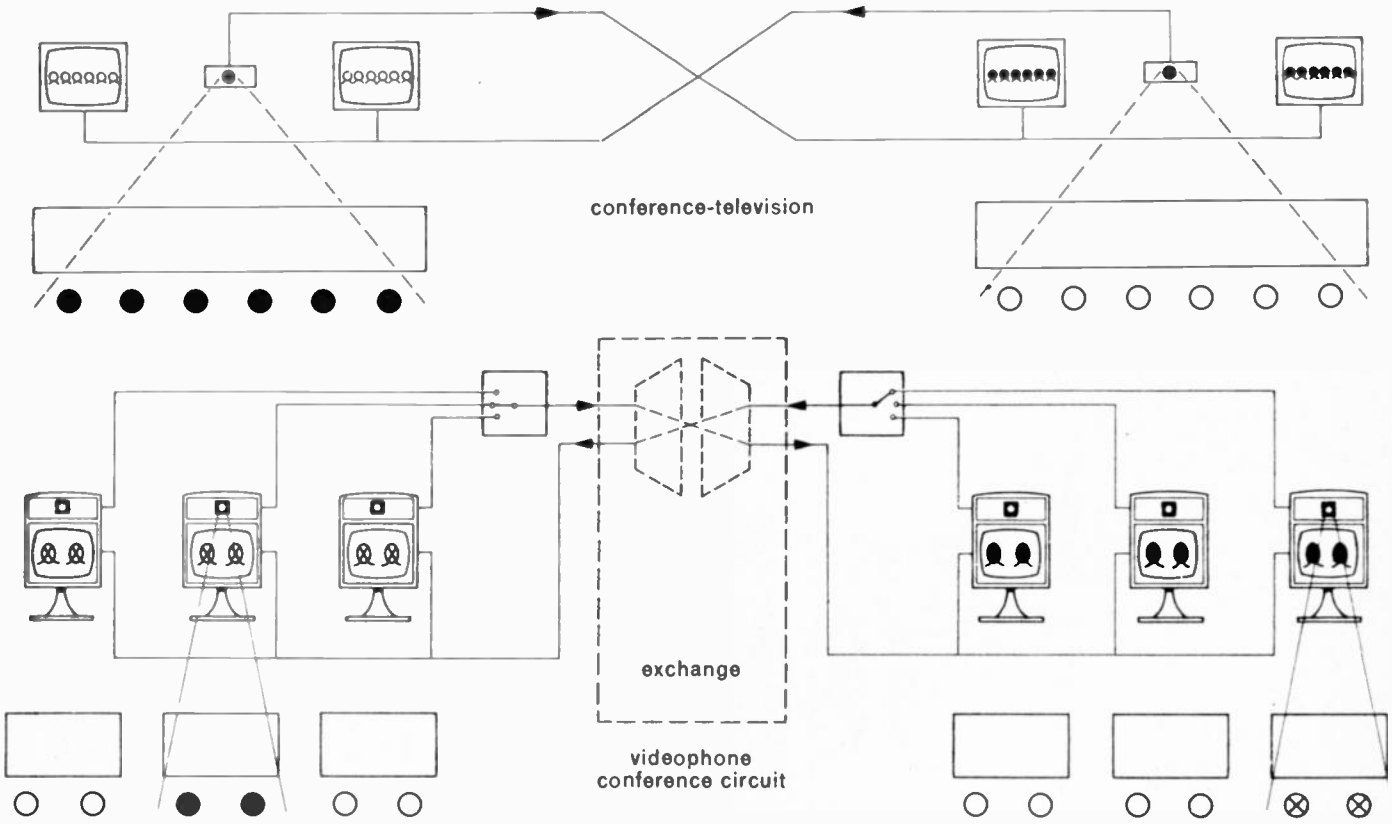
PICTURE TELEPHONE CONFERENCES

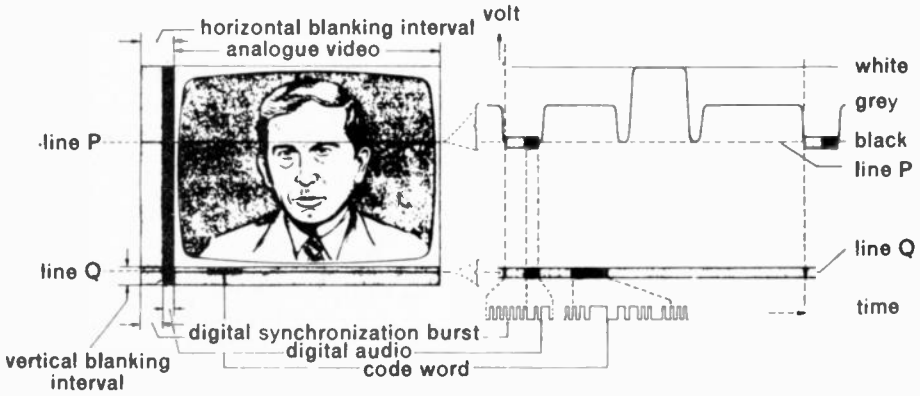
For conferences to be held by picture telephone, participants at either end of the connection are seated in pairs in front of picture sets. The picture to be transmitted at any given moment is selected either automatically by speech detection or manually by the chairman. Thus the screens at the other end of the line will always show a picture of the present speaker and his neighbour.

Connections between the conference are established via the normal picture telephone circuits: to this end the equipment need only be supplemented with a conference control unit and a few picture telephone sets. The connection existing between the two groups taking part in the conference can be interrupted for consulting a third party connected to the network. This is a feature distinguishing picture telephone conferences from "conference television" or a similar form of meeting conducted by line television, where the parties at either end assemble in special studios interconnected by fixed circuits employing the 5 MHz transmission standard.

	picture telephone	broadcast television
– number of picture lines	325 *	625
– picture frequency	25 Hz	25 Hz
– line interlacing	1:2	1:2
– bandwidth	approx. 1.3 MHz	approx. 5 MHz
– aspect ratio (picture width-to-height ratio)	4:3	4:3

* For full compatibility of the two systems, a change to 313 lines for picture telephony would be preferred.





A. Transmitted picture in blanking mask
B. Waveform of transmitted picture

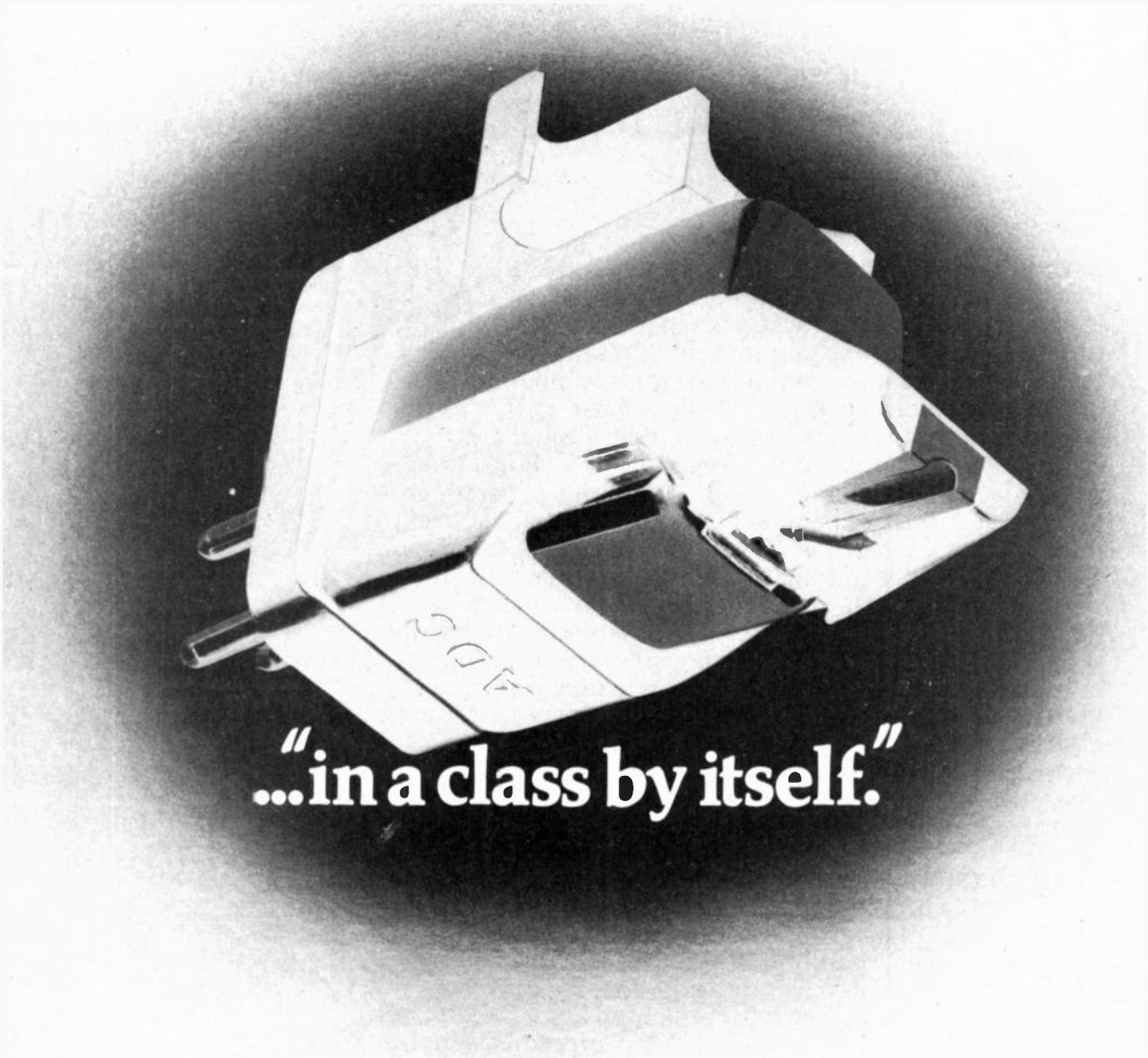
FREQUENCY RESPONSE "The CBS STR-100 test record showed less than ± 1.5dB variation up to 20,000Hz". *Stereo Review.*
"...response is within ± 2dB over the entire range". *Audio*
"Frequency response is exceptionally flat". *High Fidelity*

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 reproducing 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*



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."

Audio echoed them with, "The ADC-XLM appears to be state of the art."

With the critics so lavish in their praise of the XLM, there's hardly any necessity to add anything. Far better to let experts continue to speak for us.

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15 Orchard Road, Brookvale 2100. Phone: 9391900

11104

BSR HAVE MADE

BSR 810 Automatic/Manual Transcription Turntable

1

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

BSR HT70 Three Speed Single Play Turntable.

2

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

BSR McDONALD

The range of BSR changers are available at your nearest Hi-Fi store. *Recommended retail price at the time of going to press.

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

SOME CHANGERS

(Now we distribute famous ADC Cartridges too!)

3

BSR 710 Automatic/Manual Transcription Turntable

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

BSR 660 Two Speed Magnetic Automatic/Manual Turntable

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

4

5

BSR 560 Two Speed Magnetic Automatic/Manual Turntable.

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

BSR (A'sia) Pty. Limited,
Anne Street, St. Marys 2760.
Telegrams "BSR" St. Marys 2760.
Telephone 623 0375. Telex: 23159.

USING THE LM3900N

Four amplifiers on a single chip

ONE of the most noticeable trends in modern electronics is for more and more components to be packed into smaller and smaller spaces. One example of this is the fairly new LM3900 device manufactured by the National Semiconductor Company. It contains four separate internally compensated amplifiers in a single 14 pin dual-in-line encapsulation.

All four amplifiers are fabricated on a single silicon chip. Each amplifier contains seven transistors, a diode and a capacitor, whilst other internal components are used in the bias and power supplies.

One might expect that new devices of this type would be quite expensive, but the LM3900 is available at just over $2.00 each — or even less in quantities of ten or more.

CONNECTIONS

The connections of the four separate amplifiers are shown in Fig.1. Each amplifier has a non-inverting input (marked +), an inverting input (marked —) and an output connection.

In addition, there is a single common positive supply connection and a common ground connection (negative supply line) for the whole device.

INTERNAL CIRCUIT

Conventional high gain amplifiers employ a differential input stage to provide inverting and non-inverting inputs, but a rather different approach is employed in the LM3900N. A 'current mirror' is employed in the non-inverting input circuit, the current 'reflected' in this mirror being subtracted from that which enters the inverting input.

This type of amplifier therefore acts as a differential stage by amplifying the difference between two *currents* rather than the difference between two voltages (as in a conventional amplifier).

The type of amplifier used in the LM3900N may be referred to as a 'Norton' amplifier, since Norton is the name of the person who developed a theorem relating the *current* flowing in a circuit to the equivalent current generator and shunt impedance.

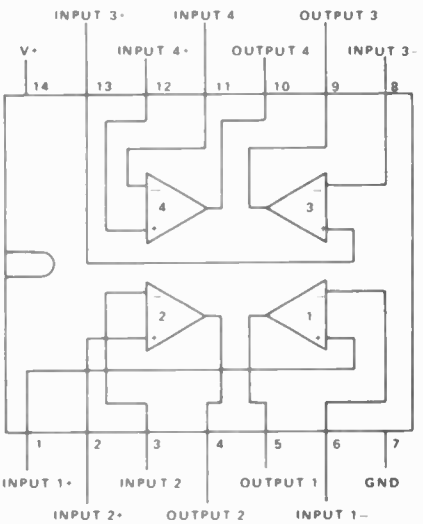

Fig.1. The connections of the LM3900N.

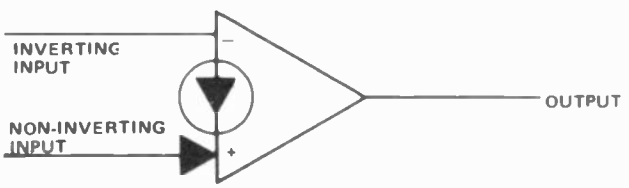

Fig.2. The symbol for one of the Norton amplifiers of the LM3900N.

SYMBOL

The symbol recommended for each of the four Norton amplifier stages in the device is shown in Fig.2. This symbol distinguishes this type of amplifier from the standard operational amplifier symbol and avoids confusion in circuits.

The symbol of Fig. 2 contains an indication that there is a current source between the inverting and non-inverting inputs and implies that the amplifier uses a current mode of operation. In addition, the circuit symbol indicates that current is removed from the inverting input, whilst the arrow on the non-inverting input shows that this functions as a current input.

PERFORMANCE

The LM3900N has the advantage that it can operate from a single supply voltage over the range of four volts to 36 volts. Most conventional operational amplifiers require supplies symmetrical with respect to ground (typically ± 15 V); the LM3900N can be used with such supply lines if desired.

The maximum peak to peak output amplitude of an LM3900N amplifier is only 1 V less than the supply voltage employed. The current consumed from the power supply is typically 6.2 mA (maximum 10 mA).

The typical voltage gain of each amplifier is 2800 or nearly 70 dB. The

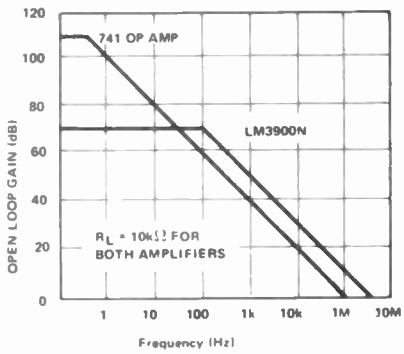

Fig. 3. Comparison of the gain of the LM3900N with that of a 741 amplifier at various frequencies.

minimum gain of any amplifier is 1200. The variation of this gain with frequency is compared with that of the well known type 741 operational amplifier in Fig. 3. It can be seen that the LM3900N amplifiers provide about 10 dB more gain at all frequencies above 1 kHz.

APPLICATIONS

The Norton amplifiers used in the LM3900N device entail the use of somewhat different circuit design techniques than those used with conventional operational amplifiers.

The inverting input of the LM3900N amplifiers must be supplied with a steady biasing current. The current to the non-inverting input modulates that to the inverting input. The fact that current can pass between the input terminals leads to some unusual applications.

Both inputs of each of the amplifiers in the LM3900N are clamped by diodes so as to keep their potentials almost constant at one diode voltage drop (about 0.5 V) above the ground potential of pin 7. External input voltages must therefore be converted to input currents by placing series resistors in each input circuit.

USE AS AN AC AMPLIFIER

The LM3900N forms a useful ac amplifier, since its output can be baised to any desired steady voltage within the range of the output voltage swing. The ac gain is independent of the biasing level and the single power supply required greatly simplifies circuit design.

A simple ac amplifier circuit is shown in Fig.4. The gain is approximately equal to R_2/R_1 or 10 with the circuit values shown, the mean potential at the output is half the supply voltage. The value of R_3 should be twice that of R_2 since the current' passing through of these resistors is then the same. The positive supply and ground connections are not shown in Fig. 4

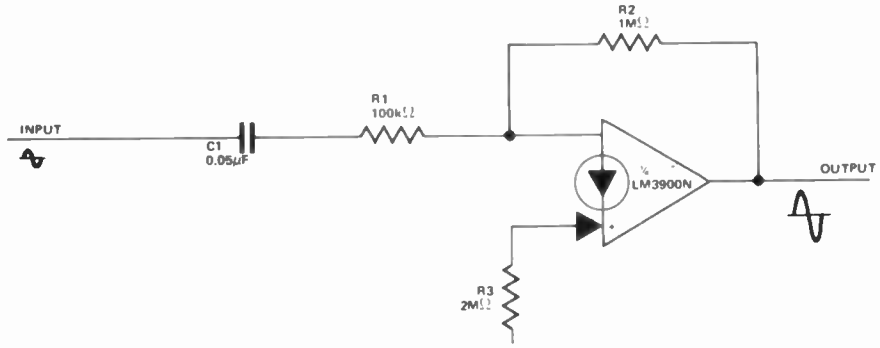

Fig.4. A simple a.c. amplifier circuit.

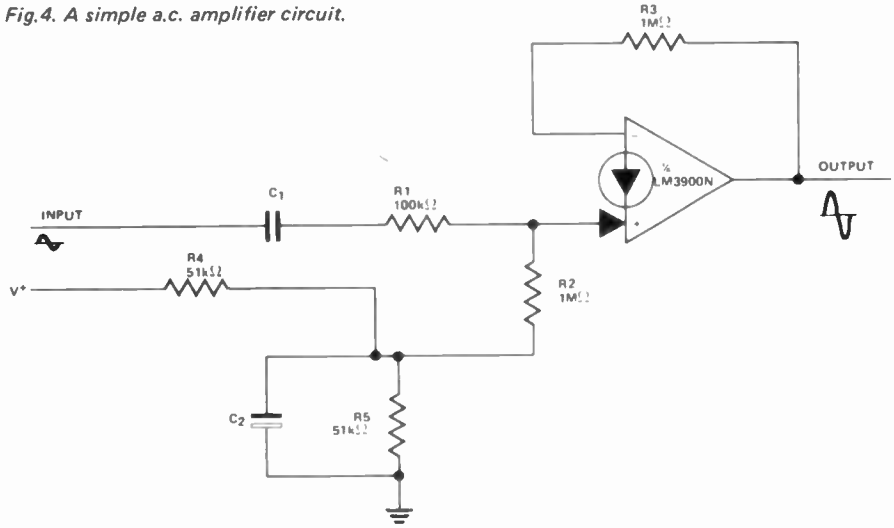

Fig.5. A simple non-inverting a.c. amplifier.

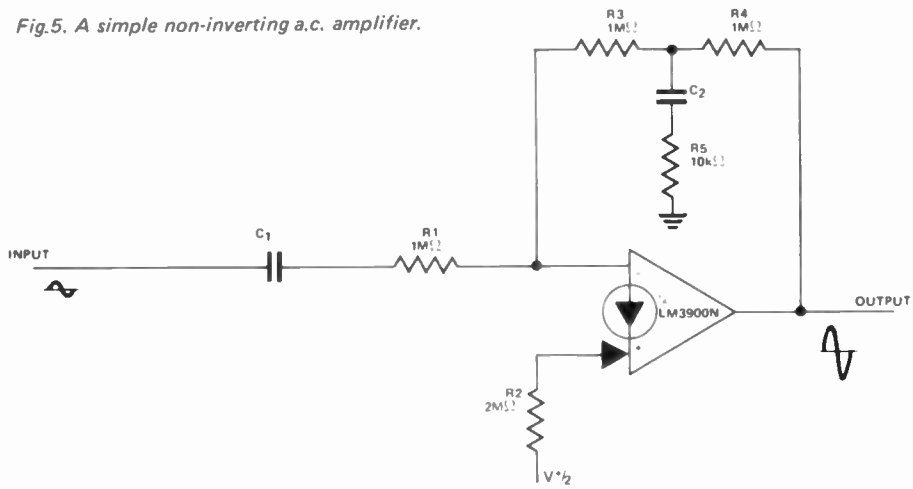

Fig.6. An amplifier which has a high gain and a high input impedance.

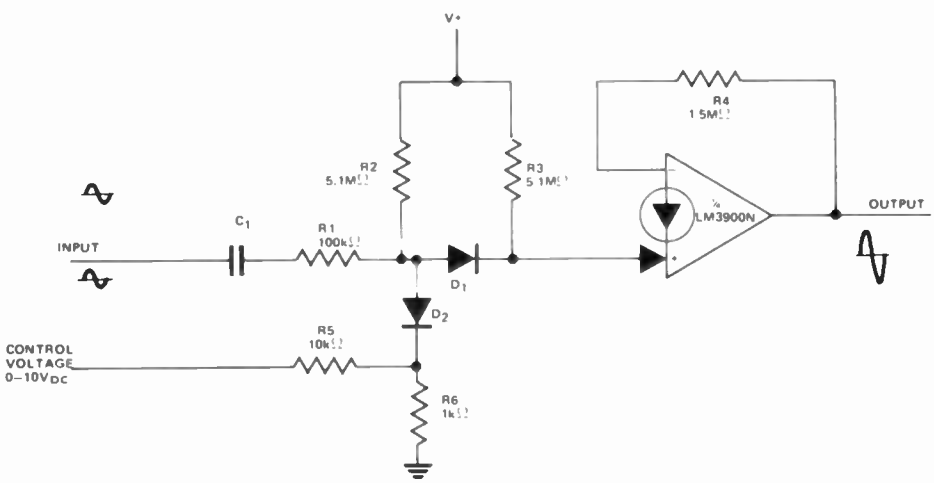

Fig.7. An amplifier which has a gain controlled by an input voltage.

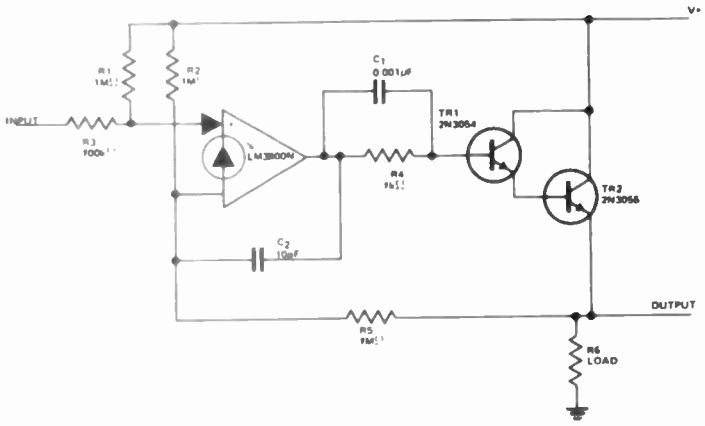

Fig.8. A direct coupled power amplifier.

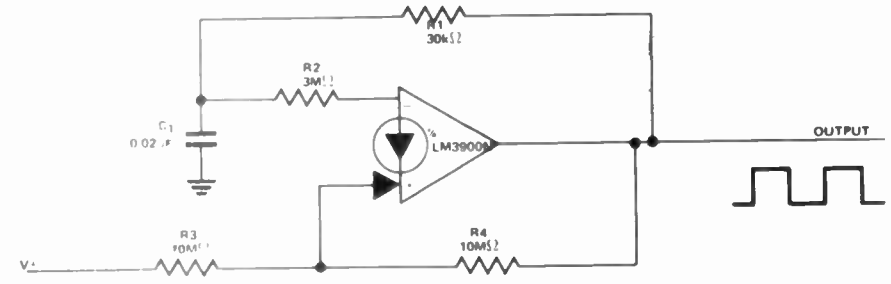

Fig.9. A simple square-wave generator.

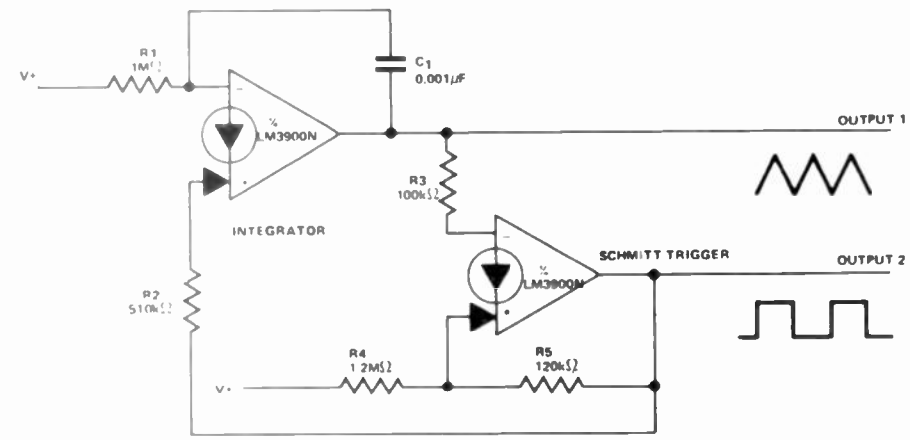

Fig.10. A circuit for generating triangular and square-wave.

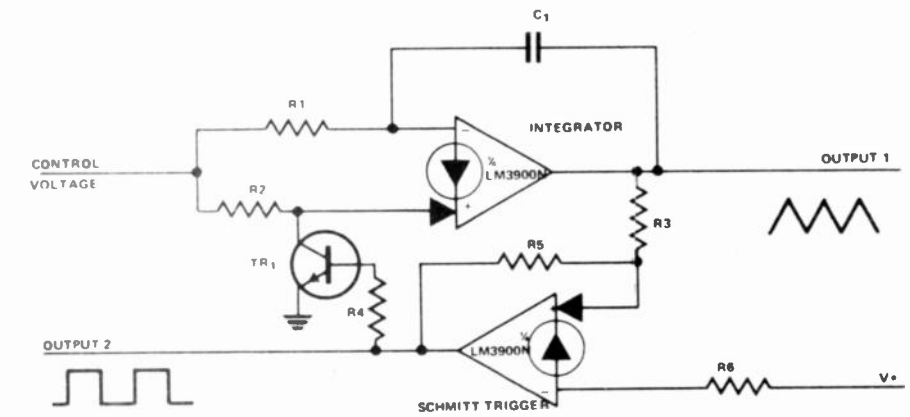

Fig.11. A voltage controlled oscillator which produces triangular and square-waves.

for simplicity, but R_3 should be returned to the same positive supply line as that used to feed pin 14.

The circuit of Fig. 4 provides a phase inverted output. Any ripple on the power supply line will appear on the output at half amplitude.

NON-INVERTING AC AMPLIFIER

The circuit of Fig. 5 shows an amplifier which provides an output in phase with the input. The gain is equal to $R_3/(R_1 + r_d)$ where r_d is the small signal impedance of the input diode. The value of r_d is equal to 0.026 divided by the current passing through R_2 to the non-inverting input.

The capacitor values should be chosen so that the impedance of these components is considerably less than the circuit impedance at the points concerned.

HIGH IMPEDANCE AND HIGH GAIN

The circuits of Figs. 4 and 5 have an input resistance, R_1 or 100 k ohm. If this resistor is increased to provide a higher input impedance, the gain of the circuit will fall. However, the circuit of Fig. 6 has been designed so that it provides both a high input impedance and a high gain using a simple amplifier. With the component values shown, the input impedance is one megohm and the gain 100.

The voltage applied to R_2 is made equal to the output voltage (which is half the supply voltage). The value of R_2 is equal to the sum of R_3 and R_4; these resistors set the dc bias. If desired, R_2 may be made four megohms and its lower end connected to the V+ supply.

Resistors R_4 and R_5 form a potential divider so that only 1/100 of the alternating output voltage is developed across the C_2 – R_5 circuit. This fraction of the output voltage is fed back to the inverting input via R_3. As R_3 and R_1 are equal, the gain is R_4R_5. As R_5 is decreased, the gain approaches the open loop gain of the amplifier.

VOLTAGE CONTROLLED GAIN

An amplifier with a gain which can be controlled by the value of a steady applied voltage is shown in Fig. 7.

A current flows from the positive supply through R_3 to provide a bias which prevents the output of the amplifier from being driven to saturation as the control voltage is varied. When D_2 is non-conducting, the currents passing through both R_2 and R_3 enter the non-inverting input and the gain is of maximum. This occurs when the control voltage approaches 10 V.

The gain is a minimum when the control voltage is zero. In this case D_2 is conducting and only the current passing through R_3 enters the non-inverting input of the amplifier.

DIRECT COUPLED POWER AMPLIFIER

In the circuit of Fig. 8, the output from an LM3900N amplifier is fed to a Darlington pair of power transistors. This circuit can deliver over three amps into a suitable load when the transistors are correctly mounted on heat sinks.

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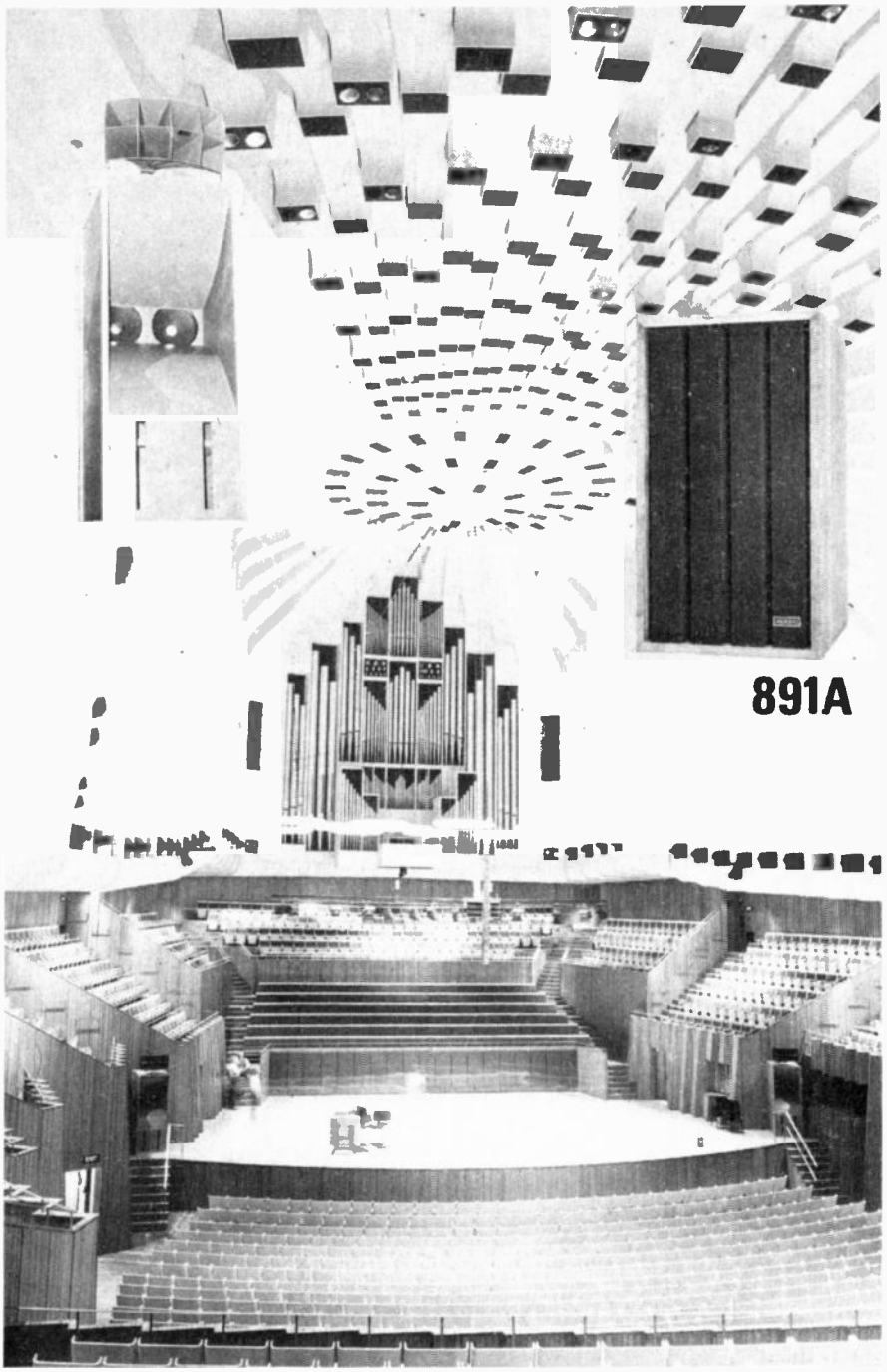

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Sales in the U.S. have reached new peaks – and in the highly competitive and selective European market demand for ALTEC systems has never been greater.

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Ask any of the sound engineers who specify and enthuse over ALTEC quality monitors. Once you've heard and enjoyed ALTEC sound, *you'll never be satisfied with anything else.*

NEW DOMESTIC SPEAKERS

*Altec 891A. In just a year, this model has become a best seller. It features a 12 inch woofer and a high-frequency radiator tweeter and comes in an enclosure measuring 25-1/2 x 14-1/2 x 12-1/2 inches with a charcoal-colored sculptured foam grille. ALTEC have said it was designed for "younger people who want good sound but want to pay less." Our tests revealed it to produce an open, realistic sound and a crisp high end. It delivers this sound with only 12 watts of amplifier power.

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

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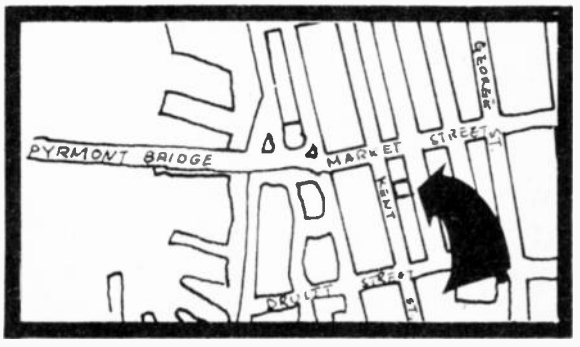


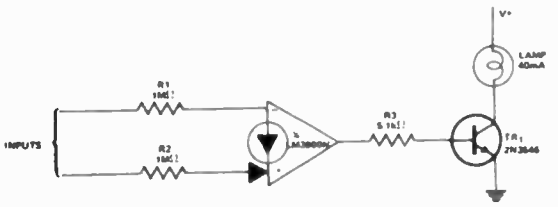


Fig.12. A voltage comparator with an indicator lamp.

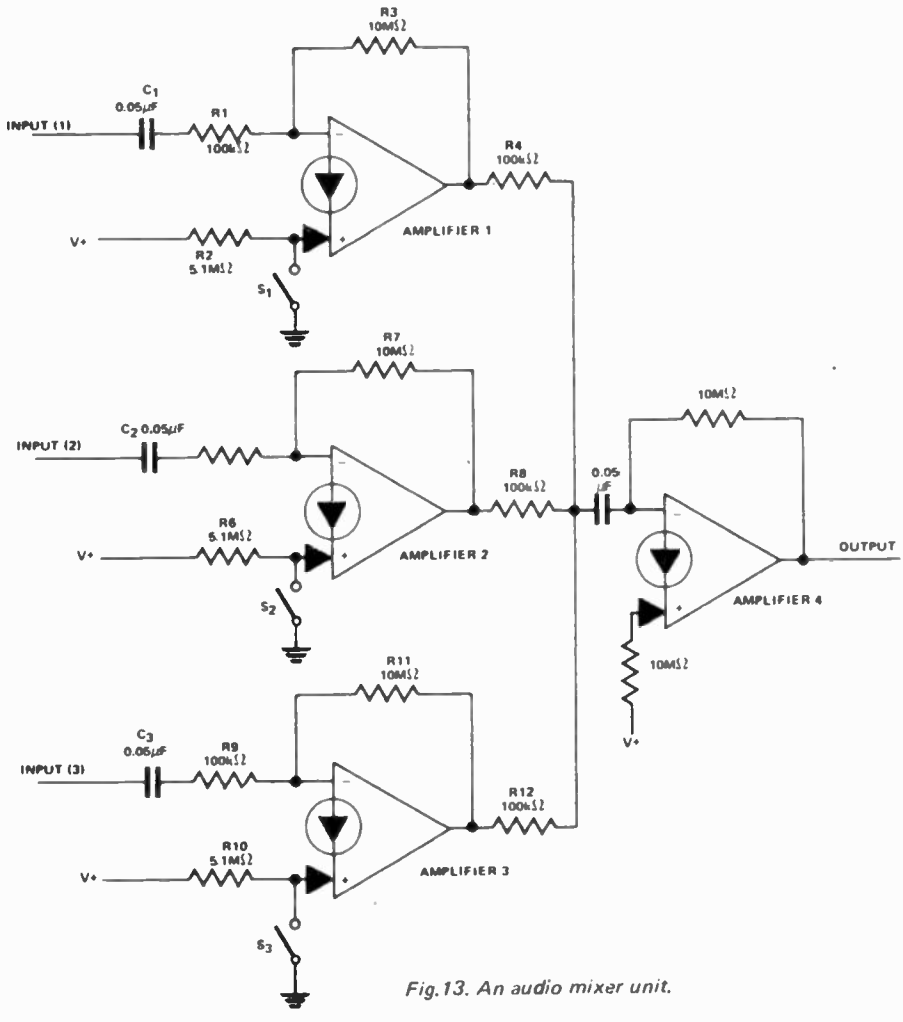


Fig.13. An audio mixer unit.

SQUAREWAVE GENERATOR

The multiple amplifiers in the LM3900N device are very suitable for use in waveform generators at frequencies of up to about 10 kHz. Voltage controlled oscillators (the frequency of which is dependent on an input voltage) can also be designed using the device.

A simple square wave generator is shown in Fig. 9. The capacitor C_1 alternately charges and discharges between voltage limits which are set by R_2 R_3 and R_4. The circuit is basically of the Schmitt trigger type, the voltages at which triggering occurs being approximately V+/3 and 2V+/3.

TRIANGULAR WAVEFORM GENERATOR

A triangular waveform generator can be made by using one amplifier of a LM3900N device as an integrator and another amplifier as a Schmitt trigger circuit. A suitable circuit is shown in Fig. 10; it has the unusual advantage that only the one power supply is required.

When the output voltage from the Schmitt trigger circuit is low, the current flowing through R_2 is integrated by C_1 to produce the negative slope of the triangular wave at output 1. When the output 2 voltage from the Schmitt trigger is high, current flows through R_2 to produce the rising part of the waveform at output 1.

The output waveform will have good symmetry if $R_1 = 2R_2$. The output frequency is given by the equation:

$$f = \frac{V^+ - V_{BE}}{2R_1C_1V}$$

where $R_1 \cdot 2R_2$, V_{BE} is the steady voltage at the inverting input (0.5 V) and V is the difference between the tripping points of the Schmitt trigger.

VOLTAGE CONTROLLED OSCILLATOR

A simple voltage controlled oscillator circuit which produces both triangular and square wave outputs is shown in Fig. 11. As in Fig.10, one amplifier is employed as an integrator.

When the output of the Schmitt trigger is high, the clamp transistor TR_1 is conducting and the input current passing through R_2 is shunted to ground. The current passing through R_1 causes a falling ramp to be formed.

When the Schmitt circuit changes state, its output switches TR_1 to the non-conducting state. The current flowing through R_2 can be made twice that flowing through R_1 ($R_2 = R_1/2$) so that the rising part of the ramp has a similar slope to the negative part.

The greater the value of the control voltage in Fig.11, the greater the frequency of oscillation. However, the voltage must exceed the constant input voltage (V_{BE}) or the circuit will fail to oscillate.

VOLTAGE COMPARATOR

The circuit of Fig. 12 shows how an LM3900N amplifier may be employed to compare two input voltages and to indicate the result by means of a small lamp. If the input voltage connected to the non-inverting input is appreciably more positive than the other input, the output of the amplifier will provide a positive voltage which renders TR_2 conducting. The lamp will then be illuminated.

One of the inputs may be a reference voltage so that one can then compare a single input voltage against this constant reference.

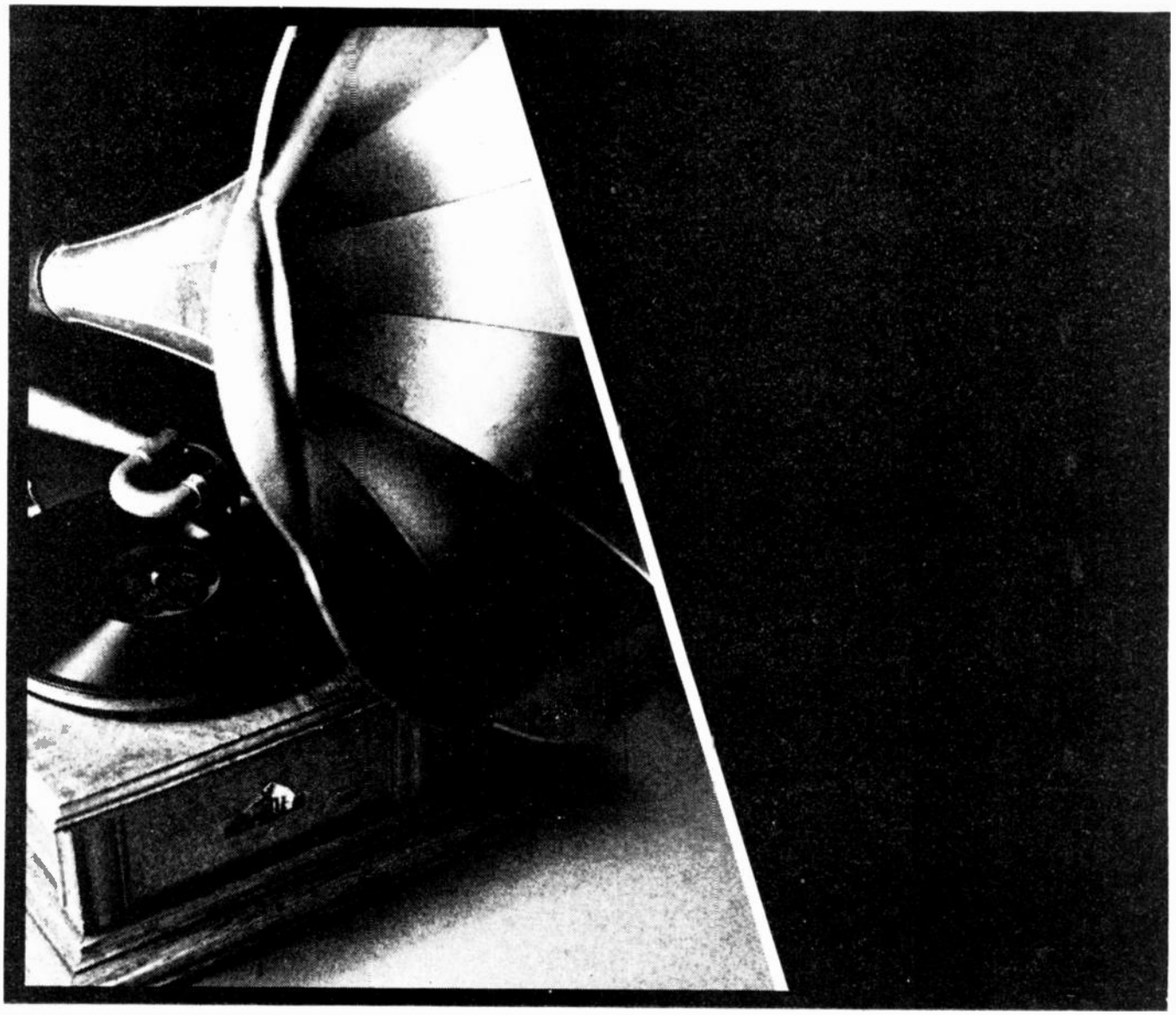
AUDIO MIXER

The amplifiers of a LM3900N device can be conveniently used to make a mixer unit for audio purposes; the unit enables three separate audio signals to be mixed together to produce a composite output. The circuit shown in Fig. 13 provides this facility using only a single LM3900N device and also enables any one channel to be selected be switches. The currents passing through the resistors R_4 R_8 and R_{12} are summed in the input circuit of the fourth amplifier.

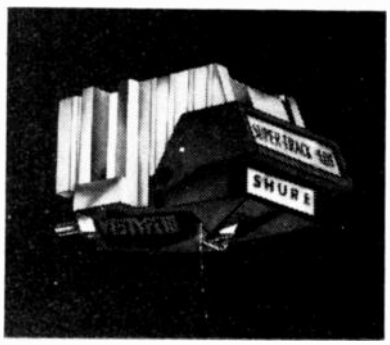
If S_1 is open, amplifier 1 will be driven to saturation by the current passing through R_2. It will therefore be inactive.

CONCLUSION

This short article has attempted to show a few of the numerous applications of this economical integrated circuit. Many more applications (such as phase locked loops, temperature sensing circuits, differentiators, tachometers, staircase generators, active filters, etc) are given in a report AN-72 produced by National Semiconductor. ●



Spirit of '78



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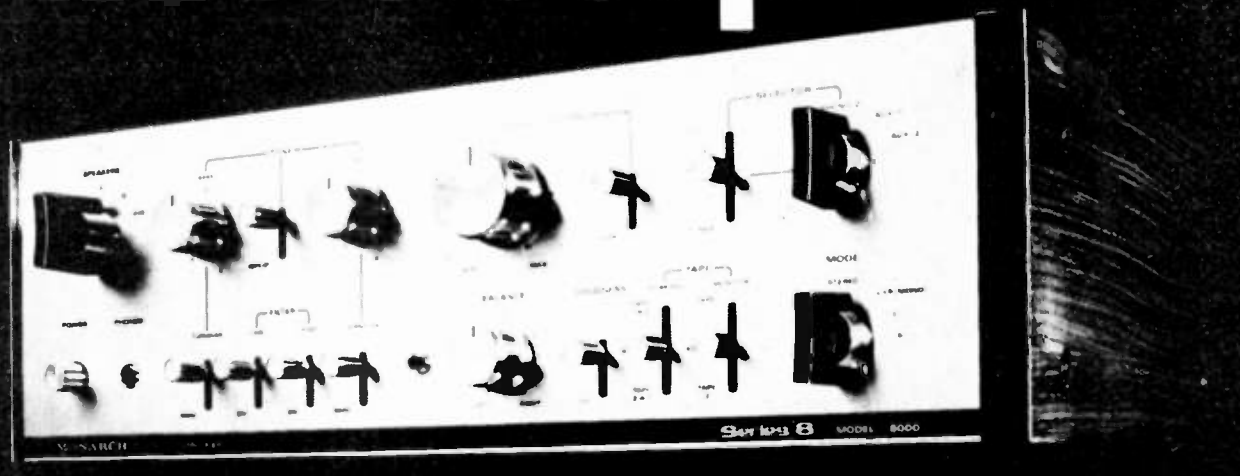
"It's no surprise!"



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

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

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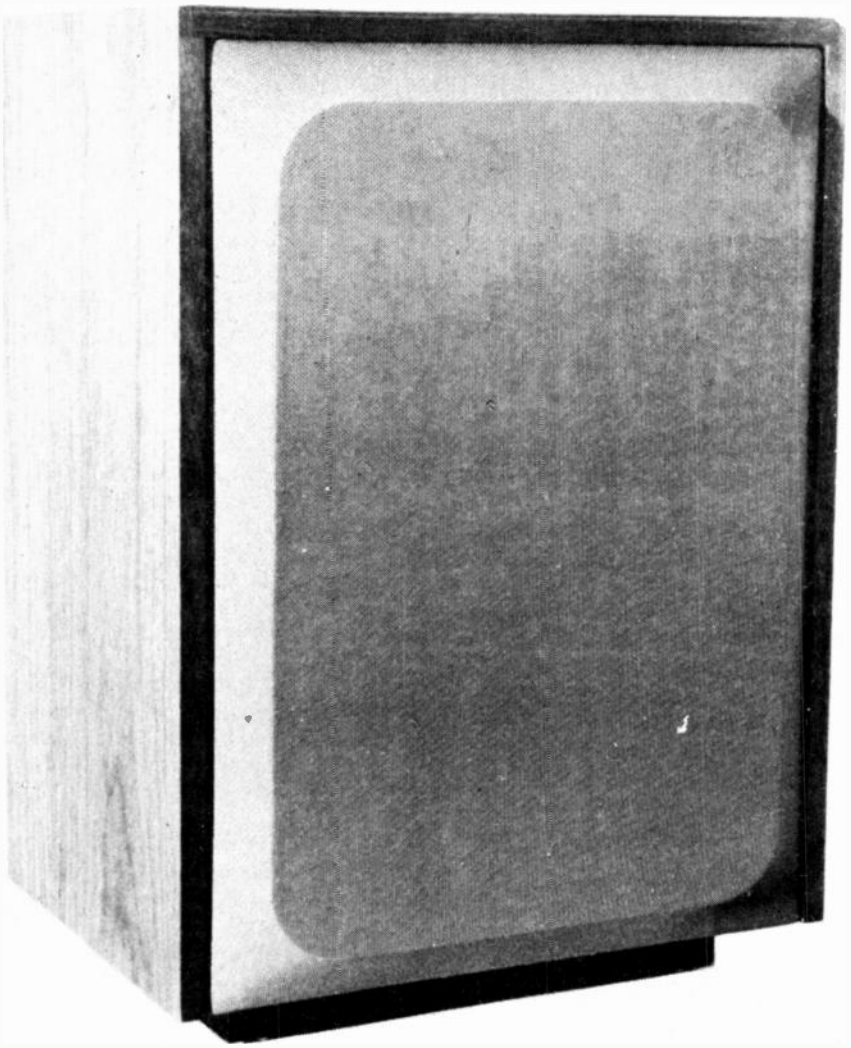
JBL JUBAL LOUDSPEAKERS



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Recommended retail price $1228 pair.

JAMES B. LANSING Sound Incorporated are innovators. When it comes to salesmanship, artistic presentation, and general quality of sound, they are one of the leaders in their field.

The design of the Jubal L65 loudspeaker combines advanced quality and striking appearance. A combination which should sell to both men and women. The unit is also designed functionally as a piece of modern furniture. For example it has a glass top rather than the more conventional veneered timber – less likely to be damaged by misplaced schooners! The glass mass overlays a black plaster foam-faced cardboard backing piece thus providing excellent acoustic damping for the enclosure's top.

A further unusual feature is the front grille. This is based on a steel moulding which is spaced out from a solid core backing frame over which is stretched the face cloth – which is then glued to the back of the frame. The result is really practical, acoustically efficient, does not suffer from the loss of very high frequency radiation which was a minor limitation of JBL's Century L100's, (and also enables the owner to replace the face cloth at any time).

The 250 mm diameter woofer has a 76 mm diameter voice coil and uses an edge wound copper ribbon strip on a magnetic assembly weighing 3.1 kg. The assembly has a polyurethane flexible surround, and in keeping with other similar JBL enclosures the drive unit is mounted from the front to facilitate mounting or replacement.

The mid-range unit is a conventional 130 mm cone radiator with a 22 mm voice coil, also edge wound with copper ribbon.

Described by JBL as an 'ultra-high frequency transducer', the tweeter is a most interesting device. This unit is JBL's 077 ring radiator. It is a slot radiator and diffraction horn – basically an exponential horn but with built-in diffraction characteristics. The horizontal dispersion of this slotted horn is extremely good being virtually unchanged at 30° to the main axis of the speaker. Even at 60° to the main axis we found it particularly difficult to determine any significant change in the radiation pattern, and there is still substantial radiation at 130° at frequencies as high as 130°. Vertical dispersion is not as good as it is horizontally but it is nevertheless more than adequate.

The enclosure itself is vented by a 70 mm tuned port whose length is extended by a right angle bend.

One feature which we did not like was the mounting of the mid-range speaker and the tweeter on the same plane, instead of vertically one above the other. The location of these two speakers in the same plane results in some mutual inter-action in the vicinity of their cross-over frequencies, degrading their off-axis response to a minor extent.

MEASURED PERFORMANCE

Our first series of tests were of the frequency response on-axis and at various other angles to the main axis. The results were particularly gratifying, the frequency response being essentially flat from 50 Hz to 20 kHz with the performance at both ends of the spectrum being substantially better than any comparably-sized JBL speaker system that we have previously measured.

ETI PRODUCT TEST

MEASURED PERFORMANCE
JBL JUBAL MODEL L65 LOUDSPEAKER SYSTEM
SERIAL NO. 14846

Frequency Response	± 6 dB	45 Hz – 20 kHz
Total Harmonic Distortion (for 90 dB at 2 metres on axis)	100 Hz	0.46%
	1 kHz	0.28%
	6.3 kHz	0.66%
Electrical Efficiency (for 90 dB at 2 metres on axis)	3 watts	
Measured Impedance	100 Hz	6Ω ohms
	1 kHz	15Ω ohms
	6.3 kHz	13Ω ohms
Crossover Frequencies	1 kHz	6.5 kHz
Dimensions	315 x 445 x 625 mm	
Weight	30 kg	

The high frequency performance of the new 077 tweeter is particularly smooth and highly commendable. Even at angles of the order of ± 80° to the main axis the combination of high frequency performance and lateral dispersion is substantially better than any other frequency radiator that we have measured.

Having substantiated the frequency performance we next measured the distortion. This too is particularly good, being 0.5% at 100 Hz, 0.3% at 1 kHz, and 0.6% at 6.3 kHz for our standard level of 90 dB at two metres on axis.

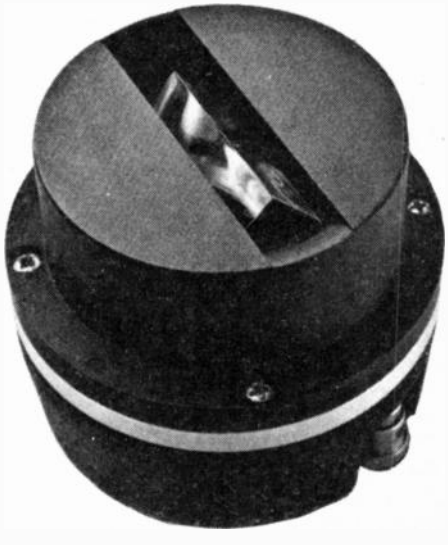
Our next evaluation was of the tone burst performance using the ETI tone burst generator. This is a very objective test of the speaker performance for which we have standardised on frequencies of 1 kHz and 6.3 kHz. Not surprisingly, the tone burst performance was good but it is nevertheless slightly degraded by the previously described inter-action between the mid-range and tweeter units.

It is apparent that the designers have gone to a lot of trouble to achieve a reasonable low frequency performance with the new low frequency driver utilised in the system. The bass is good, but does not quite match the improvement in performance that the mid-range and tweeter have over previous models produced by JBL. We suspect that this is in part due to a change of design philosophy for the low frequency driver, but only JBL could answer this question positively.

Two level controls for the mid-range and tweeter, described as presence and brilliance controls, are located behind the grill cloth at the top right hand of the enclosure. Our main testing was done with these controls at the zero settings indicated by the scale around the periphery of the screwdriver slots. On the units tested, at least, these controls provide an astonishing amount of attenuation – in the extreme positions it was no less than 35 dB from 750 Hz! It is possible that this feature is intentional but we are at a loss to know why!

HOW THEY SOUNDED

Our subjective listening tests extended over several days using a large number of records including classical, jazz, rock, and guitar, and some high quality test records



JBL's 077 ring radiator.

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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**

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

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

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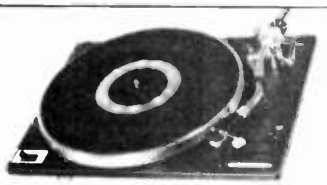

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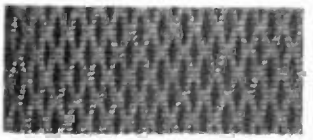

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JBL JUBAL LOUDSPEAKERS

including those put out by JBL themselves:

Collectively these convinced us that this speaker system is an improvement in terms of quality, clarity, and most definitely lack of colouration compared with other JBL speaker systems which we have heard and grown to like.

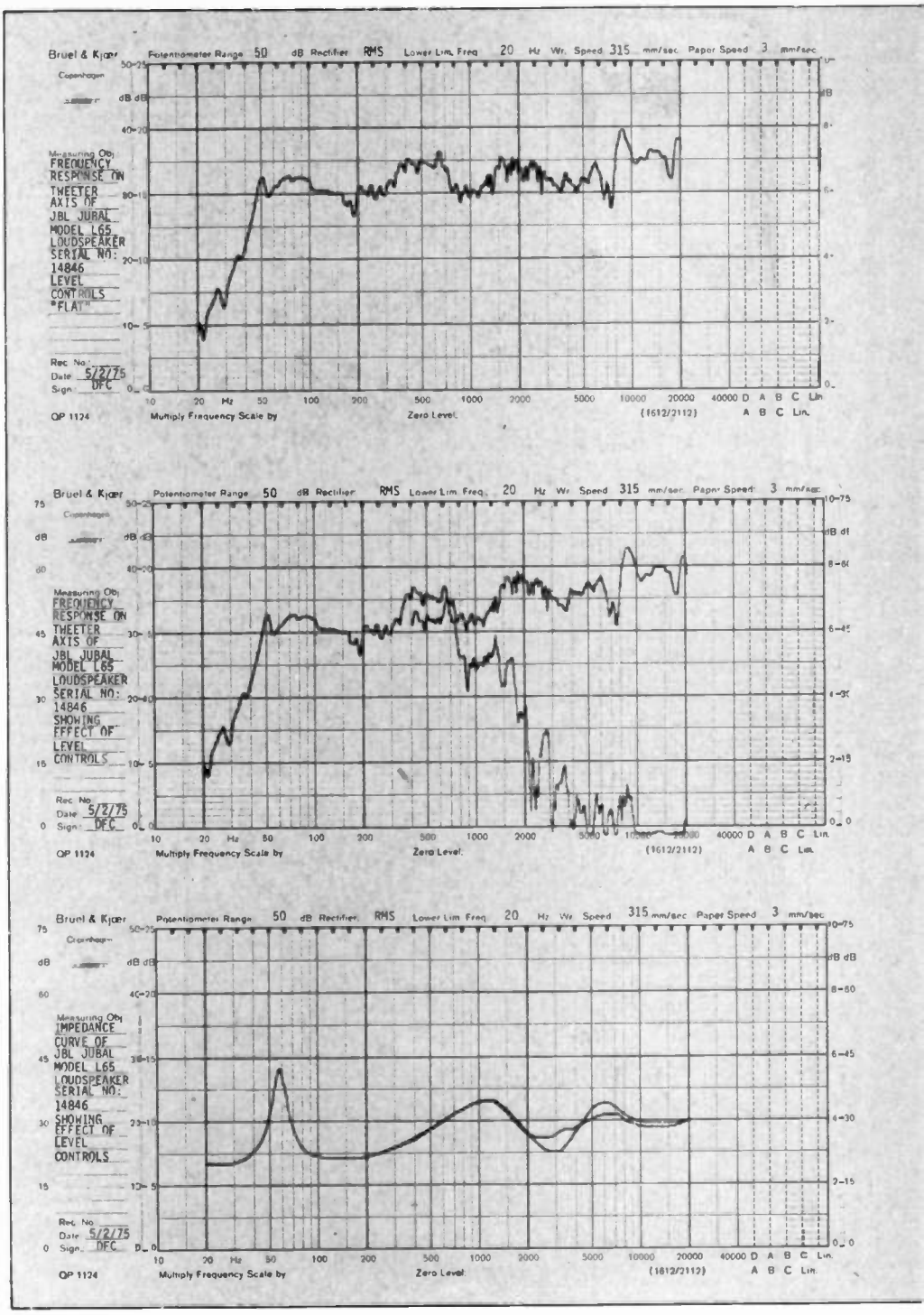
In A-B testing against JBL Model 4311 Control Monitors and the earlier JBL Century L100's we chose the Jubals every time for more faithful reproduction, lower distortion, and in particular a dramatic reduction in colouration.

The manufacturers state that they will take a 75 watt continuous programme content and we found this to be true. With a full 70 watts into each speaker, at levels so loud we had to protect our hearing with ear-muffs, the Jubals never flinched!

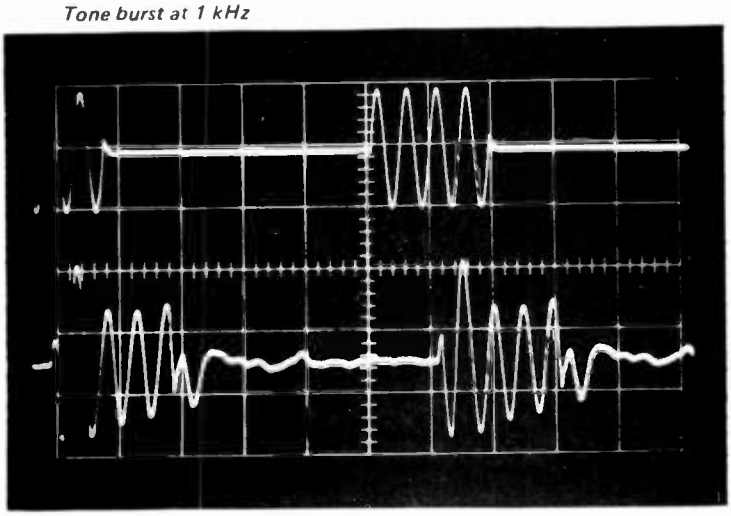
Earlier JBL speakers gained an enviable reputation for their ability to withstand very high power input levels and for their excellent reproduction of rock and pop music.

They tended to have rather more presence than most other top-quality speakers and because of this did not gain as strong a following amongst hi-fi purists as they did from the rock set — where they surely reigned supreme.

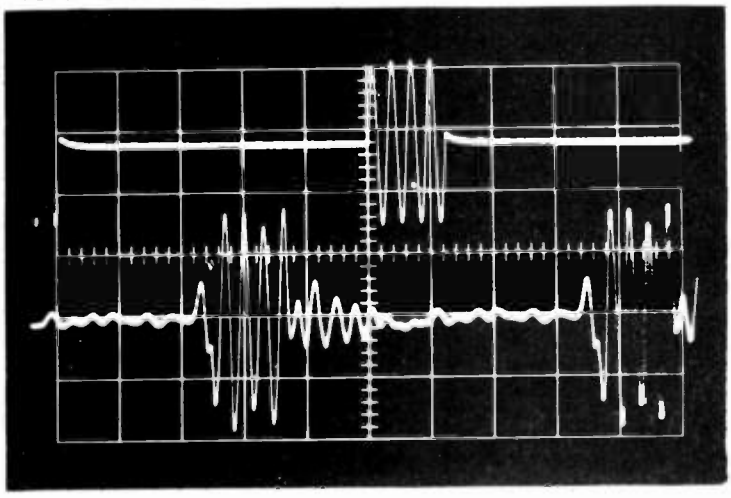
The Jubals have a slightly 'flatter' response and this, combined with their previously mentioned qualities, should ensure their acceptance by all music lovers — regardless of their musical preferences. ●



Tone burst at 1 kHz



Tone burst at 6.3 kHz



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Note: RT 222, RT 322 and RT 622 are made in the same style and finish as the popular RA 211, RA 311, and RA 611 Rotel amplifiers.

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AR 3A

Long considered the reference standard loudspeaker the AR 3A uses a 12" woofer and two hemispherical domes for mid and high range. "Stereo Review" said of it . . . "The best speaker frequency response we have ever measured using our present test setup . . . virtually perfect dispersion at all frequencies."
Highly detailed data available.

AR 2AX

The performance standard in the design of the AR 2AX was the same as that for the 3A: natural reproduction of music without exaggeration or artificiality of sound. But where quality in the case of the AR 3A has been limited only by the state of the art and our own engineering skill, for the 2AX price was also a consideration. "American Record Guide" said '1970 brings us a better than ever 2AX and I am nuts about it'.

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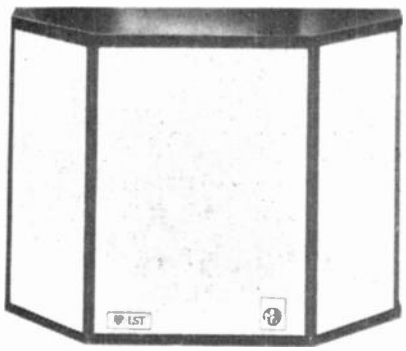

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AR 7

This speaker is very small (248 x 400 x 150 mm) and therefore particularly suitable for 4 channel use where space is at a premium. It uses a tweeter essentially the same as that used in the renowned AR 6. The smooth and well dispersed energy output of this speaker is well balanced by a newly designed woofer which offers a standard of low distortion bass exceeding that of speakers of much greater size and cost.

AR 6

In the three years or so that the AR 6 has been available it has already become the speaker that all others are compared to in its price range. It employs the very best technology in its cone woofer and tweeter that the state of the art permits and stands comparison with the most expensive AR systems. Also available in unfinished pine.

AR 4XA

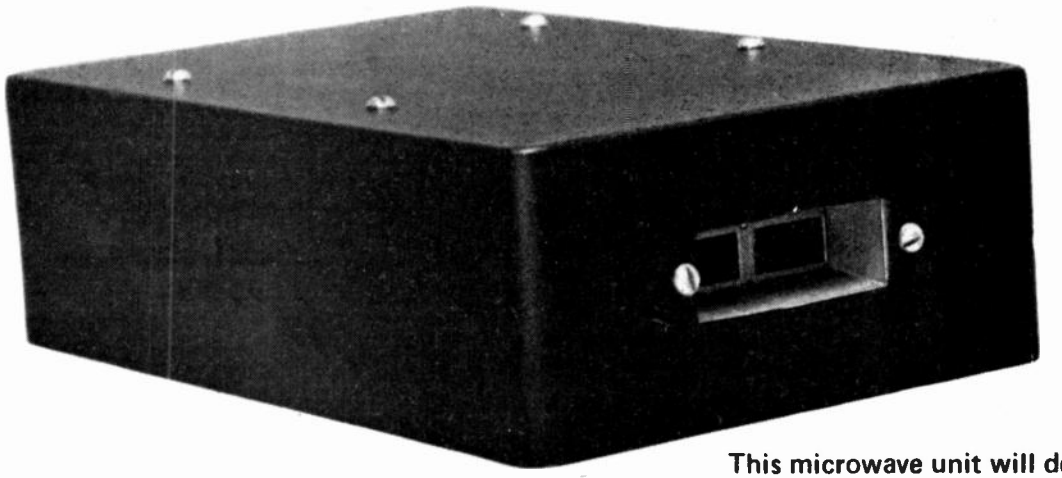
A new addition to the AR range and bringing you a third AR loudspeaker under $300 a pair is the AR 4XA. A successor to the AR 4X the AR 4XA uses the same woofer and cabinet as its predecessor but utilises the AR 6 tweeter and a modified crossover. An audition of the AR 7, AR 4XA or AR 6 will show even the most critical listener that the differences are subtle yet obvious.

AR GUARANTEE:
The workmanship and performance in normal use of AR products are guaranteed from the date of purchase 5 years for speaker systems, 3 years for turntables, 2 years for electronics

WE2315R

PROJECT 702

RADAR INTRUDER ALARM



This microwave unit will detect moving objects at ten metres range.

IN 1963 J B Gunn reported that he had obtained coherent oscillations by applying an electric field to a crystal of gallium arsenide, and that a power of 0.5 watt at a frequency of 1 GHz could be obtained by this means. Since that time a great deal of research and development effort has been devoted to producing a range of solid-state microwave generators with stable and predictable properties.

The Gunn effect oscillator is the first practicable solid-state microwave source. About five times cheaper than an equivalent klystron source (including power supply), the Gunn oscillator, because of its inherent efficiency, reliability and portability is finding wide use in contactless object detection and observation equipment. Applications include intruder detectors in security systems, aids for the blind, automobile anti-collision systems, contactless actuators and speed and rotation measuring equipments.

Microwaves have many advantages over light, infra-red and ultrasonic waves for such duties. Principal among these is the relatively "unpolluted" section of the spectrum in which they operate: few natural phenomena or electrical machines generate incidental microwaves. Additionally, conventional radio-signal processing techniques may be used to improve the signal-to-noise ratio and the immunity to interference.

One of the latest devices to become available, in this field, is the Philips Elcoma CL8960 radar module. This device is intended for short range doppler radar applications.

In essence it transmits a beam of very high frequency radiowaves – virtually anything intercepted by the beam will reflect some energy back to the unit. If the intercepted object is moving then the reflected energy will be at a frequency slightly different from the transmitted frequency (the difference depends on the speed and direction of the moving object).

Thus if there *is* a difference between the transmitted and the reflected signal frequencies (i.e. a Doppler shift) then, by definition, a moving object must have caused it.

The CL8960 modules consists of a dual cavity and integral aerial assembly. A self-oscillating Gunn diode is mounted in one cavity and a microwave mixer diode in the other.

Hence the unit is self-contained, needing only a power supply and amplifier for the Doppler audio output.

CONSTRUCTION

We did not attempt to miniaturize the unit as ultra-small physical size is unlikely to be required in intruder detection systems. Our prototype was therefore mounted in a 185 x 120 mm diecast box, the side of which makes

SPECIFICATION

Frequency	10.675 – 10.7 GHz
Power Output with 7.0V dc supply	8 mW typical
Beam Width free space	approx 60°
Range	up to 10 metres
Sensitivity maximum	50 μV at 10 Hz
Internal Filter	30 Hz, five pole low-pass
Output	by relay – either latching or 20 seconds on plus automatic reset.
Input	10-15 volts dc at 150 – 200 mA.

RADAR INTRUDER ALARM

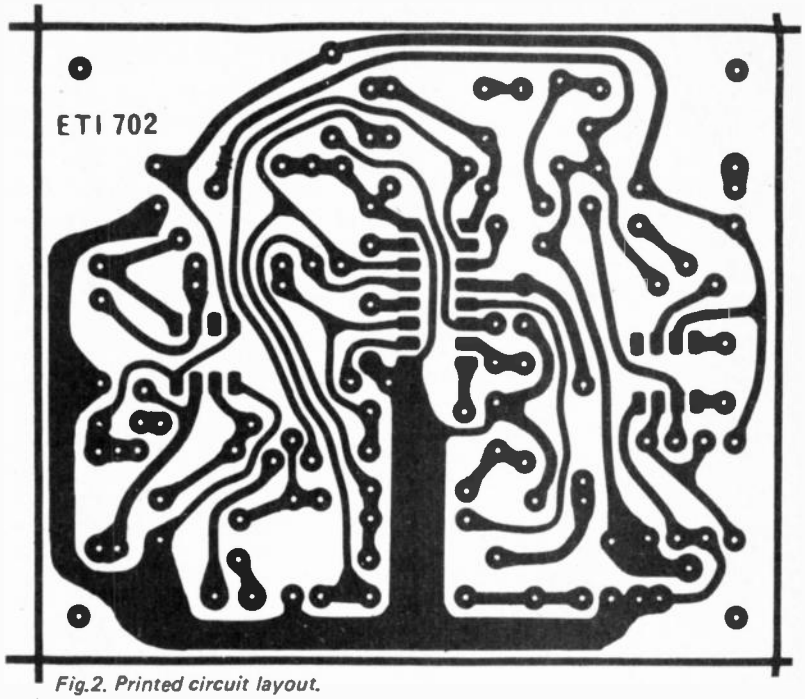


Fig.2. Printed circuit layout.

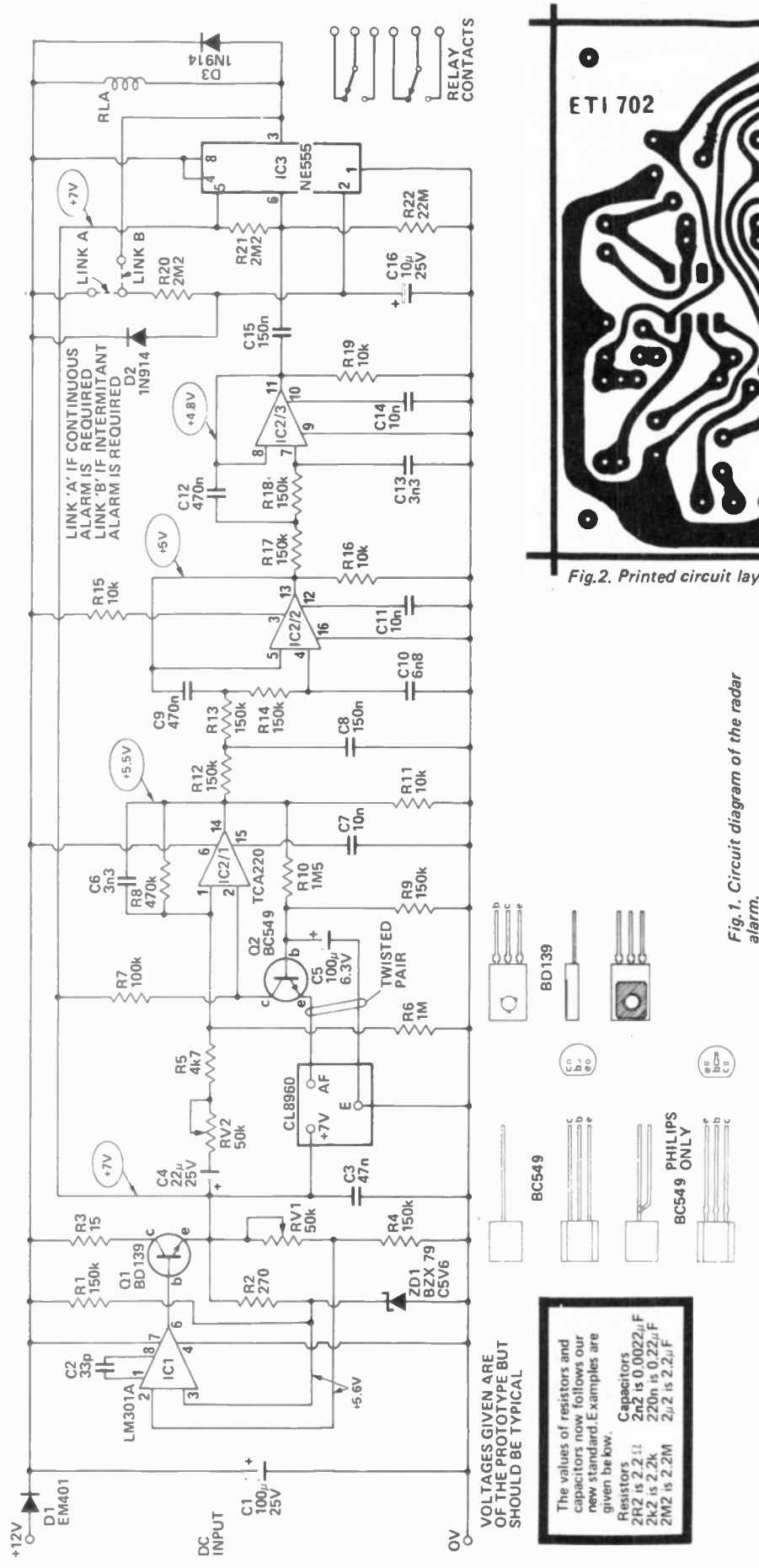


Fig.1. Circuit diagram of the radar alarm.

an ideal rigid support for the radar module.

Assemble the components to the printed circuit board with reference to the circuit diagram and the component overlay. Take particular care with polarization of components and watch for the differing connections of BC549 transistors (see connections at bottom of circuit diagram). The relay may be mounted by simply glueing it to the side of the box.

Do not remove the shorting strap, between the mixer diode and ground, until the module is completely wired into the circuit. The wires from the printed circuit board to the mixer diode should be twisted to minimize pickup – as there is a very low signal level at this point. After these are connected remove the strap by unwinding the end on the mixer diode with the aid of a pair of long-nose pliers and then disconnecting it from the earth terminal.

SETTING UP

The only adjustments required are the setting of the +7 volts supply for the transmitter and setting the sensitivity control.

Initially the transmitter should be left disconnected and a resistor (100 to 1k ohm) inserted from the +7 V line to ground as a simulated load. Switch on and adjust RV1 to obtain exactly 7 volts output. Use some glue or nail polish to secure the potentiometer in this position, switch off, and reconnect the transmitter.

To set the sensitivity it is advisable

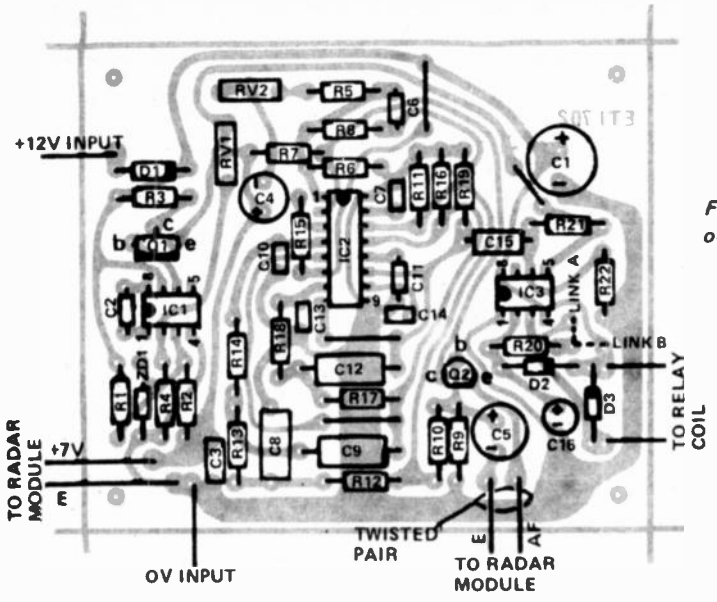


Fig.3. Component overlay.

initially to link the unit for intermittent alarm operation. It may be changed to latching mode later if required. Mount the unit in its normal operating position and adjust the sensitivity such that the desired range is achieved without the unit being over-sensitive. Note that the 10.7 GHz transmitted will pass through timber walls with almost zero attenuation – so movement outside the protected room could set off the alarm if the sensitivity is too high.

This characteristic can be valuable though as it enables the complete alarm to be concealed behind a plastic or wooden screen – or even inside the wall itself if desired.

PARTS LIST – ETI 702

R3	Resistor	15 ohm ½W 5%
R2	"	270 ohm ¼or½W 5%
R5	"	4k7 " " "
R11,15, 16,19	"	10k " " "
R7	"	100k " " "
R1,4, 9,12	"	150k " " "
R13,14, 17,18	"	150k " " "
R8	"	470k " " "
R6	"	1M " " "
R10	"	1M5 " " "
R20,21	"	2M2 " " "
R22	"	22M " " "
RV1, RV2	Potentiometer	50k Trim. " "
C2	Capacitor	33pF ceramic
C6,13	"	0.0033μF Polyester
C10	"	0.0068μF "
C7,11, 14	"	0.01μF "
C3	"	0.047μF "
C8, 15	"	0.15μF "
C9,12	"	0.47μF "
C16	"	10μF 25V electrolytic
C4	"	22μF 25V "
C5	"	100μF 6.3V "
C1	"	100μF 25V "
Q1	Transistor	BD139 or similar
Q2	"	BC549 or similar
IC1	Integrated Circuit	LM301A
IC2	"	TCA220
IC3	"	NE555

D1 Diode EM401 or similar
D2,3 Diode IN914 or similar

ZD1 Zener Diode BZX79C5V6
RLA Relay 185 ohm miniature

Radar Unit CL8960 (Philips)

Die cast box Eddystone 6827P or similar

Four Screw-type Terminals.

HOW IT WORKS ETI 702

The intruder alarm consists of four main sections:

1) The Gunn diode assembly and associated power supply.

2) An amplifier for the output of the mixer diode.

3) A 5-pole, low-pass filter.

4) A detector and relay driver.

The transmitter consists of a Gunn diode in a tuned cavity that requires a supply of 7 volts ±0.1V dc at about 140 mA. No other input is required and the diode automatically oscillates at 10.7 GHz. The regulation of this supply is critical as any variation will frequency modulate the Gunn diode. In security applications a 12 volt battery, together with a separate charger, will most commonly be used and the output of such a system will be anywhere between 11 and 15 volts. Hence we have used a series regulator which has a 5.6 volt zener as the reference element. Integrated circuit IC1 compares the zener voltage to the voltage, as set by RV1 and R4, and controls the series transistor Q1 to keep the relationship of output voltage constant with respect to the zener voltage. Thus RV1 controls the output voltage and is set to obtain 7 volts. A diode D1 is used in series with the input to prevent damage due to reversed polarity.

The mixer diode is in a second tuned cavity next to the transmitter and receives two signal sources. The first of these is 'spill" from the transmitter, constituting a local oscillator signal.

The second signal consists of energy reflected from all objects in the target area. If nothing is moving in the area the reflected signal will be of the same frequency as the transmitted frequency – so the output from the mixer will be the transmitted frequency only.

However a moving object in the area will doppler shift the reflected signal. The difference in frequency will be proportional to the objects velocity, in accordance with the following formula.

$f = 71.3\ V\ Hz$ (V = velocity in metres/sec perpendicular to module)

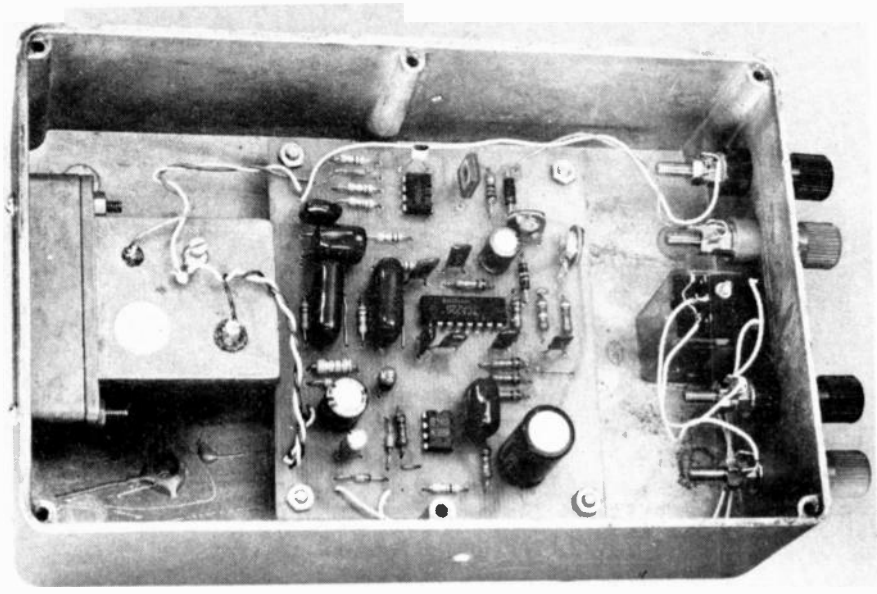
This doppler frequency is amplified by Q2, connected as a common-base amplifier, and again by IC2/1 providing a maximum gain of some 85 to 90 dB.

Approximately 20 dB of gain control is provided by RV2. The collector load of Q2 (R1) provides the 35 micro-amp bias required by the mixer diode and R6, 9 and 10 provide the correct dc conditions for the combination.

The filter consists of two active sections, one three-pole and one two-pole, which together make a five-pole Chebyshev filter. The cutoff frequency is about 30 Hz and the attenuation at 50 Hz is more than 40 dB.

An NE555 timer IC is used as a detector. This IC has two level detectors, one at two-thirds of V_S (input A) and one at one third V_S (input B). However, by connecting the control voltage input (pin 5) to +7 volt these levels will be +7 V and +3.5 V respectively. If input B is less than 3.5 V the output will be high irrespective of input A. If input B is above 3.5 V and input A goes above 7 V, the output will go low until input B again goes below 3.5 V. The voltage at input A is normally held at 6.4 V by R21 and 22 and hence about 600 mV increase is needed to reach the trigger point.

On initial switch on, C16 will be discharged causing the output to be high and the relay unenergized. After about 10 seconds C16 charges to 3.5 volts and this allows input A to assume control of IC3. This initial period is required to prevent false alarms whilst the rest of the electronics stabilizes. If the resistor R22 is connected to the output of the IC (link B) the relay will reset itself after about 25 seconds. If it is retriggered within the next two minutes it will re-latch, however the on time will be less than 25 seconds. If link A is used the initial 10 second delay still occurs, however once activated the alarm will remain on until power is removed.



LIMITATIONS

The alarm has a filter which rejects all frequencies above 30 Hz. A person walking towards the unit at a reasonable rate generates frequencies in excess of 100 Hz. However parts of the body will be moving at different rates and there will be frequencies below 30 Hz as well. It may be possible to approach the unit from a distance at a high and uniform rate without setting off the alarm but the alarm will be triggered the moment one stops or changes pace.

Fluorescent lights, when operating, generate 50 Hz and 100 Hz noise. Whilst this is rejected by the filter the alarm may be triggered by the impulses generated when the lights are switched on, especially if switch-start types are used which flick on and off a few times when starting. This is not normally a problem as the lights will be left either on or off whenever the alarm is armed. ●

ABOUT MICROWAVES

Nature and properties

Microwaves, as the name suggests, are high-frequency, short-wavelength electromagnetic waves. Being of short wavelength, their properties lie somewhere between those of normal radio and visible light waves. They can be focussed and directed by comparatively small structures, but being of high frequency they are more easily deflected and attenuated by solid objects. The high quantum energy involved with microwaves means that some precautions are necessary to avoid personal injury.

The microwave region of the electromagnetic spectrum is arbitrarily defined as lying between 1000 MHz (1 GHz) and the far infrared region beginning at 300 GHz. Over this range of frequencies, similar signal generating and processing techniques may be used. The wavelengths involved range from 30 cm to 1 mm, the location of the microwave region of the spectrum.

In most countries, radiation health regulations specify a safe limit of exposure to microwaves of 10 mW/cm^2, however, under normal circumstances a maximum intensity of 1 mW/cm^2 should be regarded as the limit for continuous exposure. The CL8960 output is only 8 mW. There is therefore no danger in using this device.

Guiding and Directing

The high dielectric and skin losses, together with the small wavelengths, rule out the use of normal discrete components and transmission lines. Coaxial lines, if of low loss, may be employed at the low-frequency end of the region, but at frequencies above about 5 GHz wave-guides are usually employed. Where attenuation is unimportant, short lengths of coaxial line fabricated from copper tube and wire can be used. Careful attention should be paid to matching if stable, efficient performance is expected. Discontinuities, such as sharp bends, are undesirable.

Aerials for use at microwave frequencies may be made of high gain in small sizes, a 5 dB gain antenna is supplied with the CL8960 but other higher gain horn antennas are available from Elcoma.

Detection

In low-power industrial practice, microwave signal-frequency amplification is seldom employed. Signals may either be detected directly, or converted to some lower frequency by a diode mixer, or Gunn effect mixer-oscillator.

USING THE CL8960

1) The Gunn diode will be damaged if the supply voltage is reversed.

2) The mixer diode will be damaged by forward current in excess of 10 mA.

3) The module is despatched with a shorting strap between the mixer a.f. terminal and −E terminal.

The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is recommended that soldering irons be isolated from the mains and that *the shorting strap should not be removed until all wiring is completed.*

4) A 10 nF capacitor should be connected to, and between, the +7 volt terminal and −E terminal to suppress parasitic oscillations in the supply circuit.

5) Power supplies should have a low source impedance and be capable of supplying up to 250 mA at approximately three volts during the initial voltage rise following switch on.

TABLE 1

Attenuation of 10 GHz microwaves by various materials. Note: true only for thicknesses greater than 1 wavelength (3 cm).

material	attenuation (one way)	notes
heavy rain	0,2 dB/km	not significant in short range radar
dense fog	0,1 dB/km	not significant in short range radar
dry wood	10 to 50 dB/m	very variable, greater when wet
Plexiglas Perspex	15 dB/m	methyl methacrylate type plastic
polyethylene/ polystyrene	< 1 dB/m	dry surfaces
expanded polystyrene	< 1 dB/m	dry and fresh
glass	up to 50 dB/m	extremely variable
pure water	approx. 5000 dB/m	

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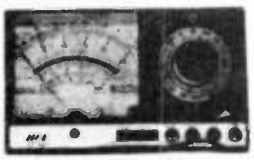

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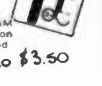

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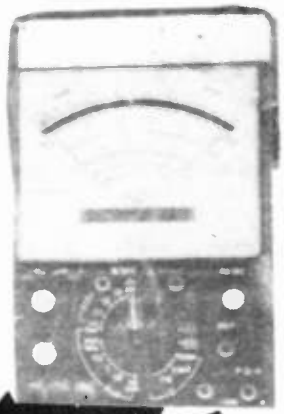

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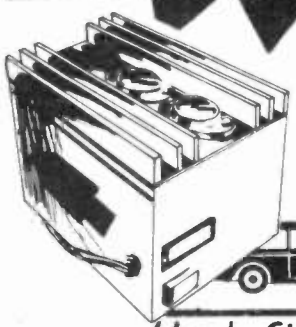

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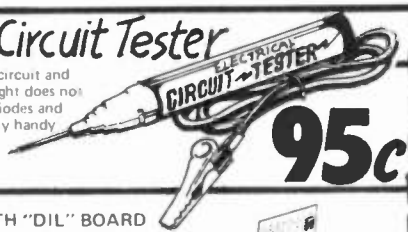

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95c

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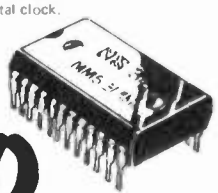

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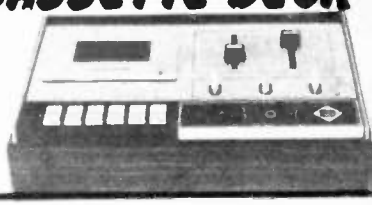

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Manufactured by Hills (need we say more?) 3 element $12.05. Long range 7 element $29.55. (Both road freight on).

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"Very good value indeed" Neville Williams, Electronics Australia, Feb. 75

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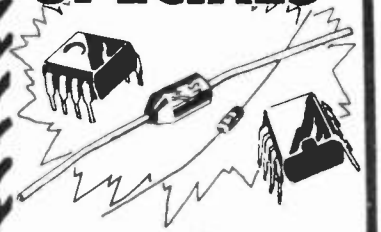

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COMPLETE system including Speakers and turntable from $199.00

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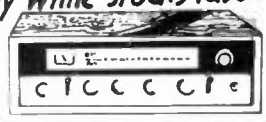

PROJECT 250

See our ad in June 74 E.A. or review in May issue. Fully built—just add power supply and four pots! Philips and Motorola components. Heatsinked 10 transistor and 4 diode. Preamp and tone control board included. Kit A consists of fully built and tested amplifier and instructions Add four pots 3 x 50k dual log and 1 x 50k single linear and a power supply of 24-30V at 1A. Yes, you've got a 25W (peak) amplifier for $14.95 (P & P $1.00). Kit B is as A above but has four rotary pots also. Just add power supply and a few wire links $19.95 (P & P $1.50). Kit C is as B above but also has components for power supply. Here is a COMPLETE kit for just $29.95 (P & P $2.)

Amp kit $14.95

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Not only is this unit to be sold at a very competitive price but EVERY purchaser will help his Division of the WIA to obtain a FREE IC22A.

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Features:

- 146-148 MHz in 22 Channels
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The IC22A is Icom's new and improved version of the very popular IC22. The IC22A is ideally suitable for home or mobile use. We are offering this unit with 3 channels, i.e. channel 50 simplex and channels 42/54 and 48/60 repeat.

We have the IC22A INCLUDING 3 CHANNELS of crystals (normal price $217) for only $200.00 (P & P Insured anywhere in Australia $3.00).

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Unit including battery **$139.00**

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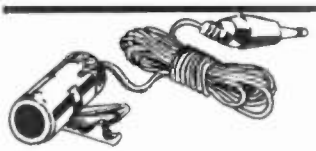

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Dick breaks the TIME~PRICE barrier! See E.A. APRIL 75

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Even the basic beginner can build one in under an hour following our simple instructions. Full money-back guarantee so why not buy one, inspect it at home for 7 days and if not satisfied return the kit and we will refund your money.

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Basic kit **$24.90** P&P $1.00

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Sporty 4-band portable FM,SW,MW & Marine

+60min timer!!

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3 "C" size flashlight batteries, 5.6V in total, car boat battery with car battery cord DCC-127 (optional) or AC 100, 110, 127 or 220 - 240V with AC power adaptor AC-3W (optional)
163(W) - 204(H) - 66.5mm(D) (6 3/8 x 8 - 2 5/8")
1.56kg (3 lb 7 oz)

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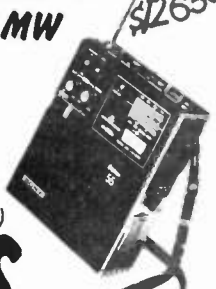
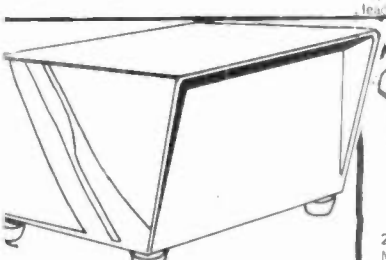


MAY SPECIALS



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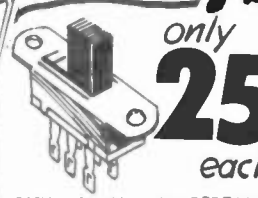

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Extension speaker lead 18 feet of tough twin lead in grey with polarising stripe. Complete with 2 pin plug and Utilux speaker clips. Use them in the car or home. Was $1.20 Now cut down to only 40¢. Get 10 for $3.00

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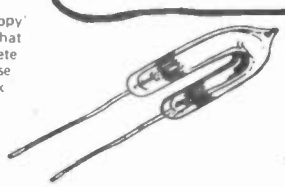

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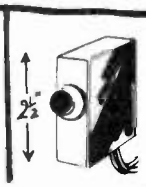

WATCHBIRD PL200 $10.50

The Watchbird's sole function is to automatically turn on a light or lights (up to1000W) at dusk and then turn it off at dawn. It contains only 3 parts and outperforms all the conventional electromagnetic or bimetallic type relay operated devices. Ideal for security lighting or when away on holiday etc. Easy to install and you need never worry whether essential lights have been switched on or off!

Also at 361 Hume Highway Bankstown Tel: 709 6600

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THE BIG MIRROR

How and why radio waves act as they do is not yet fully understood. Our present knowledge is built on the work of a large number of pioneers – in this article, Ian Sinclair outlines the history.

SIR ISAAC NEWTON, in the middle of the seventeenth century, thought that light consisted of a stream of small particles. Jan Christian Huygens, working at the same time, thought that light was a waveform.

The evidence which turned up over the next century or two favoured the wave theory; but, as we know now, both were right; light is a set of pulsed waves and the pulses, containing millions of cycles of wave motion, behave like particles. Before this was clearly understood, there was much confusion over why a ray of light should sometimes seem to act as a stream of particles (as when it releases electrons from a photocathode) and sometime as a wave (as when it is polarised); one point was, however, agreed on.

Whether wave or particle, light travelled in perfectly straight lines over distances which were long compared with its wavelength and past objects large compared to its wavelength. The comparison with wavelength is important, as any wave will roll merrily past objects which are about the size of a wavelength or smaller, and interference effects, caused by waves meeting in or out of phase can be detected when this happens.

The wavelength of light is around 500 nm (nanometer – 10^{-9} m or one millionth of a millimetre), and so for all practical purposes travels in straight lines over distances which we can see.

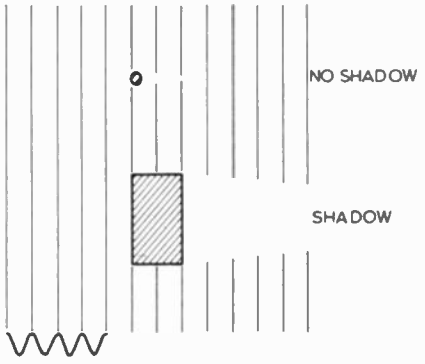

Fig. 1. In a stream of waves (the lines represent the peaks of the waves) small objects cast no shadow for more than a few wavelengths away. Small in this respect means small compared to the wavelength . . . even a house is small compared to a 200m wavelength radio signal.

It is this point of size relative to wavelength, incidentally, which makes it impossible for an ordinary microscope, no matter how powerful, to see atoms or other very small objects.

For a very long time visible light, together with infra-red (causing strong heating effects) and ultraviolet (tanning skin and causing chemical changes) were the only waves of their kind known. Sound is not the same type of wave, because it needs some material to travel in, whereas light appears to travel across empty space. The speed of light, estimated first by an astronomer in the 17th century, is 300 *million* metres per second compared to the 330 metres per second of sound in air, and the wavelength of light is much smaller than the wavelengths of sound.

MAXWELL AND HERTZ

Little more was learned until the middle of the 19th century when a Scottish physicist, Maxwell, started to worry about a missing equation. He was looking at the equations linking electricity and magnetism; one showing that electric current in a wire caused a magnetic field, another showing that a changing magnetic field caused a voltage. Maxwell felt that there *should* be another equation, one which linked a changing electric field (change of volts) with magnetism in space with no wire present; the equations seemed to form an incomplete set unless the last one existed.

He assumed that it did and examined the set of equations. With the missing one inserted, the equations had a solution in the form of the equation of a wave motion, travelling at a speed which depended on the capacitance and inductance of the material through which the waves were travelling. At the time, because of the system of units used for electrical and magnetic measurements, it was not realised that capacitance and inductance were involved, not that space could have capacitance and inductance, but it was possible to work out the speed of Maxwell's theoretical waves.

It was exactly the speed of light.

Many people were sceptical, they doubted that light could be electrical or magnetic in nature, despite the fact that Faraday and others had shown that magnetic fields and electrical fields both affected light. The greatest difficulty was that the equation did not simply imply that light was electromagnetic, it also implied that there should be an infinite variety of waves of the same type, differing only in wavelength and frequency, but that the quantity: wavelength x frequency should be constant and equal to speed. No such other waves had been detected, nor was there any method of measuring the frequency of light waves, only their wavelength. Meanwhile, not suspecting any connection, electrical engineers had discovered that a combination of inductance and capacitance could tune

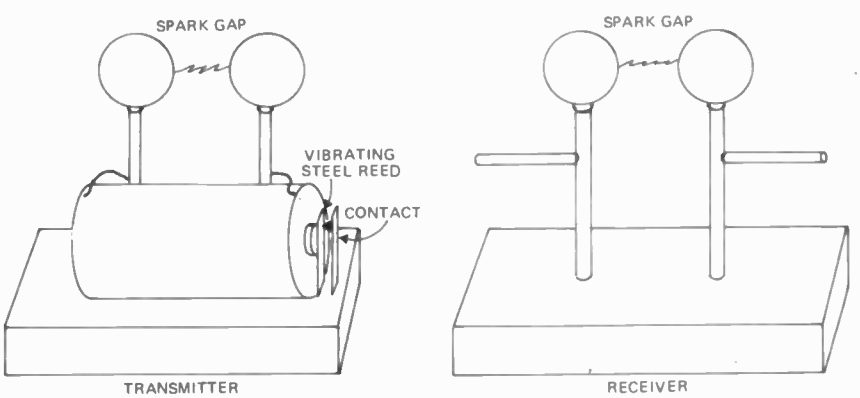

Fig. 2. Hertz's apparatus. When a spark passed between the metal spheres on the 'transmitter' sparks could also be seen at the 'receiver' which used a form of dipole aerial.

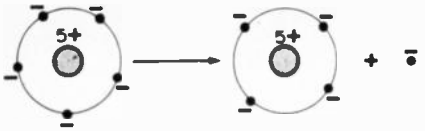

Fig. 3. Ions. When an atom parts with an electron (by heating or collision) both particles left are charged. The electron carries a negative charge and the ion (the remains of the atom) carries a positive charge.

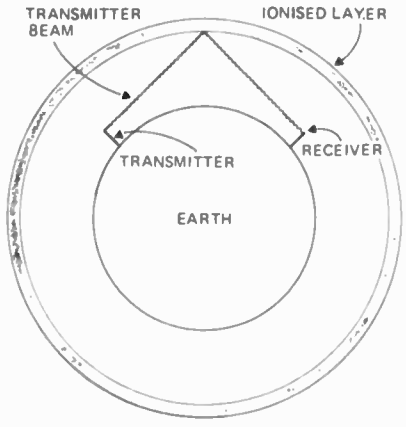

Fig. 4. How long-distance communication could be achieved using reflection at a layer of ions (not to scale!)

to a definite frequency of electrical oscillation.

Twenty years passed with no direct experimental evidence to back up Maxwell's equations. Then Heinrich Hertz, in a series of experiments using what we would now call a spark-gap transmitter and receiver, generated, transmitted, and received electromagnetic waves of short wavelength, about 130 mm or so.

By the end of the 19th century, radio waves were established as part of a family of electromagnetic waves, differing only in frequency and wavelength, of which light formed only a very tiny portion. Later other waves with wavelengths even shorter than that of light would be discovered.

THE STRAIGHT LINE PROBLEM

Since the newly discovered radio waves were of the same family as light, it was logical to suppose that they would, allowing for the wavelength difference, behave in the same way as light. They were used for very short range communications at first, but then as technology progressed, longer wavelengths which could pass round obstacles started to be used for longer distance communications. It was quite obvious, however, even to men of the stature of Sir Oliver Lodge, that communication from one side of the Earth to the other was quite impossible, since an aerial long enough to launch a wave of the required wavelength would be long enough to stretch round the earth anyway! Marconi was less convinced. Having done many experiments in long distance communication he was sure that for some reason, the straight line argument was unsound. He tried transatlantic transmission — and it worked!

But *why* did it work? The answer was important because of the possible problems it posed. Was there something wrong with wave theory? Was light, after all, different from radio waves in some other way? Or was there some other quite unsuspected effect operating which caused radio waves to travel farther than expected?

Oddly enough, the problem had been solved and hardly anyone knew it.

HEAVISIDE

Oliver Heaviside (1850-1925) was a genius who was almost incapable, temperamentally, of communicating the results of his work to others. Because of this much of his work was unpublished and the published fraction was largely ignored by his contemporaries either because they did not understand it or because Heaviside would not answer criticism.

Heaviside's best known contribution to electrical engineering during his lifetime was the formulation of the conditions for transmitting pulses along long cables, using a technique which later turned out to be very useful in radar.

One less well known exercise was a theoretical study of the effects caused outside the Earth's atmosphere by particles emitted by the Sun. At the temperature of the Sun, and even at considerably lower temperatures, materials ionise, splitting off electrons from the atoms to leave positively charged particles. Heaviside argued theoretically that these ions should be trapped by the earth and should form a layer round the Earth considerably beyond the atmosphere. Furthermore because the particles were charged, the layer should act as a reflector for electromagnetic waves of more than a metre or so in wavelength. What Heaviside visualised was no less than a huge mirror for radio waves completely surrounding the Earth and reflecting back any wave beamed towards it.

No-one paid much attention to this idea before Marconi's successful experiment. Everyone paid considerable attention to it afterwards,

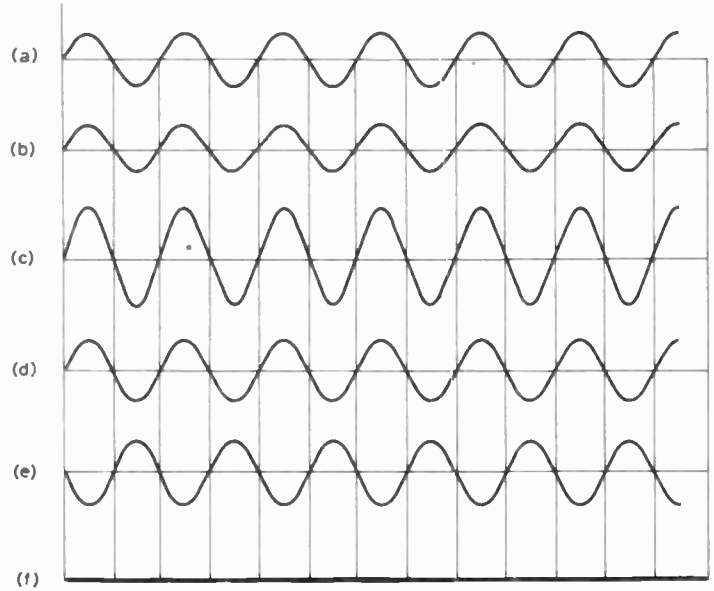

Fig. 5. Waves in and out of phase. a/ Transmitted carrier wave. b/ Second wave in phase with (a). c/ Result of adding waves (a) and (b). d/e Two waves 180° out of phase. f/ Result of adding waves (d) and (e), (f) is zero output.

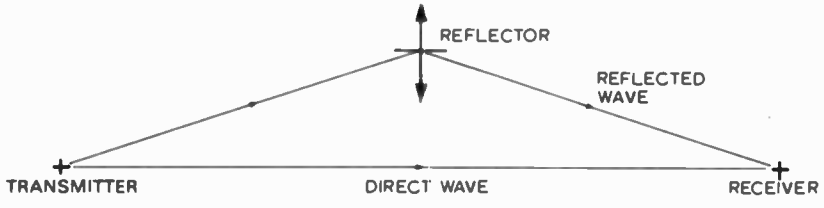

Fig. 5(g). This sketch shows how the reflected wave travels a greater distance than the direct wave - and why the distance travelled (and hence the phase relationship) varies as the height of the reflecting layer varies.

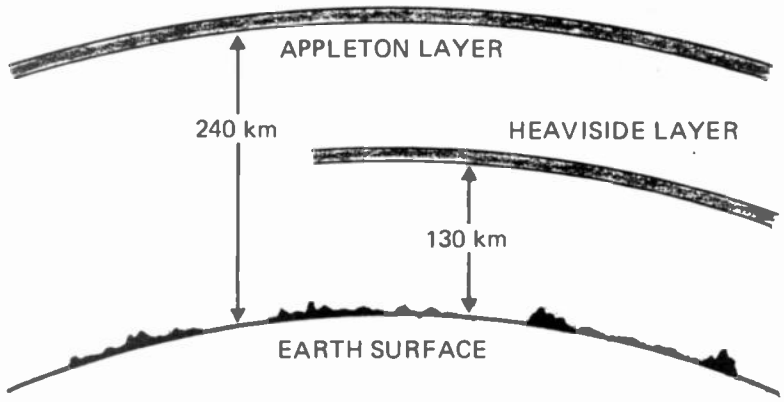

Fig. 6. Relative heights of layers.

and the layer was later named the Heaviside Layer in posthumous honour of the man who had the vision to imagine it.

USES AND PROBLEMS

Even when it was realised that radio waves were transmitted over long distances by a process of reflection from the Heaviside layer, the full implications of Heaviside's thory were still ignored. The wavelengths most favoured for long distance communication were the very long wavelengths of several thousand metres, though these were not very efficient. The wavelengths of a hundred metres and less were allocated to amateur use, since it was thought that these were too close to the limit of reflection to be of much practical use. The official attitude at the time was rather like that of tossing a bone to a dog.

A closer study of Heaviside's work, together with some measurements, would have revealed that the region of 100 m to 1 m was probably the most efficiently reflected of all, a fact which was very quickly shown by amateurs who soon devised techniques of transmitting and receiving at these wavelengths. The result was that governments all over the world promptly reclaimed the short-wave bands, leaving only a few small portions for amateur use "for all time" as a mark of gratitude.

The reflections which make long-distance radio possible also bring problems, however, and fading is the worst. On any particular transmission it is highly likely that there will be more than one possible path of rays in straight lines from transmitter to receiver so that more than one signal from a given transmitter will be received at one time. Unfortunately, these signals will have travelled different distances, so that there will normally be a difference in phase between them. Referring to Fig. 5 if the distances were equal, the signals would arrive in phase, with all parts of one signal corresponding to the other. This would also be true if one signal path were an exact number of wavelengths longer than the other, because the only difference in the signals would be an insignificant time difference.

With waves travelling at 186,000 miles per second, it takes a large distance difference to cause a noticeable echo effect in this way. The usual problem arises when the distance is not an exact number of wavelengths, and the signals tend to cancel each other. This would be no great problem if the conditions remained steady as we could always site an aerial to take advantage of a good signal. Unfortunately, conditions do not remain steady. Our mirror in the sky is not a fixed metal sheet but a sea of charged particles, topped up now and again during the huge eruptions of the sun which are called flares, shifting continually in position and density.

The net effect is that the reflected signal travels different distances at different times, and will interfere with other signals, direct or reflected so that the resultant is alternately strong and weak with no definite pattern. In the early days of radio, this was called the "Luxembourg Effect" as it was most noticeable to ordinary listeners (as distinct from radio amateurs) when tuned to Radio Luxembourg, the first commercial station whose broadcasts could be received in England.

For domestic receivers the answer was AGC – automatic gain control, which varied the gain of the receiver to match the fluctuations of the signal. For professional communications, this was not sufficient, and the answer was diversity reception, where several aerials at different sites feed to receivers tuned to the same frequency and an automatic switching device keeps the output connected to the strongest signal available. Both methods are still used but the best answer to the fading problem has proved to be most expensive one of all, the use of very short wavelengths which pass easily through the ionised layers together with repeater satellites which retransmit the beamed signals.

MODERN TECHNIQUES

We still have to live with the big mirror, though an increasing fraction of radio communication is done by means of satellite. The Heaviside layer is not the only ionised layer. Research into the regions above the atmosphere, the Appleton, resulted in the discovery of the layer which now bears his name, and new belts of ionised particles (Van Allen belts) were discovered as a result of satellite investigations.

For the radio channels which still rely on reflection from the layers, a "weather forecast" for the Heaviside and Appleton layers is as essential as conventional weather forecasts to an airport, and ionospheric research stations are positioned all over the globe. These use radar techniques to find the position and movement of the shifting layers; sending pulses of carriers of different frequency vertically upwards and monitoring the time for reflection. The results of this work are interpreted as a forecast of reflection conditions and sent to long-range radio stations all over the world.

Exceptional ionospheric conditions can still cause problems, however, television and other services using wavelengths of a few metres and less are hardly affected by reflection; the normal range is the straight line range. On occasions, however, a solar flare-up causes such a high intensity of ions in the layers that the amplitude of reflected signal becomes large, and long distance television reception becomes easy.

Long distance reception is always possible, particularly on the longer wavelengths, because there is always some reflection, but the direction properties of the receiving aerial usually prevent the reflected signals from being picked up on domestic receiver. Under solar flare conditions, though the reflected signals from distant transmitters may be strong enough to overcome the directional bias of the aerial and cause picture and sound disturbance. At time, with a suitable receiver and aligned aerial, very long distance hops are possible and have been well documented. The UHF bands are less likely to be affected than the VHF in this respect.●

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81. Ceramic Stereo Cartridge — a good quality hi-fi stereo cartridge with excellent freq. response for small stereo systems and radiograms. Same as BSR Model C-1 cartridge. Cat. No. 12-200-017. $4.95.
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102. Rotary Wafer Switch — 3 position 9 hole triple wafer OAK switch, latest type, 3/8" diameter mounting hole, ¾" long shaft. $1.00 ea.
103. 2 — Rotary Wafer Switches — 3 position plus mains on-off, 3 pole, 3/8" diameter mounting hole, ½" long knurled shaft. $1.00.
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114. 6 Earphone Plugs/Socket sets — standard 3.5mm plugs and panel mounting sockets, available in red/black. $1.00.
115. 2 — Mono 6.5mm Plug/Socket sets — very useful for microphones, guitars, speakers etc. Comprises 2 plugs and 2 sockets (panel mounting) with changeover switch. $1.00.
116. 2 — Stereo 6.5mm Plug/Socket sets — for all stereo applications, comprises 2 plugs and 2 panel mounting sockets. $1.50.
117. 6 — RCA type plug/socket sets — standard audio input connectors for amplifiers etc. Comprises 6 plugs and 6 panel mounting sockets. $1.00.

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118. Stereo headphone control box — allows 2 pairs of stereo headphones to be operated from any amplifier fitted with a standard 6.5mm headphone socket. Each pair of headphones has its own slider volume control and a stereo/mono switch is included. $5.50.
119. 5-2 Pin Polarised Line Plug/Socket sets with covers. $1.00.
120. 8 — Standard 3AG In-Line Plastic Fuse Holders. $1.00.
121. Radio Dial Kit — handspan clear plastic circular dial, all states dial scales, bush, etc., to suit most Japanese plastic tuning condensers. $1.00.
122. Tuning Condenser with dial — standard ¾" x ¾", 200pf gang with radio dial kit as described above. $2.00.
123. 10 Asstd. potentiometers — ideal for experimenters and hobbyists. All new and useful — includes preset, ganged, switched and standard types. $1.00.
124. 12 Pot — Nuts and washers — shiny brass nuts and steel lock-washers. Keep 'em on hand — very useful. $1.00.
125. 6V DC — DC Car Convertor — plugs directly into any car cigarette lighter socket. For use with cassette tape recorder, transistor radio etc and provides regulated output up to 300 mA. $6.90.
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133. RCA Audio Leads — RCA phono plug each end of 1 metre shielded cable. Set of 2 for $1.00.
134. Ignition Suppressor Resistors — insert in HT leads to suppress ignition interference. Pack of 3 for $1.00.
135. Car Radio Suppression Kit — includes 2 suppressor condensers, 1 HT lead resistor, 6 adaptor lugs, mounting hardware etc., and illustrated instruction sheet. $1.95.
136. 3 — 240V Neon Bezels — safe, plastic neon indicators in orange, green, clear colours; include in built resistor, most popular types (normally 70c each) 3 for $1.00.
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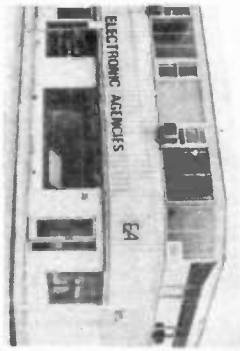


The Library Pen
-A DATA CAPTURE SYSTEM FOR LIBRARIES

by Terry Mendoza B. Sc. (Hons).

Issuing terminal – the librarian simply runs the 'pen' over the borrower's card and then over the books.

EVERY major library has the formidable task of keeping track of the whereabouts of their stock of books. In addition to those on the library shelves, and those actually on loan, some will be at the binders and others on extended loan to branch libraries or schools. A complex amount of cross-checking is necessary when, for instance, a person wishes to reserve a book which is already on loan.

The British Plessey company have developed a flexible computerized system, adaptable to any sized library which takes all the hard work out of this gargantuan and continuous stock-taking operation.

The system may even be applied to groups of libraries which feed data by handline to a central data capture unit and, ultimately to a computer.

Self-adhesive bar-coded labels or 'badges' affixed to the books, and on each borrower's loan-ticket, are the basis of the whole system. The number of each label consists of nine BCD (binary coded decimal) 4-bit figures, the digital coding relying on thin or thick strokes for registering 0 to 1. Above the coding the number is printed alpha-numerically. To the left of the BCD number code is the start code sequence of two thick strokes, one thin and one thick stroke.

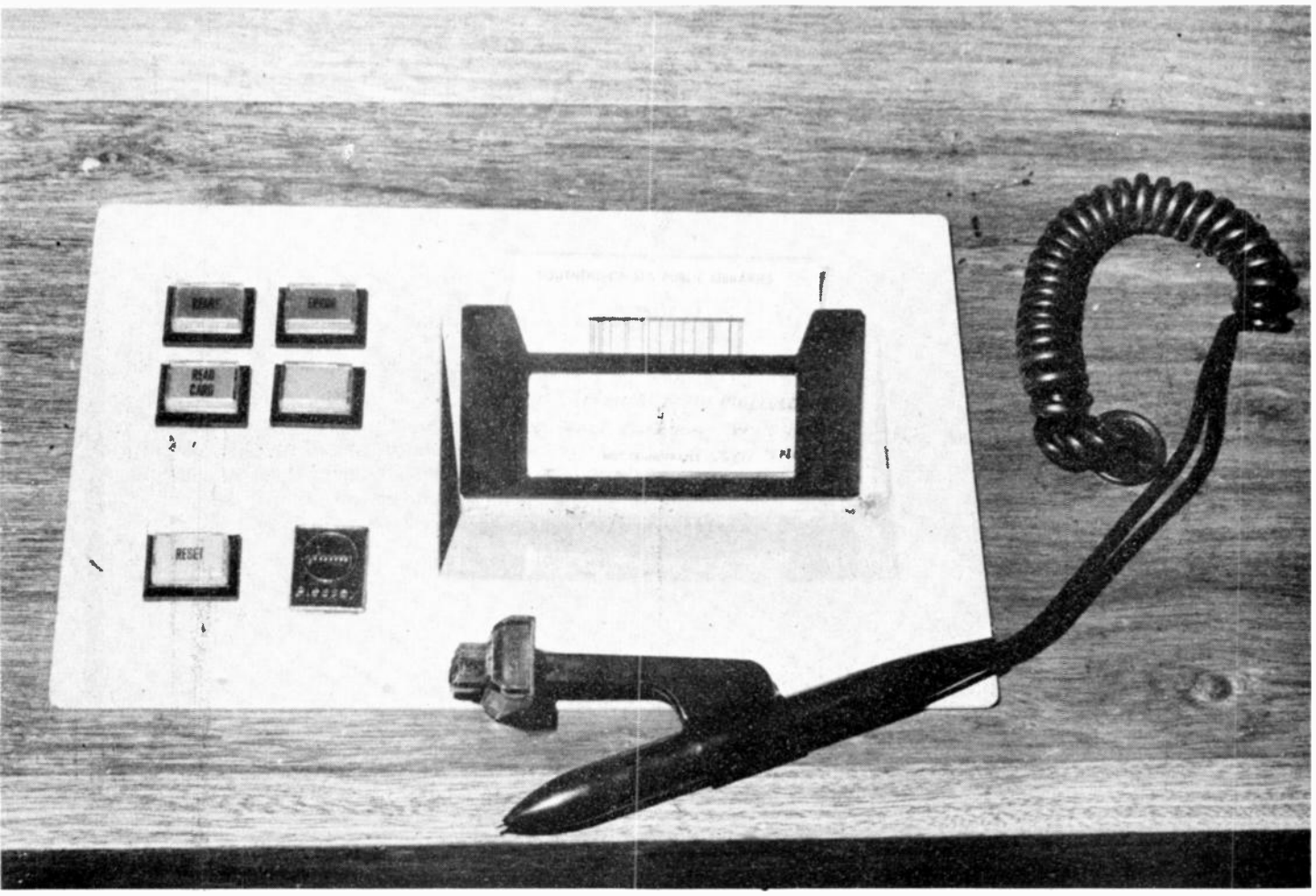
To the right of the numeral code is a 'check' code related to the number and ending with a thick terminating bar and an 'end' code. The start/end codes allow the reading to be carried out in either direction with the special 'library pen' and hence is equally suited to left or right-handed individuals.

Attached to the pen is a self-inking date stamp and after the code has been 'read', the date can be stamped as normal. The pen 'nib' is linked by a fibre-optic pathway to the issue and discharge terminals at the librarians' counter. These terminals are connected to a cassette tape storage unit which is part of a Data Capture Unit. A 2000 entry 'Trapping Store' and a Composite Terminal with a small manual keyboard complete the basic system.

THE SYSTEM IN USE

In use a borrower takes his chosen books to the issue terminal where the librarian's first action is to run the pen over his membership card, registering a nine digit number in BCD form. If the numeral and the check code do not tally, the librarian is informed by a flashing 'error' light that she has to repeat the 'read card' operation.

The coding of the 'read card' is as follows: The first digit differentiates the various classifications of borrowers from the material borrowed! Hence '1' may indicate an adult, '2' a junior, '3' a student, whereas '0' may be a book and '9' a disc. The second digit indicates the period allowed before overdue notices are automatically sent by the computer i.e. '0' is allocated to visitors and four weeks elapse before overdue notices



The recording pen and associated unit.

are sent out, '1' is allocated to normal borrowers who are 'chased' after six weeks and so on to '9' which indicates an indefinite loan period, as when material is transferred from one library to another.

The next six digits indicate the borrower's number, allowing 999,999 possible borrowers. (One beauty of a computerized system like this is that the library can be informed of any borrowers who have not taken out books for over a year. This gives the library a true idea of how many people are using the library facilities. Many other statistics may be made readily available, from 'which days are most popular with borrowers' to 'which type of reading matter is favoured'.

Having registered the details of the borrower, the librarian now runs the pen over the 'badges' on the books. The first digit here identifies the number as relating to a *book* and not a

A coded label (shown here full size) is attached to each book and also the borrowers' cards.

disc or borrower; the next six digits identify the book title, the eighth the type of book, fiction or non-fiction and the last digit can be either used in conjunction with the previous one to detail the subsection in which the book is catalogued within the library or the number of copies of the title owned by the library.

All information goes into the data capture unit and at the end of each day is fed from the cassette tape onto the central computer memory.

Now if a borrower wishes to reserve a book, say by telephone, the reference code of the book is keyed into the trapping store using the keyboard of the composite terminal. An LED display on the composite terminal visually indicates the number that is going to be keyed into the trapping store when the 'enter' key is depressed so that the librarian can double-check the number before entering it.

If the required book is out on loan, the librarian receives visible and audible 'trap' indication as it is being returned that it has been reserved, and the number is automatically erased from the trap store. If the book has been taken from the shelf by a borrower the 'issue' librarian will be warned that the book has already been reserved, but the book number in this instance will not be removed from the trap store. Borrowers' numbers may also be keyed into the store so that once a card has been reported lost it cannot be utilised by another person. Every so often the contents of the trapping store are transferred onto magnetic tape and may be printed out so that the progress of a reserved book in the system may be checked.

Another regularly used print-out is the 'error' sheet which tabulates 'impossible' book or borrower numbers, which might occur with a defaced label.

At the front end of the data capture unit is a high-speed multiplier which can accept ten lines of data, not only from the 'pen terminals' in the vicinity, but also by landline from other libraries in the area. The multiplexer labels each signal with a source code (main or branch library etc) and the function being performed — renew, reserve, issue or discharge.

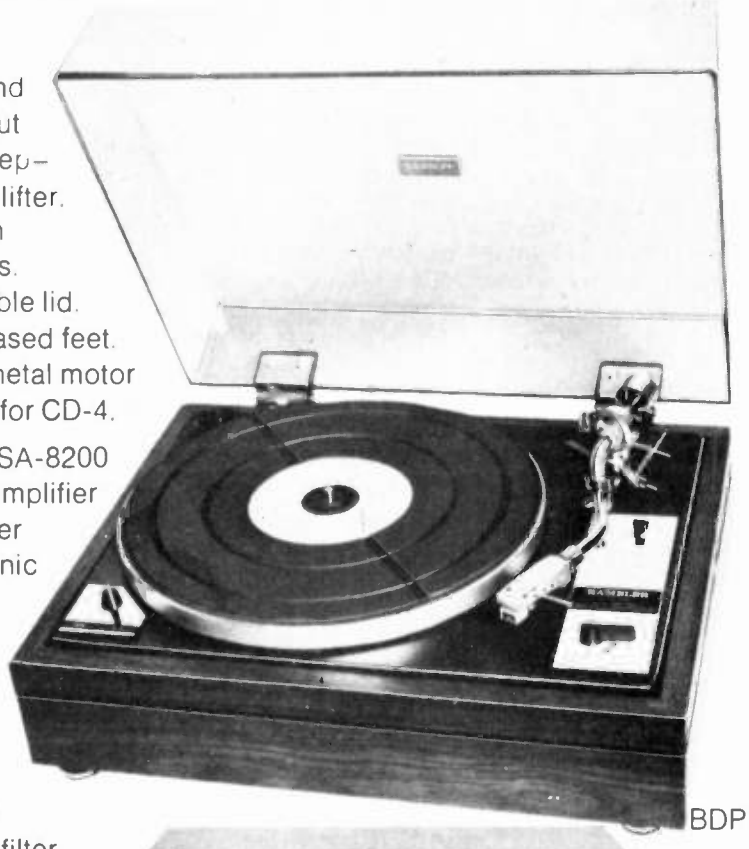
Although it is not a feature of this system, the day cannot be far away when it will be possible for a borrower to type the subject of his interest on an alpha-numeric keyboard and select his choice of books from the instantaneous computer print-out which will also indicate which books are already on loan. ●

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 independent 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.



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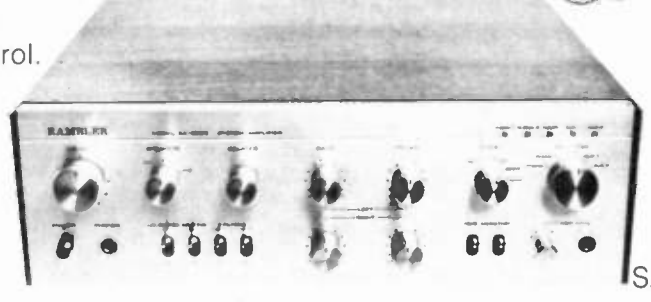

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MR160

LINC

Linear Interlaced Network Contest — a game, by A.J. Lowe

IF YOUR hobby budget is down at rock bottom, here is a project that will cost from nothing to a maximum of $2; depending upon what you can find at home! For that small outlay you can have hours of fun.

LINC is a game for two players. The name stands for Linear Interlaced Network Contest — and that's what it is. Originally the game was devised (not by this writer) to be played with pencil and paper; — it can tax the brains of anybody from a seven-year-old to a Ph.D. 'Fun for young and old alike' as the advertisements would say. That this game is not trivial may be judged from the fact that its pencil and paper version gets no less than three pages in Martin Gardner's book 'More Mathematical Puzzles and Diversions'.

This project is an electrical version of the original — no pencil or paper is required.

The game is played by two players we'll call Red and Blue, who sit at adjacent sides of the board (not opposite sides as in chess). The board has 42 blue pegs set out in a regular matrix or network, and the same number of red pegs set out in an identical matrix at right angles to the first, and interlaced with it. Referring to Fig. 1 the circles represent blue pegs and the diamonds represent red pegs. This is the layout of the board shown in Fig. 2.

The idea of the game is for each player to try to form a link between any of the six pegs on his base line and any of the six pegs on the opposite side, before his opponent does so — from his own base line to his opposite side. Thus it will be seen that the player's directions of play are at right-angles, and as players can play only on pegs of their own colour, they block one another.

To form a link, players take it in turns to join any pair of adjacent pegs of their own colour, by placing a small bridge between them. (Bridges are shaped as shown in Fig. 3.)

As soon as one player has formed a link then his 'Win' light comes on and the game is over. A contest might comprise the best of ten games or first to score ten, and so on.

Each player is provided with 24 bridges marked in his own colour. By placing a bridge between two pegs a player prevents his opponent from following a particular route, and so the links wander in many directions, Figure 4 shows a partially completed game. Often the route of the link is so circuitous that the 'Win' light comes on as quite a surprise.

If we must have rules for the game here they are:

RULES

1) Each player is provided with 24 bridges of his own colour.
2) Decide by the toss of a coin who shall make the first move.
3) Players then take turns to place a bridge on any two adjacent pegs of their own colour, but are NOT allowed to cross any bridge placed by the opponent; indeed the shape of the bridges makes this impossible. Players do NOT have to start by placing a bridge on a base line peg, but may start and play anywhere on the board on pegs of their own colour. Players do NOT have to place every bridge so that it joins on to a bridge already placed on the board, but may put a bridge anywhere on pegs of their own colour. It will be clear then that any peg may have as many as four bridges radiating at right angles from it.
4) The first player to form a link wins, and this will be indicated by his 'Win' light shining.
5) In the unlikely event that all bridges are on the board without either player having formed a link, then play proceeds by moving bridges already placed to new locations.

Variation. The game may be played with a smaller number of bridges — say 18, and making full use of Rule 5.

CONSTRUCTION

First of all let it be said that the board may be of any reasonable size, and the network of pegs may include more pegs than in the prototype. The thing can be built to taste.

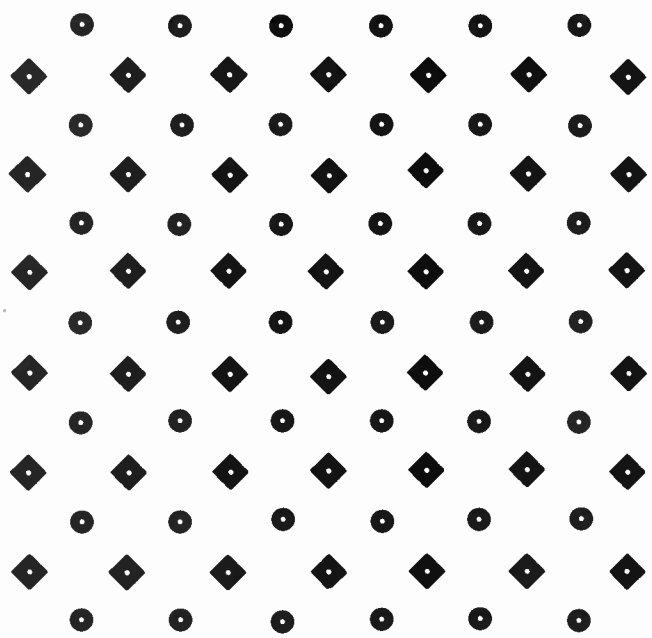


Fig. 1. Layout of interlaced networks of pegs.

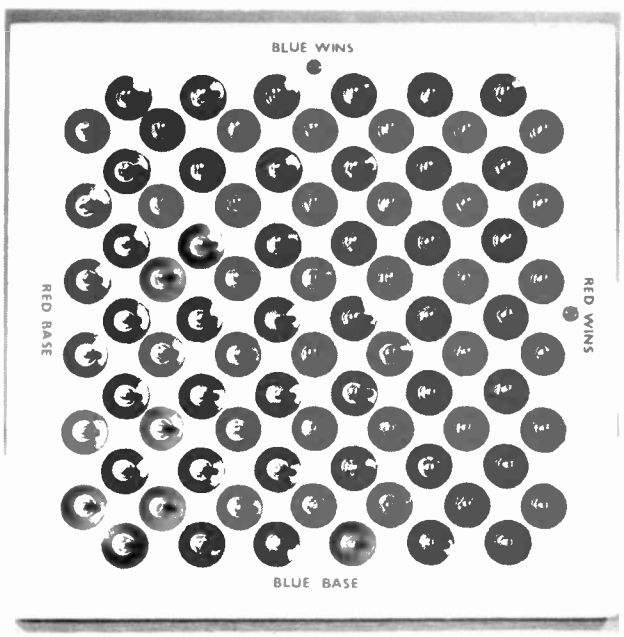
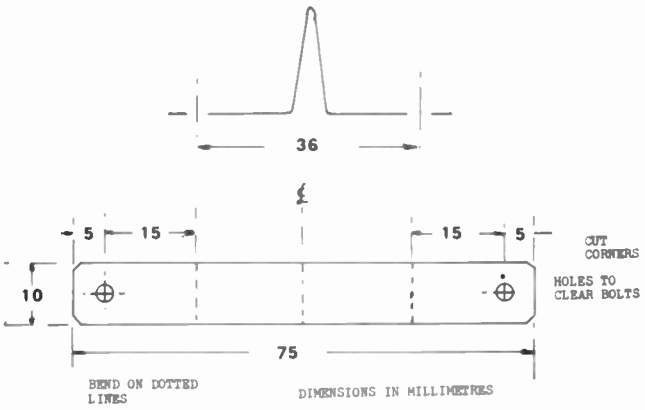


Fig. 2. Top view of LINC board.



Dimensions of bridges.

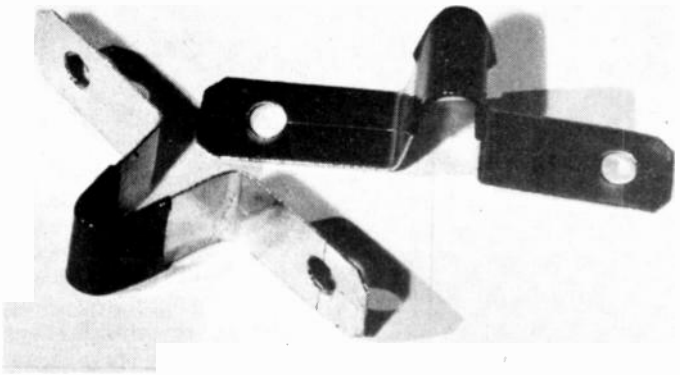


Fig. 3. The bridges – shaped to prevent one crossing another.

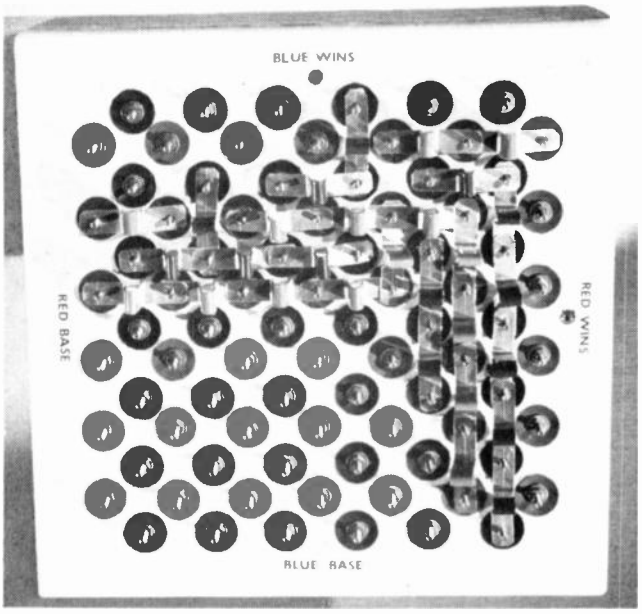


Fig.4. A partially completed game.

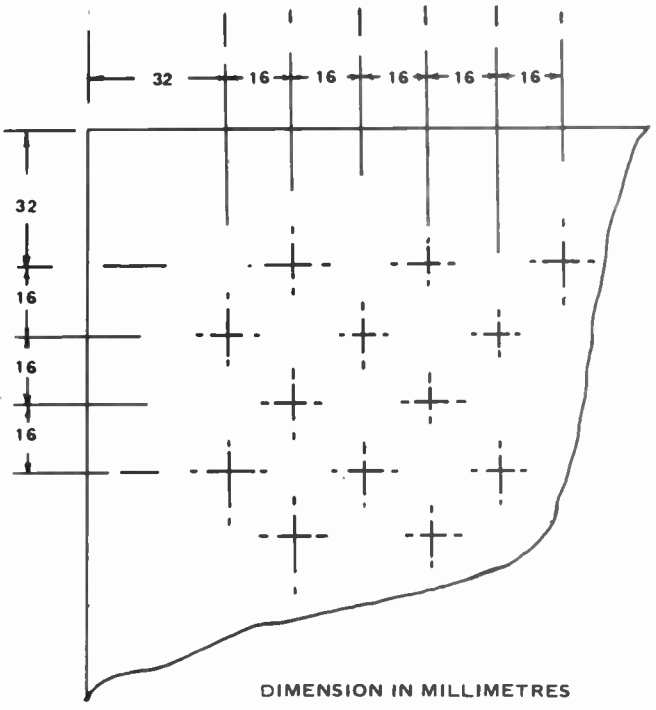


Fig.5. Dimensions for drilling the board.

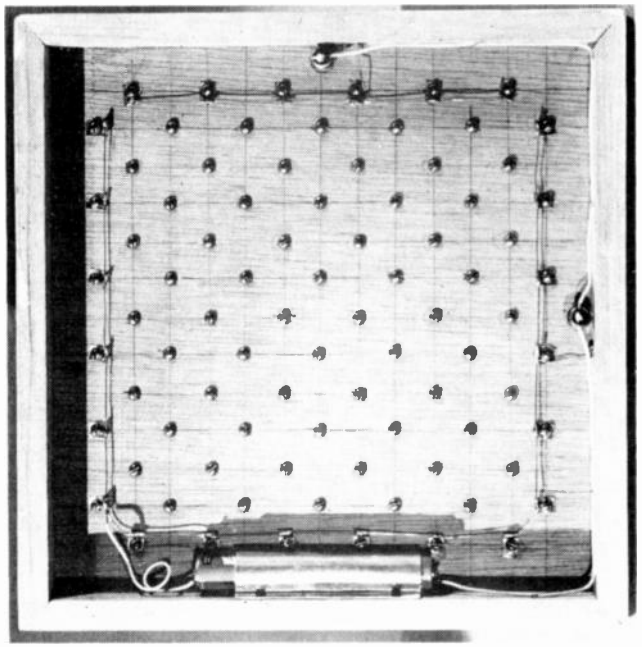


Fig.6. Underside view of board.

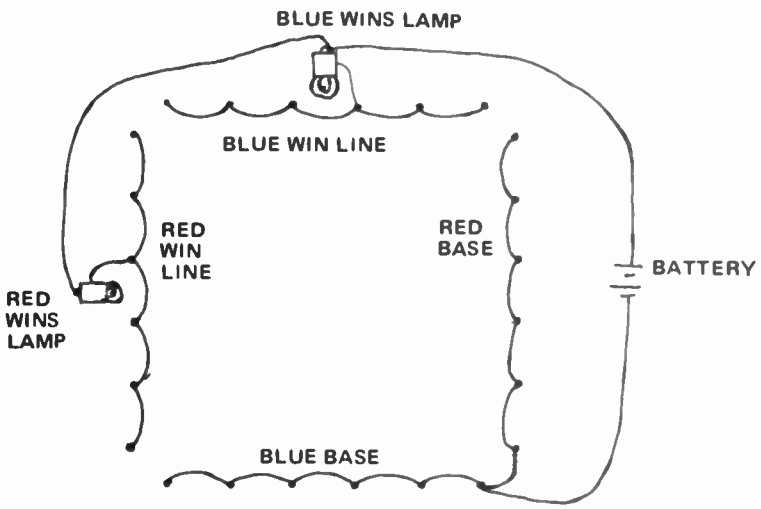


Fig.7. Wiring diagram – simplicity itself!

LINC

The prototype was built on a piece of three-ply 256 mm square, supported on a frame of suitable timber. The pegs of each network were set out on 32 mm centres. One corner is shown dimensioned in Fig. 5.

Pegs in the original version were ½" x 1/8" steel nuts and bolts, but smooth-sided pegs are easier to use.

The pegs were colour marked by fitting coloured plastic discs on each bolt below the nut. The plastic came from old desk diaries, and was reasonably thick, so it lay flat.

The underside of the board is shown in Fig. 6, where it is made clear that only the base line and win line pegs have any wiring. When the bridges form a link between a base line and a win line, then a circuit is closed and the appropriate lamp indicates the winner. The wiring is shown in Fig. 7. Clearly no switch is required. The battery — two AA cells in series — is held under a clip made from aluminium, and leads soldered to it. The win lamps were lens-end bulbs held in clips fashioned from brass, with leads soldered on.

Bridges were made from 0.015" brass shim stock, to the dimensions shown in Fig. 3. These bridges are adjusted so that they must be squeezed a little to place them on the pegs. In this way they make adequate contact. That's why the hole spacing shown in the side view of the bridge exceeds the spacing of the pegs. If the bridges get loose then they must be spread out to restore their grip on the pegs. Note that the holes in the bridges must be an easy clearance over the pegs. To make these bridges it is best to mark them all out on a sheet of shim brass — including the bending lines, drill them, and then cut them apart.

Bridges can be colour coded with coloured plastic tape or by dipping them into tins of enamel and letting them dry with the V hanging down.

If your budget is so low that shim brass is 'out' — don't despair — try tinplate, jam tins etc!

That's all there is to it. Good lincing. ●

PARTS LIST

Three ply about 256 mm square
Timber for support framework
Nuts and bolts — 84 ½" x 1/8" or similar
Shim brass enough for 48 bridges.
Battery — two AA cells
Bulbs — two lens end torch bulbs
Hook up wire, coloured plastic, paint.

LOUDSPEAKER PROTECTION

IT IS generally safe to drive a loudspeaker from an amplifier of several times the speaker's power rating — as long as the volume control is not wound fully up — or much treble boost applied, there is little danger of burning out drive units.

Nevertheless it is advisable to insert fuses in the speaker leads.

FUSE VALUE SELECTION

Power rating of speaker		3Ag fuse ratings in amperes. (Do not use slow-blow-fuses) 4-ohm speaker	8-ohm speaker	16-ohm speaker
15 – 25 watts	Safest	1	½	¼
	Good	2	1	½
	Maximum	4	2	1
25–35 watts	Safest	1½	¾	3/8
	Good	3	1½	¾
	Maximum	6	3	1½
35–50 watts	Safest	2	1	½
	Good	4	2	1
	Maximum	8	4	2
50–75 watts	Safest	2½	1½	¾
	Good	5	3	1½
	Maximum	10	6	3

This chart, prepared by Altec Lansing indicates the fuse values that should be used.

Ideally, start with the lowest rated fuse in each category — increase to the 'good' value if the 'safest' one blows out too often. Never exceed the 'maximum' though.

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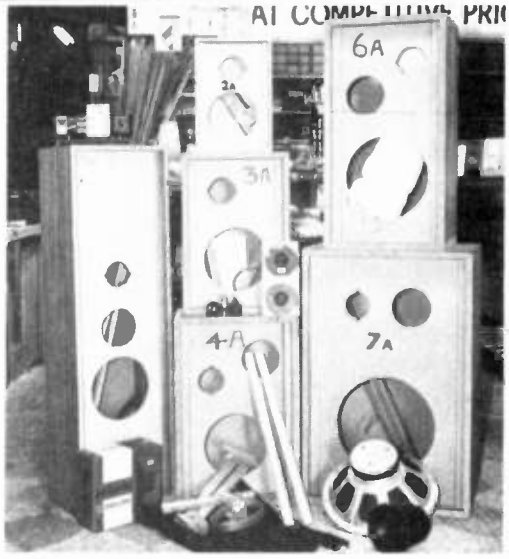

SYSTEM 2A	2 x AD7066/W8 woofers 2 x AD0160/T8 tweeters 2 x ADF1600/8 x overs 2 x enclosure kits 10M speaker wire	Innerbond grill cloth terminals	ONLY $80.00
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SYSTEM 4A	2 x AD8066/W8 woofers 2 x AD5060/SQ8 mid range 2 x AD0160/T8 tweeters 2 x ADF300/4500/8 3way x overs 2 x enclosure kits	10M speaker wire Innerbond, grill cloth terminals	ONLY $129.00
SYSTEM 5A	2 x AD8066/W8 woofers 2 x AD5060/SQ8 mid range 2 x AD0160/T8 tweeters 2 x ADF300/4500/8 3way x overs 2 x enclsoure kits	10M speaker wire Innerbond, grill cloth terminals	ONLY $142.00
SYSTEM 6A	2 x AD10100/W8 woofers 2 x AD5060/SQ8 mid range 2 x AD0160/T8 tweeters 2 x ADF300/4500/8 3way x overs 2 x enclosure kits	10M speaker wire Innerbond, grill cloth terminals	ONLY $179.00
SYSTEM 7A	2 x AD12100/W8 woofers 2 x AD5060/SQ8 mid range 2 x AD0160/T8 tweeters 2 x ADF300/4500/8 3way x overs 2 x enclosure kits	10M speaker wire Innerbond, grill cloth terminals	ONLY $196.00

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AD7066/W8 7" 40w	$13.00
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AD5060/SQ8 5" 40w	$12.50
AD0160/T8 1" 20w	$8.50

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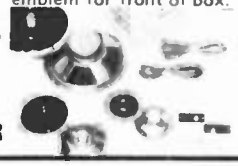
10SA—1	.$30.00 EACH
8SA—1	.$27.00 EACH

8" CORAL SPEAKER SYSTEM KIT 8SA-1

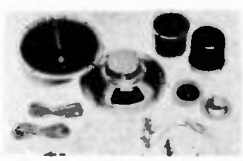
The features as assembled in a designed cabinet are as follows:
Features (8SA-1)

Type of cabinet	Closed type
Type of speaker	3-way 3-speaker
Input impedance	8 Ohms
Crossover frequency	4,000 : 9,000 Hz
Frequency response	70 ~ 20,000 Hz
Sensitivity	93 dB
Capacity	35 W

35W, 3-way 3-speaker system in kit form includes all speakers, crossovers, terminals, wire, screws, coral emblem for front of box.



$30 PAIR



Price $50 PAIR

10" CORAL SPEAKER SYSTEM KIT 10SA-1

50W, 3-way, 3-speaker system in kit form includes all speakers, crossovers, terminals, wire, screws, coral emblem for front of box.

The features as assembled in a designed cabinet are as follows:
Features (10SA-1)

Type of cabinet	Closed type
Type of speaker	3-way 3-speaker
Input impedance	8 Ohms
Crossover frequency	2,000 : 6,000 Hz
Frequency response	40 ~ 20,000 Hz
Sensitivity	93 dB
Capacity	50 W

12" CORAL SP. SYSTEM KIT 12SA-1

60W, 3-way, 4-speaker system in kit form includes all speakers, crossovers, terminals, wire, screws, coral emblem for front of box.

The features as assembled in a designed cabinet are as follows:
Features (12SA-1)

Type of cabinet	Closed type
Type of speaker	3-way 4-speaker
Input impedance	8 Ohms
Crossover frequency	1,000 : 10,000 Hz
Frequency response	30 ~ 20,000 Hz
Sensitivity	95 dB
Capacity	60 W

Price $70 PAIR

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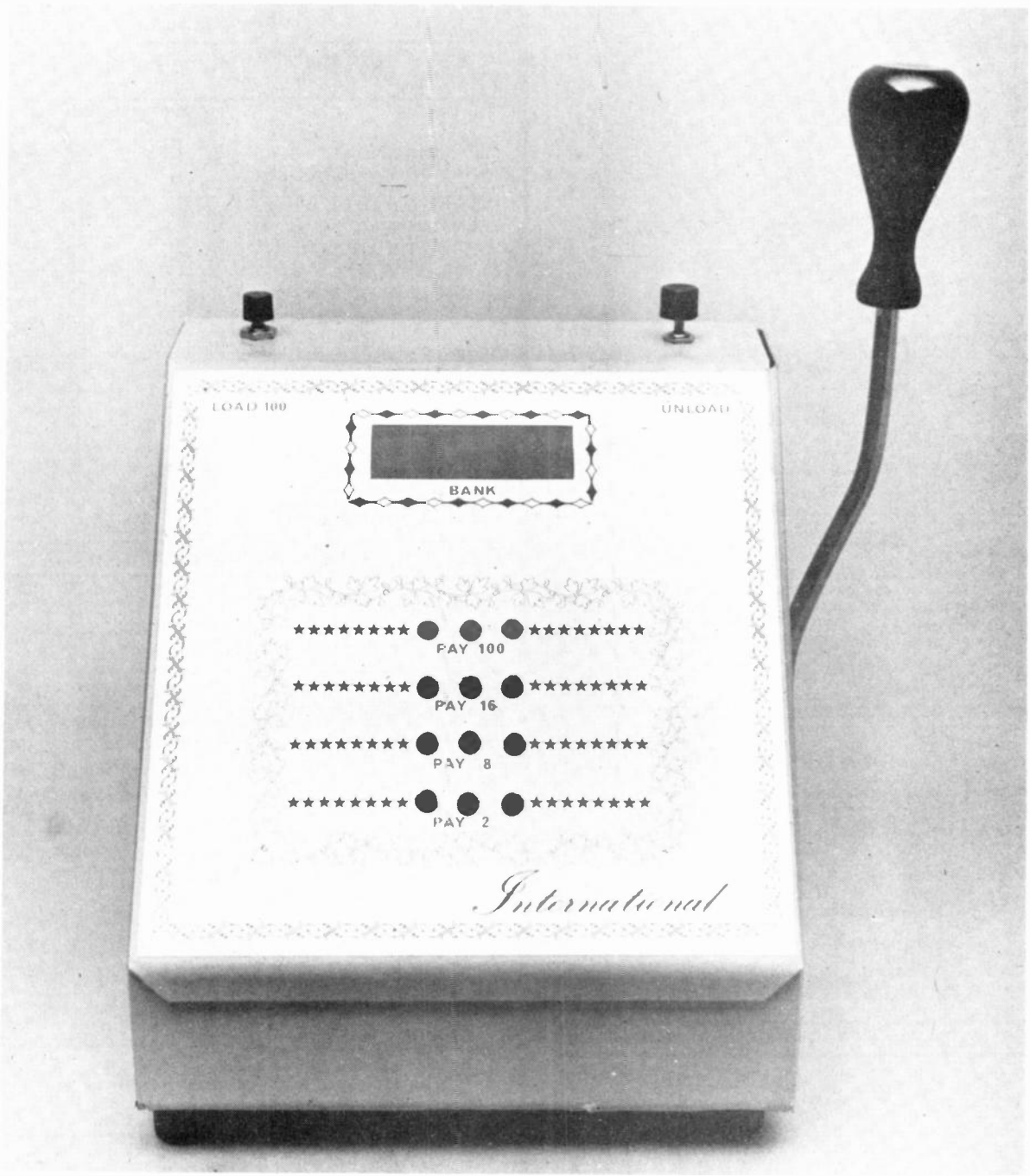

OVER THE PAST YEARS we and other magazines have published many electronic games and puzzles ranging from very simple to very complex. We have published mainly simple ones since many complex games like noughts and crosses are expensive and have limited appeal since once the routine has been found the machine can always be beaten.

Here however is a rather more complex game — but one that cannot be

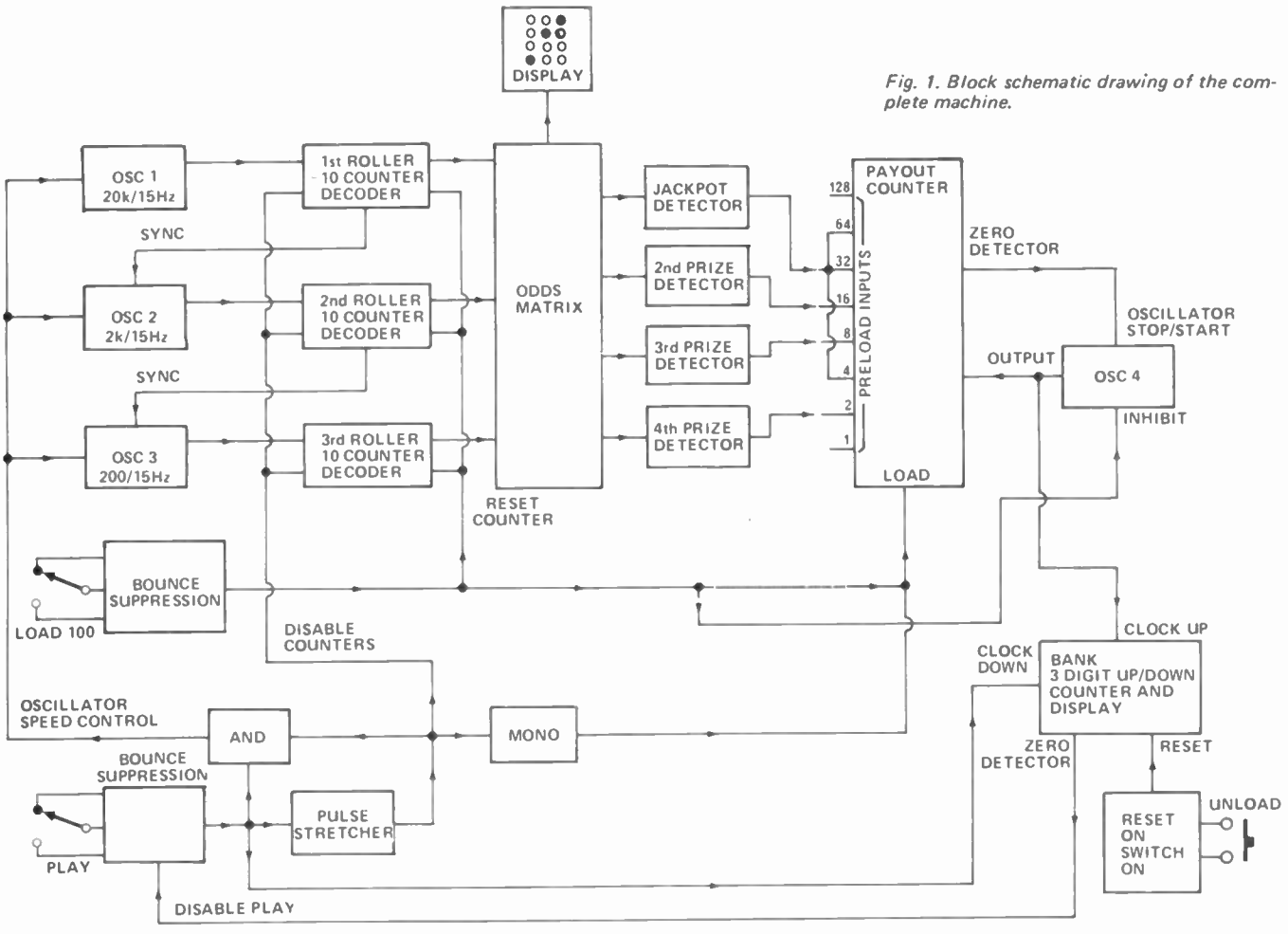

Fig. 1. Block schematic drawing of the complete machine.

beaten in the conventional sense.

The poker machine described here works similarly to a conventional mechanical machines with which most people are familiar. It requires no skill and can be enjoyed by all types of people.

So that the machine does not contravene gaming laws no coin slot or tray is used, instead we use a three-digit display to show the status of the game. Every time the handle is pulled one unit is subtracted from the display or "bank" and if a winning combination is obtained then the appropriate number is added to the bank. To start the game 100 is added to the bank by pressing the load button (which would be a key switch if money was involved). The game finishes when you like by pressing the unload button or when the bank reaches zero.

PRINCIPLE OF OPERATION

Each wheel of the conventional poker machine has been replaced by a decade counter which has ten separate outputs which represent positions on the wheels. These three counters are allowed to be clocked rapidly for a random period (time the handle is pulled for) and then stopped. The final state of the counters determine if a prize has been won.

With three decade counters the total possible combinations is 1000. Therefore if we use 10 different "symbols" on each wheel the chances of a prize would be 100/1 (10 possible wins each at 1000/1). Therefore like a normal machine we weight the rollers by having less than 10 "symbols" and having some symbols repreated more than once on each roller. The table below gives the number of times each symbol is on each roller and a breakdown of the odds of each prize.

Detectors are used for each winning combination and these set the appropriate value (2, 8, 16 or 100) into the payout counter. At this time, oscillator 4 starts up and clocks this counter down to zero.

The output of oscillator 4 also adds the appropriate number into the bank, which is a three digit up down counter. When the play lever is initiated one unit is subtracted from the bank. When the bank reaches zero, further play is inhibited.

Initially on switch-on the bank is reset to zero and it can be reset at any time by pressing the unload button. To commence play the load button must be pressed. This resets the rollers to zero which represents a jackpot, loads this into the payout counter and is then clocked into the bank.

Obviously this machine would not last long in a club with a payout of 99.6%. If required the payout can be changed either by changing the value of the prize or changing the weighting of the rollers. Reducing the jackpot to 64 (which is easy) reduces the payout to 96%.

To be continued . . .

PRIZE	1st ROLLER	2nd ROLLER	3rd ROLLER	WINS 1000 Plays	ODDS	VALUE OF PRIZE	TOTAL VALUE IN 1000 Plays
Jackpot	1	1	1	1	1000/1	100	100
2nd	2	2	4	16	62.5/1	16	256
3rd	2	3	5	30	33/1	8	240
4th	5	4	10*	200	5/1	2	400
TOTAL				247	4/1		996

* 4th prize is not decoded on the 3rd roller. However if 4th prize is on both the 1st and second roller it is automatically lit up on the 3rd. This is similar to 10 10 — on a normal machine.

This table shows the number of times each symbol is on each 'roller' — and a breakdown of the odds of each 'prize'.

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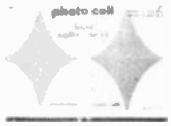

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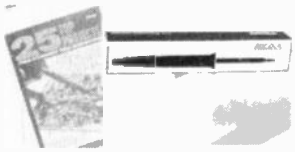

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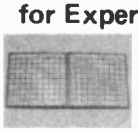

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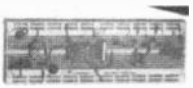

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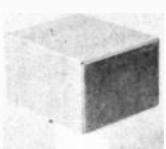

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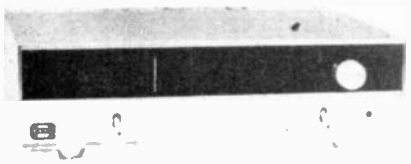

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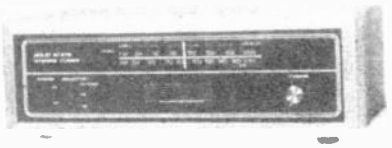

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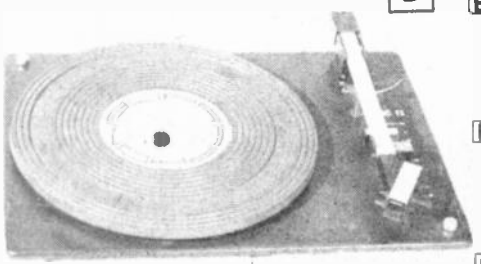

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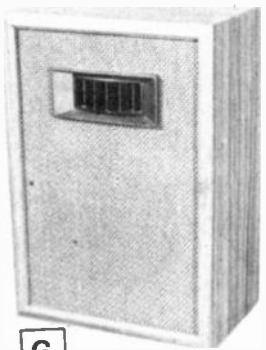

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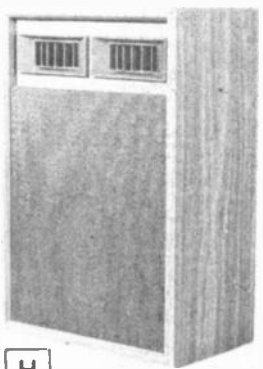

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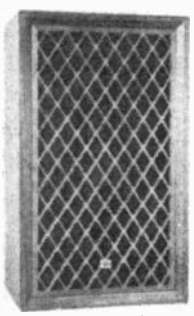

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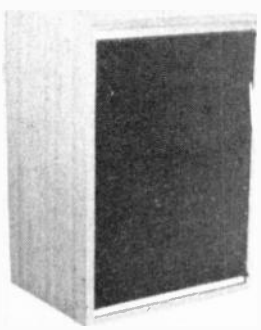

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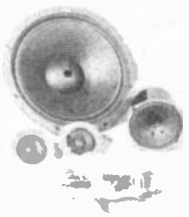

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Popular model with all useful features of much dearer turntables.

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INTERNATIONAL 3600 SYNTHESIZER

Building the voltage controlled filter

THE VOLTAGE CONTROLLED FILTER used in the model 3600 synthesizer has been designed in the light of experience gained in using the larger 4600 unit.

It was found that the bandpass and high-pass filters were seldom used and that extra presence was required in the lowpass filter. To this end it was decided to redesign the filter to provide a 'resonance' control which allowed the filter to be peaked, as required, just before the cut-off point.

The filter now has a more 'commercial' sound (and may readily be fitted to the larger unit if desired). If the filter is peaked too much it will oscillate. This is an advantage as it effectively provides a useful sinewave oscillator if required.

CONSTRUCTION

The method of assembly is similar to that used for most of the other modules. A small aluminium bracket is used to hold the printed circuit board and associated switches and potentiometers.

When assembling the components to the printed circuit board the usual care must be taken with the orientation of polarized components. Assemble the components to the board in accordance with the overlay Fig. 2 using sockets for the CMOS ICs at least. Note that IC2 MUST be a

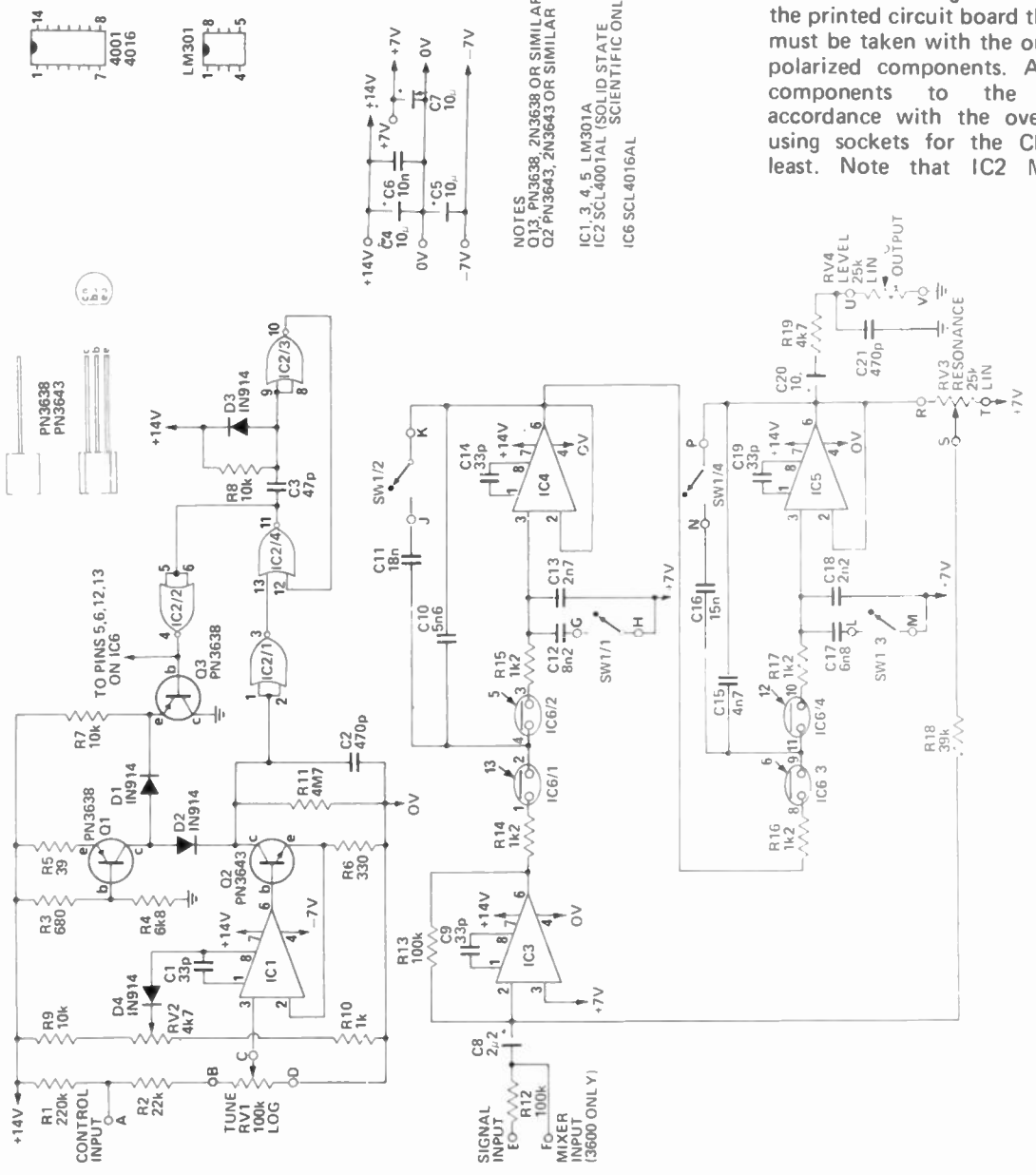


Fig. 1. Circuit diagram of filter module.

SCL4001AL as made by Solid State Scientific. Although this component is made under the same number by other companies, the Solid State Scientific version is much faster and has a much narrower linear region. If another brand is substituted the oscillator may work over a restricted range, or worse still may not work at all.

Two ways of wiring external components are shown, in Figs. 3 and 4. The second drawing (Fig. 3) applies to the larger 4600 synthesizer only.

SETTING UP

The only adjustment necessary is to set the trim potentiometer RV2. This is done as follows. Connect the control input to +14V, turn the resonance control to maximum, such that the filter acts as an oscillator, and set the range control to low. It will be found that as the tune control is advanced the frequency will increase, drop slightly and then cease. When in this state (ceased) adjust RV2 until the oscillation starts again and is at maximum frequency.

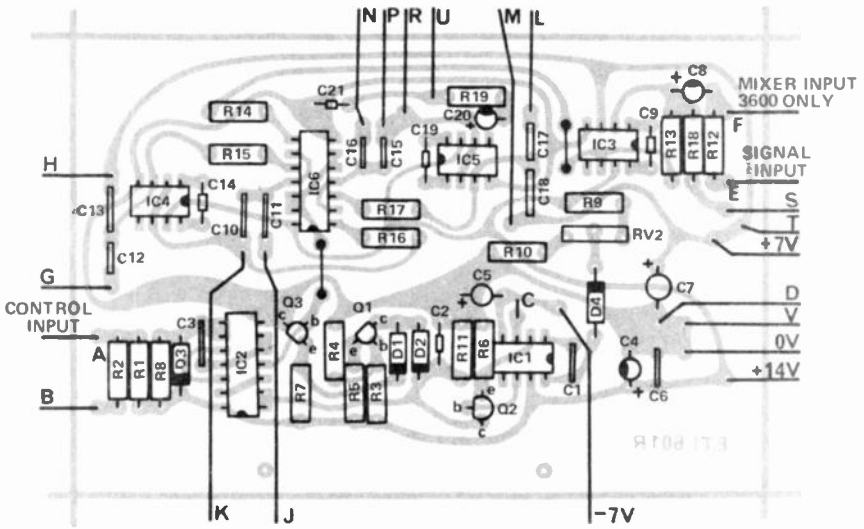


Fig. 2. Component overlay

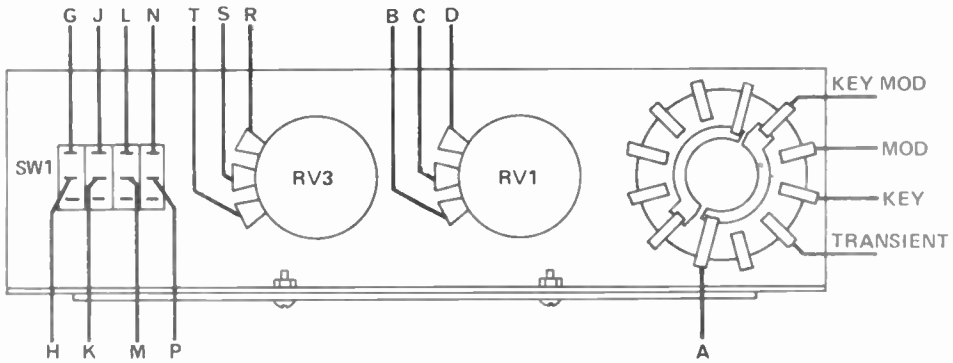


Fig. 3. Potentiometer and switch wiring for 3600 unit.

HOW IT WORKS

The voltage controlled filter consist of three main sections:–

1. The buffer amplifier – mixer.
2. A low-pass filter.
3. A voltage controlled filter.

The buffer amplifier IC3 is used to give a level shift to the input signal and to provide a constant 100 k input impedance. A second input direct to the input of IC3 is used, in the 3600 synthesizer, for additional mixing.

The 4016 CMOS IC is a four section analogue switch which when 'on' has a resistance of about 200 ohms and when 'off' a resistance of about 10^{12} ohms. Each section has its own control input but in our case all the control inputs are connected together. We may consider the switches on the filter as a normal four pole active low pass filter (two 2 pole in series). The filter has a gain of unity (output of IC3 to output of IC5) below the out-off frequency and a ultimate slope of 24 dB octave above the cut-off frequency.

As well as an amplitude change with frequency there is also a change in phase relationship. Initially the output of the filter is 180° out of phase with the input (point E), and in phase when 6 dB down. It eventually moves 180° out of phase again as the frequency increases. The potentiometer RV3 and resistor R18 takes part of the output signal and feeds it back into the input of IC3. Below the cut-off frequency this causes the output to be attenuated, at the cut-off frequency, the signal is boosted and above the cut-off it again starts to attenuate. This causes the output to peak in the region of the cut-off frequency and then drop suddenly above that frequency. The height of the peak is adjustable. If adjusted too high the filter will oscillate.

To vary the cut-off frequency we must vary the four capacitors or the four resistors in the areas of the filter.

To obtain the two ranges we switch capacitors in or out and, to give the continuously variable range, we vary the resistors by switching them in and out at a fast rate but with a mark-space ratio which is variable.

By such switching the effective value of a resistor becomes:–

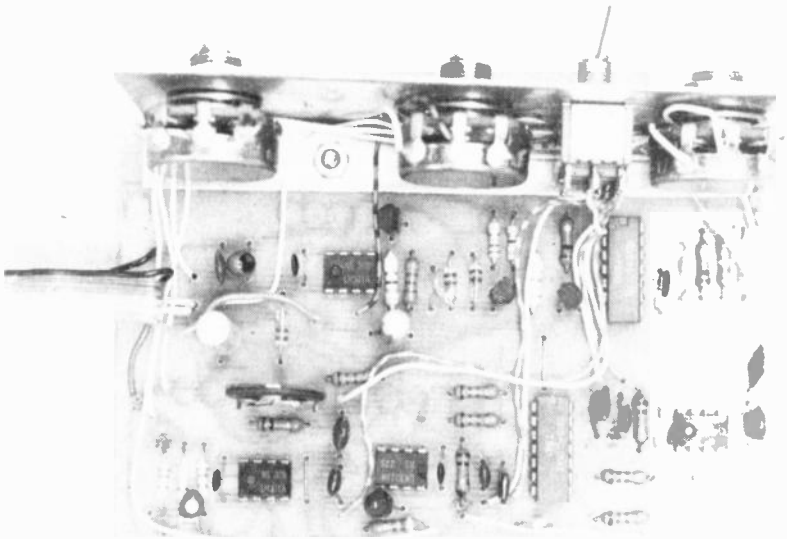
$$\frac{R \times \text{total time}}{\text{time on}}$$

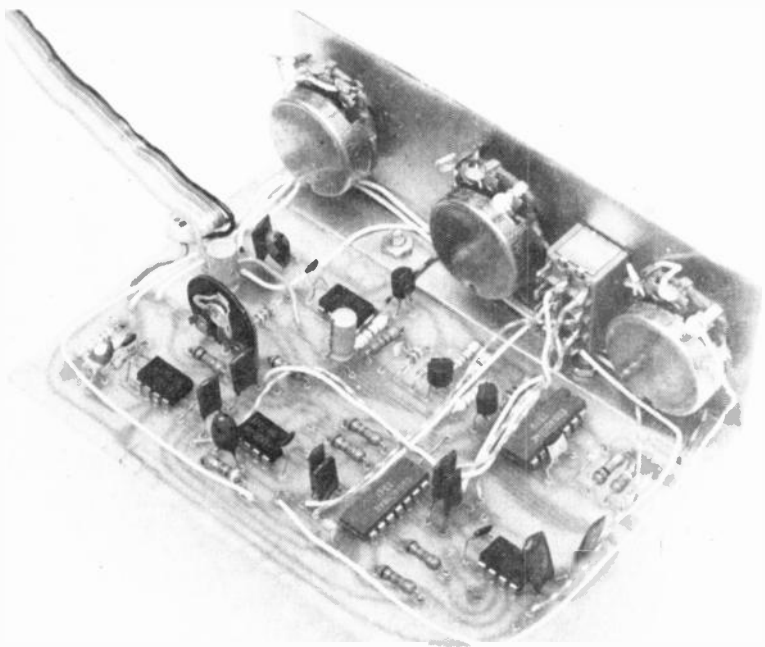
and since on time is always shorter than total time the resistance can vary from 'R' upwards. We obtain a variable mark-space ratio by using a monostable of about 200 n sec triggered by a voltage controlled oscillator which is variable from 5 kHz to about 3 MHz. We therefore keep the on-time constant and vary the off-time.

The VCO is virtually identical to that shown in the March 1975 issue and reference should be made to this for how it works. The only changes made is an addition to prevent the oscillator stopping either on overvoltage (RV2) or negative input voltage (R11).

INTERNATIONAL 3600 SYNTHESIZER

Internal views of filter module.





PARTS LIST

R5	Resistor	39ohm	5%	¼W
R6	"	330ohm	"	"
R3	"	680 "	"	"
R10	"	1k	"	"
R14,15,16,17		1.2k	"	"
R19	"	4.7k	"	"
R4	"	6.8k	"	"
R7,8,9	"	10k	"	"
R2	"	22k	"	"
R18	"	39k	"	"
R12,13	"	100k	"	"
R1	"	220k	"	"
R11	"	4.7M	"	"
RV1	Potentiometer	100k	Log rotary	
RV3,4	"	25k	LIN	"
RV2	"	4.7k	Trim type	
C1,9, 14,19	Capacitor	33pF	ceramic	
C3	"	47pF	"	
C2,21	"	470pF	"	
C18	"	0.0022μF	polyester	
C13	"	0.0027μF	"	
C15	"	0.0047μF	"	
C10	"	0.0056μF	"	
C17	"	0.0068μF	"	
C12	"	0.0082μF	"	
C6	"	0.01μF	"	
C16	"	0.015μF	"	
C11	"	0.018μF	"	
C8		2.2μF 16V	electrolytic	
C4,5,7,20	"	10μF 16V	"	
Q1,3	Transistor	PN3638,2N3638 or similar		
Q2	"	PN3643, 2N3643 or similar		
IC1,3,4,5	Integrated Circuit	LM301A		
IC2	"	"	SCL4001*	
IC6	"	"	SCL4016	

* MUST be solid state scientific

D1-D4 Diode IN914

SW1 Switch 4 pole 2 position toggle

PC board ETI 601R

3600 Synthesizer

1 pole 5 position rotary switch metal bracket to fig.

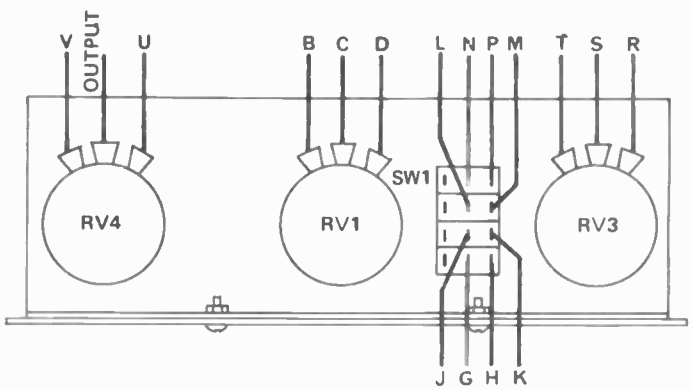
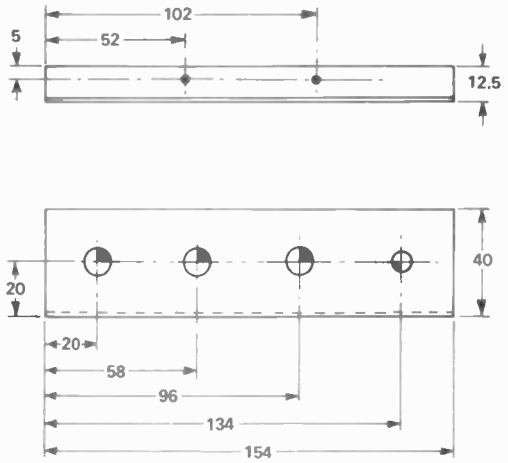


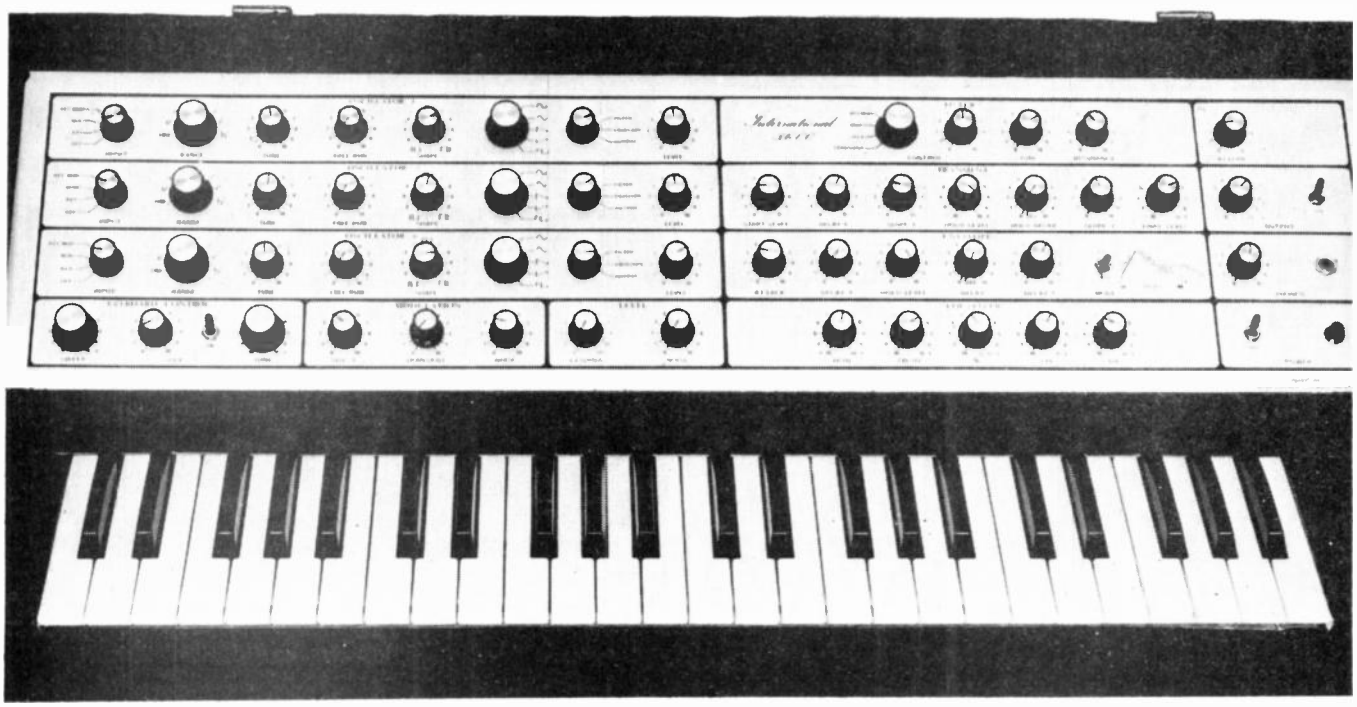
Fig. 4. If desired this filter module can advantageously replace that originally designed for the 4600 synthesizer Here's how to wire it in to the 4600 unit.



MATERIAL 1.2mm ALUM OR STEEL

- 2 HOLES 3.2mm DIA
- 1 HOLE 6.4mm DIA
- 3 HOLES 9.6mm DIA

Fig. 5. This bracket is used when the filter is used with the 3600 unit. (not needed for the 4600 unit).



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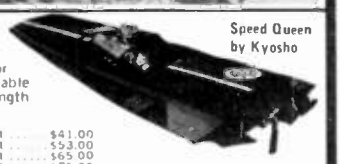
Kyosho speed Queen is shaped like a sleigh at bottom — What is called ski boat — designed for circuit and straight away running, capable of speed up to 83 km/h. Length availability.



Speed Queen by Kyosho

560mm speed queen 200 + hydro drive unit $41.00
670mm speed queen 300 + hydro drive unit $53.00
750mm speed queen 400 + hydro drive unit $65.00
920mm speed queen 600 + hydro drive unit $75.00
Order No. 101 P & P $5.00

R.C. 2 CHANNEL COMBINATION RADIO CONTROL COMBO.
Stormer 48" wingspan
Fox R/C 0.15
SALE **$145**
Order No. 102 P & P $5.00

CONTROL LINE MODELS 26" WINGSPAN

MUSTANG SCALE

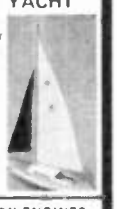
HURRICANE SCALE

WILDCAT

HUSKY

Complete with 0.10 OS engine and silencer
Retail $31.50
SALE $25
Order No. 103 (P&P $3.00)

NEWPORT YACHT



With all fittings. Good for 2 channel R/C
Height 47"
Length 32"
Retail $64.00
SALE $48.25
Order No. 104 (P&P $5.00)

CONTROL LINE PRE-FORMEO FUSELAGE

Top Flite, P 40 Warhacok Wingspan 33", plus 0.15 Fox engine.

Retail $44.90
SALE $37.00
Order No. 109
P&P $3.00

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U control profile plus O.S. 0.15 engine and silencer
Retail $49.45

SALE $34.45
Order No. 108
P&P $3.00

FOX ENGINES SERIES '75
Order No. 118, P&P $1.50

	Standard	R/C
FOX .15	19.23	24.90
FOX .19	20.90	31.45
FOX .25	20.90	
FOX .29	23.85	31.45
FOX .35 stunt		28.30
FOX .36	23.85	36.70
FOX .60	72.15	79.35
FOX .78	98.40	111.50

FOX Combat Special $52.45

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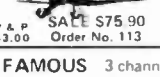
R/C short. Reg. $1.00 or R/C long Reg. $1.45. Short 3 for $2.64. Long 3 for $3.84.
P & P $0.50.
Order No. 105

PHANTOM II BY M.R.M.
48" wingspan full scale jet for .60 engine. Retail $85.39

P&P $5.00
Order No. 110 SALE $75.90

LITTLE STINKER BY M.R.M.
52" Wingspan true scale Biplane. For .60 engine
Retail $85.00



P & P $3.00 SALE $75.90 Order No. 113

Retail $55
High torque engine starter by Kyosho

will operate engines up to 80 e.i.
P&P $2.00 SALE $35 Order No. 106

SUPER MONO KOTE
The covering with the built-in finish, fuel proof, lightweight, fade proof and puncture resistance. Opaque colours. Super mono kote: 26" x 72". Colours: Clear, Missile red, international orange, piper yellow, jet white, mustang aluminium, sky blue, insignia blue, midnight black, chrome, olive drab, dove gray.
SALE 2 rolls for $20.15
Regular $11.40 P/R P&P $1.00
Order No. 111

FAMOUS BRAND 3 channel, R/C system (on 27 MHz). New and improved transmitter. Brick type receiver with two servos. All rotary servos.

SALE **$195** P & P $2.00
Order No. 114.
Only 5 units left at this price

Trident 80" R/C by Aeroflyte

Retail $22.95
sale $20.40
P & P $2.00
Order No. 112

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B.B. 0.09 STO $14.90
B.B. 0.09 STO muffler $1.95. B.B. 0.20 STO $26.55. B.B. 0.20 STO muffler $5.70. B.B. 0.20 R/C car engine $28.80. B.B.A. 0.20 R/C air engine $28.80. B.B.M. 0.20 R/C marine engine $35.99.
P & P $1.50
Order No. 115

Jet-X STO jet engine pack plus extra fuel pack
Reg. $10.20
SALE **$9.10**
P & P $1.50 Order No. 119

CESSNA 310 Q BY M.R.M.
70" wingspan, scale model for two .40 engines.

Retail $110.40
Sale $98.20
Order No. 117 P&P $5.00

TANKS P & P $0.75

	Reg.	J Bs
Medium stunt wedge	1.25	1.11
Large stunt wedge	1.75	1.55
Class A team race	1.25	1.11
Small stunt wedge	1.25	1.11
Large pressure stunt	1.75	1.55
Small square stunt	1.25	1.11
Large stunt wedge	1.25	1.11
Monster pressure stunt	1.75	1.55

Order No. 116

Hustler 60" WINGSPAN plus Fuji 15 R/C engine

Retail
SALE $56
Great model for beginners or experts single to six channels.
Order No. 107 P&P $4

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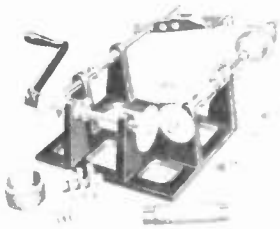
Coilmaster



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$23-95
Post & Pack $1.50

This Easy-to-use machine winds honeycomb, spiderweb and solenoid coils of various widths and diameters — equal in appearance to a factory job. Also suitable for winding chokes, transformers and filter inductors. Indicator counts number of turns on coil. The COILMASTER is suitable for both experimental and practical work. Supplied with accessories including wood spools, metal pegholders and extension for making long solenoid coils. Instructions included.

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MONTHLY AT ALL NEWSAGENTS – 60c

SIMPLE LOUDNESS CONTROL

This circuit, intended primarily for the experimenter, enables basic loudness control to be added to simple amplifiers.

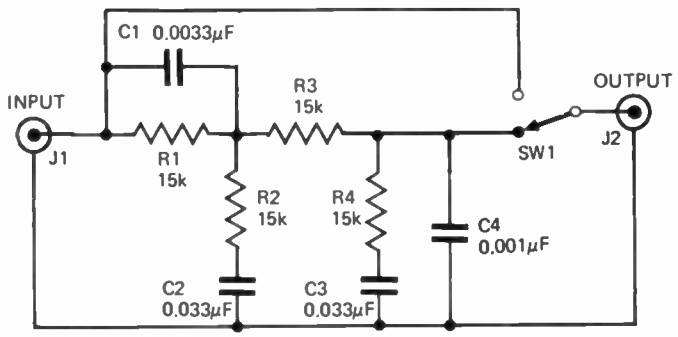

Fig. 1.

PARTS LIST

R1	15k	5%	½ W
R2	15k	5%	½ W
R3	15k	5%	½ W
R4	15k	5%	½ W
C1	0.0033μF		
C2	0.033μF		
C3	0.033μF		
C4	0.001μF		
SW1	DPDT Toggle Switch		

THERE YOU ARE, sitting in the lounge room enjoying Beethoven's Fifth. All of a sudden your enjoyment is shattered by your wife – who insists that the music is far too loud, the neighbours five doors up are complaining, and the kids can't get to sleep. So reluctantly you turn the volume down – only to find that the music just doesn't sound the same, the bass has dropped-off badly and even the treble seems to be down.

It is to cater for situations like this, that amplifier manufacturers include 'loudness' controls.

'Loudness' is a subjective evaluation, primarily a function of a sound's intensity, but also strongly influenced by frequency. The keyword is of course 'subjective'. That is the response of the ear is non-linear – both to changes in sound level and also frequency.

This is best understood by reference to the standard curves for the *average* ear. These curves, due to Robinson and Dadson, are now generally accepted as being more accurate than the classical ones generated earlier by Fletcher and Munsen (after whom the effect is called).

In essence, loudness controls compensate for the Fletcher Munsen effect, producing what is generally (but by no means universally) agreed to be a subjectively more pleasing sound at low listening levels.

Loudness circuits do this by progressively boosting bass – and to a lesser extent treble – as volume is reduced.

The objection to loudness controls is that the effect is totally artificial – as one moves further away from an original sound source bass and treble *will* be attenuated more than midrange sounds. So if your penchant is listening to orchestras a hundred metres or so away then loudness controls are not for you!

Nearly all modern high quality amplifiers have loudness controls built in. In most instances they are manually switched into circuit when required – in a few amplifiers the circuit is switched in at all times.

Nevertheless there are innumerable older or present-day low-priced amplifiers that are not fitted with loudness compensation – and it is for units such as these that this simple project has been designed.

The device shown in Fig. 1 is for a mono amplifier – two are required for stereo amplifiers. It can be very simply assembled on tag strips or matrix board, and, when completed connected between your pre-amplifier and main amplifier. If yours is an integrated unit it should be readily possible to break into the volume control circuit – just connect the unit in series with the slider terminal of the potentiometer. Screened leads may be necessary if long lengths are required.

We would like to emphasize that this is a 'compromise' circuit. Ideally a loudness control must be designed specifically to suit the amplifier for which it is intended. Also the degree of loudness compensation should be related to the volume control setting.

This latter requirement involves replacing the existing volume control by a suitably tapped potentiometer – a device that is not readily available "off the shelf" – so the circuit shown here introduces a fixed amount of compensation that is adequate for moderate listening levels.

This circuit will suit most amplifiers quite well – and in any case can be adjusted by minor variation of component values if required.

Switch SW2 should be a double-pole double-throw type if stereo operation is required. ●

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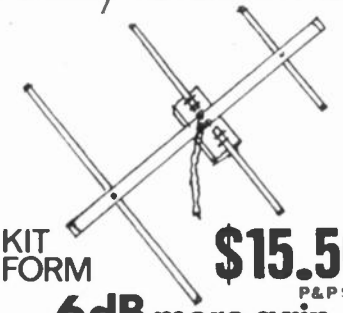
LOW COST FM ANTENNA
ready to assemble



KIT FORM **$15.50** P&P $2

6dB more gain
than simple folded dipole.

Tune in to the FM air waves with this new FM Antenna Kit from ETI (April '75). The simple folded dipole antenna, as supplied with many tuners, just isn't good enough. Especially necessary in poor signal areas, this lightweight aluminium antenna gives at least 6 dB more gain.
Assembly is fast and easy, since all pieces are pre-cut and drilled. Uses 75 ohm co-ax cable to connect to tuner. Simply advise what length of cable you require (not incl. in Kit). Various fixtures and fittings available to facilitate mounting to house.

75 ohm coax cable, per metre 55c.

TUNING & LEVEL (VU) METERS — 1st release.

TUNING METER — $4.50, post 50c
Size 40 x 40 x 23 mm, 200μA sens., 1K ohm coil, scaled 1 to 5, can be illuminated.

SIGNAL METER — $4.50, post 50c.
Size 40 x 40 x 23 mm, 200μA sens., 750 ohm coil, scaled 0 to 5, can be illuminated.

VU METER — $4.50, post 50c.
Size 40 x 40 x 23 mm, 500μA sens., 300 ohm coil, scaled — 20 dB to 3 dB, can be illuminated.

STEREO VU METER — $8.95, post 50c.
Size 80 x 40 x 25 mm, 200μA sens., 1K ohm coil, scaled — 20 dB to + 3 dB, can be illuminated.

STEREO VU METER — $6.95, post 50c.
Size 80 x 40 x 25 mm, 400μA sens., 650 ohm coil, non-illuminated scale.

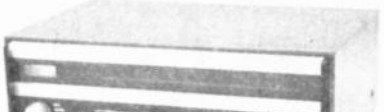
2 models:
STEREO 25 OR SUPER-QUAD 4

Ready-built, not a kit
Incredible Value — $85 P&P $4.00
Complete, as pictured, with teak base/cover and Garrard turntable.

FEATURES:
- 12.5 W/ch output (8 ohms).
- Garrard Auto-Changer 6-100.
- "Slumber" switch off.
- Headphone, tape sockets.

Simply mount turntable and amplifier (pre-assembled) in base/cover, attach your own speakers, and its ready to play. At this price you save $25, and there are only 35 available, so order your Stereo 25 or Super-Quad 4 today.

For music-lovers everywhere;
KEMSTAR AM HI-FI TUNER KIT



By special arrangement with the manufacturers of the top selling KEMSTAR wide-band tuner, we now offer exclusively, this very fine tuner, which normally retails at about $130, as a ready-to-assemble kit for only

Complete Kit. **$59** P & P $3.00

"WIDE-BAND PRINCIPLE"

The KEMSTAR Tuner employs 10 transistors in a novel circuit to provide true hi-fi performance from normal AM broadcasts. Quality approaches that obtainable with FM and, since FM transmissions are presently limited both in variety and strength, this tuner is an excellent investment for all music-lovers. A whistle filter and tuning meter is included and country listeners will appreciate the tuned RF amplifier and "Local-Distant" signal switch. The front panel is particularly attractive with back-lighted slide-rule dial and satin-aluminium trim; a walnut wood cover is included.
Comprehensive assembly and tuning instructions are supplied construction time: approx. 3 hrs.

KEMSTAR is a registered trade mark

RESISTOR COLOUR CODE

(standard carbon series)

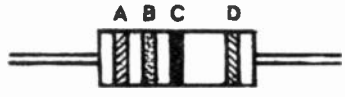
To read the colour code, hold resistor with code ring nearest to end at left hand side.

Colour	1st ring; 1st figure	2nd ring 2nd figure	3rd ring multiplier	4th ring tolerance
black	–	0	1	–
brown	1	1	10	±1%
red	1	2	10^2	±2%
orange	3	3	10^3	–
yellow	4	4	10^4	–
green	5	5	10^5	–
blue	6	6	10^6	–
violet	7	7	10^7	–
grey	8	8	10^8	–
white	9	9	10^9	–
silver	–	–	10^{-2}	±10%
gold	–	–	10^{-1}	±5%

No fourth colour indicates ±20% tolerance

Grade 1 ('high-stability') resistors are distinguished by a salmon-pink fifth ring or body colour.

Example: Resistor coded as A – grey, B–red, C–orange, D–gold indicates a value of 82 kilohms ±5%.



RESISTORS of 1% tolerance sometimes have a five band code. The same colour codes are used but the first three bands represent the first three digits and the fourth band is the multiplier. With these resistors only a few of the standard values coincide with those of the four band coded resistors. For example 220 k is standard in four band code but 221 k is standard in five band code.

STANDARD VALUES

This table shows the preferred series of values in a decade.

RESISTORS and capacitors are generally made with the values and tolerances shown. For example 20% tolerance resistors are usually made in values of 10, 15, 22, 33, 47 and 68 – whether ohms, kilohms or megohms. Thus a (nominally) 47 k, 20% resistor may have an actual value somewhere between 37.6 k and 56.4 k. A (nominally) 33 k, 20% resistor may in fact be as low as 26.4 k or as high as 39.6 k.

Closer tolerance resistors such as 10% or 5% are not necessarily better resistors – merely that the manufacturers have weeded out products falling outside the tolerance limits.

VALUES IN A DECADE

20%	10%	5 or 2%	1%							
10	10	10	100	133	178	237	316	422	562	750
		11								
	12	12	102	137	182	243	324	432	576	768
		13								
15	15	15	105	140	187	249	332	442	590	787
		16								
	18	18	107	143	191	255	340	453	604	806
		20								
22	22	22	110	147	196	261	348	464	619	825
		24								
	27	27	113	150	200	267	357	475	634	845
		30								
33	33	33	115	154	205	274	365	487	649	866
		36								
	39	39	118	158	215	287	383	511	681	909
		51								
	56	56	124	165	221	294	392	523	698	931
		62								
68	68	68	127	169	226	301	402	536	715	953
		75								
	82	82	130	174	232	309	412	549	732	976
		91								

POTENTIOMETERS

POTENTIOMETERS are made in many different forms for a vast number of applications. Factors which affect design are, for example, wattage and resistance range, whether the control is to be continually or intermittently adjustable, the 'law' of resistance and the variety of mechanical arrangements required.

POWER RATING

The maximum power which may be dissipated is specified for the condition where a voltage is applied across the end terminals continuously. However under certain conditions power dissipations much lower than this can cause damage. This is because the resistive element also has a maximum *current* limitation. Thus a potentiometer set to its lowest resistance could be damaged if excessive current were drawn via the slider terminal.

LAW

Potentiometers are constructed with various relationships of resistance versus rotation. Those most commonly used are:—

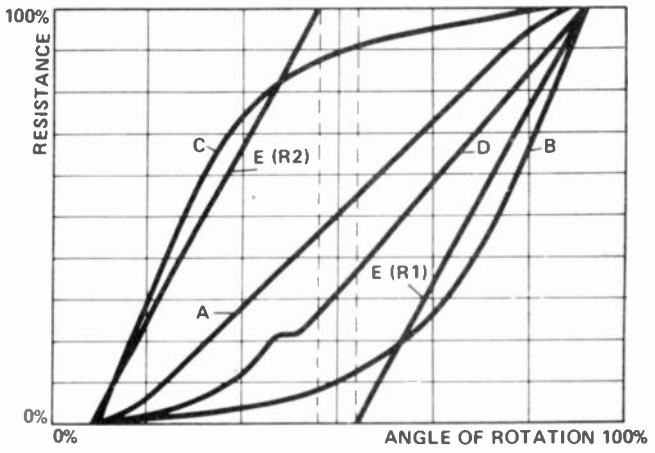
A linear
B logarithmic
C reversed logarithmic
D tapped
E balance

The type of relationship (law) used is indicated by stamping the appropriate letter symbol on the body of potentiometer.

eg. 10 kC is a 10 k ohm reversed — logarithmic potentiometer.

LOG OR LINEAR?

Most human perception is of a logarithmic nature (eg hearing, where a doubling of power is just perceivable). Hence logarithmic potentiometers are frequently used for volume controls as the logarithmic change in resistance (versus rotation) is 'heard' as a linear level-change versus rotation. Logarithmic — potentiometers are not accurate, so, where an accurate mid-point setting is required, (for example in tone controls) they are seldom used except in cheaper equipment.



Resistance/rotation curves for commonly used potentiometers.

TAPPED POTENTIOMETERS

Tapped potentiometers are generally used where some form of frequency compensation versus rotation is required. They are often used in 'loudness' controls, (bass and treble frequencies boosted at low volume levels). Tapped potentiometers are usually specially made for a specific application. Because of this they are not generally available from hobbyist supply sources.

BALANCE CONTROLS

Balance controls are built with two separate elements connected such that each alters resistance in the opposite sense. Such controls are used where it is required accurately to balance the gain of a pair of amplifiers. Such accurate balance is not required in domestic stereo amplifiers and hence in this application a single gang potentiometer is generally used.

GANGING

Potentiometers may be obtained with two or three resistance elements driven by a common shaft. These are commonly used for volume and tone controls for stereo amplifiers.

SERIES AND PARALLEL CONNECTIONS

Resistors in series

$$R_{total} = R1 + R2 + R3 + \ldots$$

Resistors in parallel

$$R_{total} = \frac{R1 \times R2}{R1 + R2}$$

Capacitors in series

$$\frac{1}{C_{total}} = \frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3} + \ldots$$

Capacitors in parallel

$$C_{total} = C1 + C2 + C3 + \ldots\ldots$$

TAG TANTALUM CAPACITORS

Because of their small physical size tag tantalum capacitors are ideal for miniature electronic work. They are more expensive than standard electrolytics though.

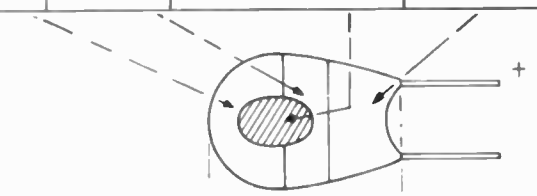
WORKING VOLTS	CAPACITANCE RANGE AVAILABLE
3	10 — 100 µF
6.3	6.8 — 47 µF
10	4.7 — 33 µF
16	2.2 — 22 µF
25	3.3 — 10 µF
35	0.1 — 6.8 µF

Tolerance ± 20%

PROJECT BUILDING GUIDE

TAG TANTALUM CAPACITORS

CAPACITANCE IN μF				D.C. WORKING VOLTAGE	
COLOUR	1st RING	2nd RING	POLARITY and MULTIPLIER	COLOUR	VOLTS
Black	–	0	x 1	White	3
Brown	1	1	x 10	Yellow	6.3
Red	2	2		Black	10
Orange	3	3		Green	16
Yellow	4	4		Blue	20
Green	5	5		Grey	25
Blue	6	6		Pink	35
Violet	7	7			
Grey	8	8	x 0.01		
White	9	9	x 0.1		

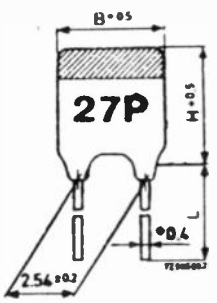


N.B. – The above sketch shows the position of the coloured spot which serves both as multiplier and anode indicator.

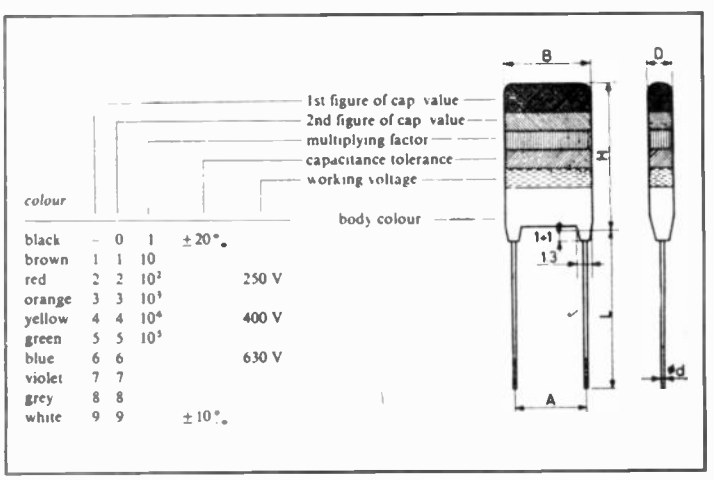
EXAMPLE
6.8μF/25 volts

CERAMIC CAPACITORS

capacitance (pF)	marking	capacitance (pF)	marking	capacitance (pF)	marking
0.68	p68	5.6	5p6	47	47p
0.82	p82	6.8	6p8	56	56p
1.0	1p0	8.2	8p2	68	68p
1.2	1p2	10	10p	82	82p
1.5	1p5	12	12p	100	n10
1.8	1p8	15	15p	120	n10
2.2	2p2	18	18p	150	n15
2.7	2p7	22	22p	180	n18
3.3	303	27	27p	220	n22
3.9	3p9	33	33p	270	n27
4.7	4p7	39	39p		



POLY-CARBONATE CAPACITORS



BUYING COMPONENTS

AS far as reasonably possible, all ETI projects are designed around components readily available 'off the shelf' from specialist component and kit set suppliers.

Many enthusiasts will have accumulated substantial stocks of components over the years and because of this may need to buy only a few odds and ends to build most projects. Beginners on the hand will generally find it much simpler to buy a complete kit of parts.

The companies listed below stock components and/or kits sets for most (but not necessarily all) ETI projects.

BUYERS' GUIDE

ACT
Electronic Components, 3 Pirie Street, Fyshwick, 2609

NSW
Classic Radio Service, 245 Parramatta Road, Haberfield, 2045.
Dick Smith Wholesale Pty. Ltd. 160-162 Pacific Highway, Gore Hill. 2065.
Edge Electrix, 34A Burwood Road, Burwood, 2134.
George Brown Pty Ltd, 174 Parramatta Road, Camperdown, 2050
Hi-Tec Electronics, 265 Princes Highway, Corrimal, 2518.
Instrol Electronics, 91a York Street, Sydney, 2000
John Carr Pty Ltd., 405b Sussex Street, Sydney, 2000
Kitsets Aust. Pty Ltd.,
657 Pittwater Road, Dee Why, 2099
M.S. Components, 95 Regent Street, Redfern, 2016
National Radio Supplies, 332 Parramatta Road, Stanmore, 2048
Oliver Electronics, 188-192 Pacific Highway, St. Leonards, 2065.
Pre-Pak Electronics, 718 Parramatta Road, Croydon, 2132.
Radio Despatch Service, 869 George Street, Sydney, 2000
Tandy Int. Electronics Pty Ltd., 280-316 Victoria Road, Rydalmere, 2116

QLD.
Dunmark Electronics, P.O. Box 702, Booval, 4304

SA
Truscott Electronics Pty. Ltd., 62-64 Hindmarsh Lane, Adelaide, 500.

TAS
Homecrafts (Tas.) Pty Ltd., 199 Collins Street, Hobart, 7000

VIC.
E. D. & E. (Sales) Pty Ltd., 232 Flinders Lane, Melbourne, 3000
Ham Radio Supplies, 104 Highett Street, Richmond, 3121
Hobipak, P.O. Box 224, Carlton South, 3053
J. H. MacGrath & Co. Pty. Ltd., 208 Little Lonsdale Street, Melbourne 3000
Lanthur Electronics, 69 Buchanan Avenue, North Balwyn, 3104
Radio Parts Group, 562 Spencer Street, West Melbourne, 3003
Royston Electronics Pty Ltd., 22 Firth Street, Doncaster, 3108
S.T.A. Electronics, 392 Centre Road, Bentleigh, 3204
Wayne Communications Electronics, 757 Glenferrie Road, Hawthorn, 3122

NZ
Kitparts Ltd, Christchurch, New Zealand

USA
Babylon Electronics, P.O. Box J, Carmichael, California, 95608, USA.
International Electronics Unlimited, P.O. Box 1708, Monterey, California, 93940, USA.

** Head Office addresses only are shown. Many suppliers have other premises inside and outside the home state. To find if there is a branch in your area consult the advertisements in Electronics Today International or the telephone directory.*

COMMONLY USED TRANSISTORS

NPN	PNP COMPLEMENT	MAX IC (MA)	VCEO (V)	POWER (MW)	@ IC (MA)	GAIN MIN (HFE)	GAIN MAX (HFE)	Ft MAX (MHZ)	NOISE (DB)	PIN CONNECTIONS (SEE DIAGRAM)
BC107	BC177	200	45	300	2	125	500	300	2	1
BC547	BC557	200	45	300	2	125	500	300	2	2
BC147	BC157	200	45	300	2	125	500	300	2	3
BC237	BC307	200	45	300	2	125	500	300	2	4c
BC108	BC178	200	20	300	2	125	900	300	2	1
BC548	BC558	200	20	300	2	125	900	300	2	2
BC148	BC158	200	20	300	2	125	900	300	2	3
BC238	BC308	200	20	300	2	125	900	300	2	4c
BC182L		200	20	300	2	125	900	300	2	4a
BC182K		200	20	300	2	125	900	300	2	4c
BC109	BC179	200	20	300	2	240	900	300	1.4	1
BC549	BC559	200	20	300	2	240	900	300	1.4	2
BC149	BC159	200	20	300	2	240	900	300	1.4	3
BC239	BC309	200	20	300	2	240	900	300	1.4	4c
TT801	TT800	1000	40/60*	800	100	40	120	150		5
BD139	BD140	1500	80	8000**	150	40	160	250/75		6
2N3643	2N3644	500	30/45*	350/300*	150	100	300	250		7
PN3643	PN3644	500	"	600	150	100	300	250		4b
	PN3638	500	25	600	50	30		100		4b
	2N3638	500	25	300	50	30		100		7
	2N3638A	500	25	300	50	100		150		7
MJE340		500	300	20000**	50	30	240			8
MJE340K		500	300	20000**	50	30	240			9

(*First number refers to NPN version, second for PNP)
(**Case temperature @ 25°C)

COMMONLY USED POWER TRANSISTORS

NPN	PNP COMPLEMENT	MAX IC (A)	VCEO (V)	POWER (WATTS)	@ IC (A)	GAIN MIN (HFE)	GAIN MAX (HFE)	FT (MHZ)	TJ MAX (°C)	PIN CONNECTIONS
2N3055	MJ2955	15	60	115/150*	4	20	70	4	200	10
MJE 3055	MJE 2955	10	60	90	4	20	70	2	150	8 (K Suffix-9)
TIP 3055	TIP 2955	15	60	90	4	20	70	2	150	11
MJE 2521	MJE 2371	3	60	40	0.2	40	200	3	150	9
TIP 29	TIP 30	1	**	30	1	15	75	3	150	12
TIP 31	TIP 32	3	**	40	3	10	50	3	150	12
TIP 33	TIP 34	10	**	80	3	20	100	3	150	11
TIP 35	TIP 36	25	**	125	15	10	50	3	150	11
TIP 41	TIP 42	6	**	65	3	15	75	3	150	12
(** TIP Suffix: None – 40 Volts, A – 60 Volts, B – 80 Volts, C – 100 Volts).										
MJ 802	MJ 4502	30	90	200	7.5	25	100	2	200	10
2N 5631	2N 6031	60	140	200	8	15	60	1	200	10

(*First number refers to NPN version, second for PNP)

COMMONLY USED FETS, UJT'S, PUT'S, SCR'S AND TRIACS

FETS (N-CHANNEL, J TYPE)	MAX DRAIN – SOURCE VOLTAGE (V)	DRAIN TO SOURCE CURRENT WHERE VGS = 0 (MA) MIN	DRAIN TO SOURCE CURRENT WHERE VGS = 0 (MA) MAX	POWER DISSIPATION (MW)	GATE – SOURCE CUT-OFF VOLTAGE (VGS) (V) MIN	GATE – SOURCE CUT-OFF VOLTAGE (VGS) (V) MAX	CASE CONNECTIONS
2N 5457 (MPF 103)	25	1	5	310	0.5	6	4e
2N 5458 (MPF 104)	25	2	9	310	1	7	4e
2N 5459 (MPF 105)	25	4	16	310	2	8	4e
2N 5484	25	1	5	310	0.3	3	4e
2N 5485 (MPF 106)	25	4	10	310	0.5	4	4e
2N 5486	25	8	20	310	2	6	4e

UNIJUNCTION TRANSISTORS	INTERBASE VOLTAGE (V)	VALLEY POINT CURRENT (MA)		PEAK POINT EMITTER CURRENT (μA)	INTRINSIC STAND-OFF RATIO		INTERBASE RESISTANCE (Ω)		CASE CONNECTIONS
		MIN	MAX		MIN	MAX	MIN	MAX	
2N 2646	35	4		5	0.56	0.75	4.7k	9.1k	13
2N 2647	35	8	18	2	0.68	0.82	4.7k	9.1k	13
2N 2160	30	8		25	0.47	0.8	4k	12k	13

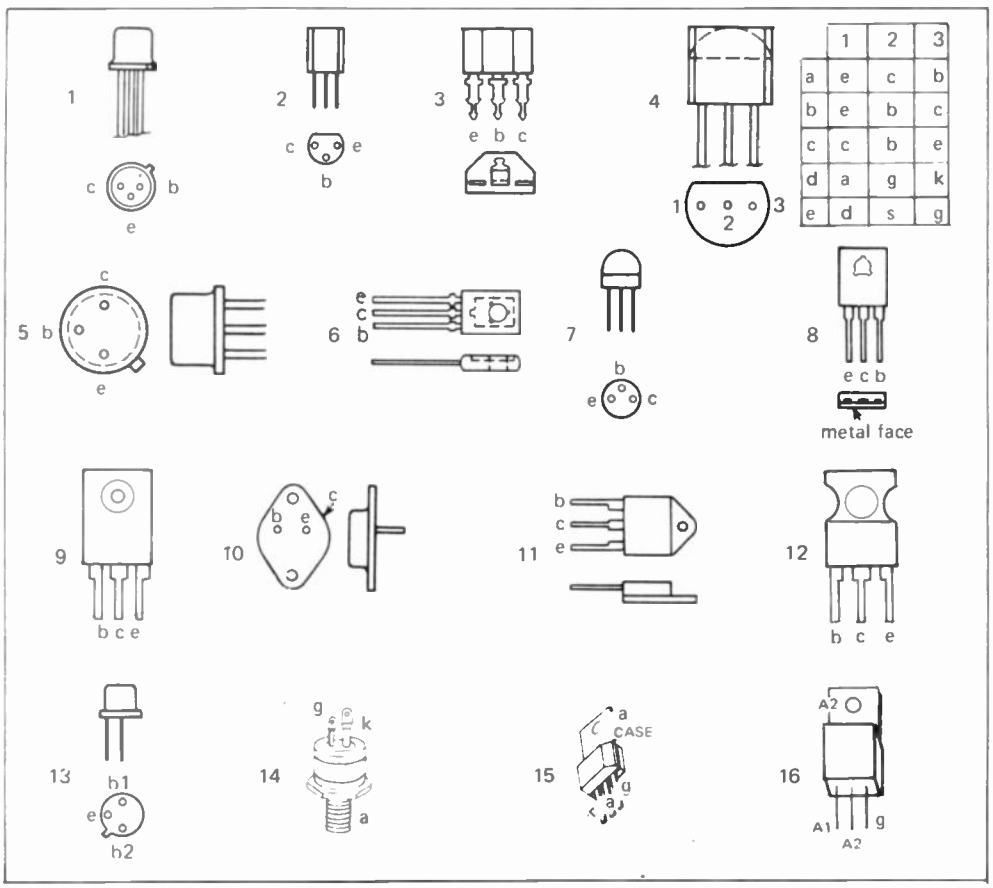
P.U.T.'s	ANODE-CATHODE VOLTAGE (V)	VALLEY CURRENT Rg= 1MHz (μA)	VALLEY CURRENT Rg= 10KHz (μA)	MAX PEAK – POINT CURRENT Rg= 1MHz (μA)	MAX PEAK – POINT CURRENT Rg= 10KHz (μA)	OFF-SET VOLTAGE (V)		CASE CONNECTIONS
		MAX	MIN			MIN	MAX	
2N 6027 (D13TI)	40	50	70	2	5	0.2	1.6	4d

	MAX RMS CONDUCTION CURRENT (A)	MAX SURGE CURRENT (ONE CYCLE) (A)	MAX GATE TRIGGER CURRENT (@ 25°C) (MA)	MAX GATE TRIGGER VOLTAGE (@ 25°C) (V)	MAX JUNCTION TEMPERATURE (°C)	CASE CONNECTIONS
C30*	25	250	25	1.5	100	14
C106*	4	20	0.5	0.8	110	15
TRIAC'S						
SC141*	6	80	50	2.5	100	16
SC146*	10	100	50	2.5	100	16
SC151*	15		50	2.5	100	

(*SCR and Triac Voltage suffixes: Y–30V, F–50V, A–100V, B–200V, C–300V, D–400V, E–500)

TRANSISTOR CONNECTIONS

Here are details and connections of solid-state components most commonly used in constructional projects.



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

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PKB70558

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Project Building Guide

BASIC BOOKS

Here's the basis for an electronics library — selected by ETI's technical editor, Brian Chapman. (Prices are approximate only)

BASIC TEXTS

- **Basic Electronics** Bureau of Naval Personnel, Dover Publications 1968 ($4.55).
  A thorough basic text designed for US Naval personnel. Is excellent value for money.

- **A Course in Radio Fundamentals** George Grammer, ARRL Publications ($4.25).
  Simply understood home course in radio fundamentals. Treats radio only, not general electronics.

- ABC's of Antennae Foulsham Sams ($4.00)
  Principles of propogation and antennas explained in non-mathematical terms.

- ABC's of ICs Foulsham Sams ($4.00).
  Describes various types of ICs and their applications in simple terms, although, some electronic knowledge is assumed.

- ABC's of Transistors Foulsham Sams ($4.00).
  How transistors work, how they are used in circuits, and how to fault find transistor equipment. Brief coverage of related devices.

- ABC's of FETs Foulsham Sams ($4.00).
  Simple introduction, in non-mathematical terms up to the principles of Field Effect Transistors. Application in practical circuitry is well covered.

- **Foundation of Wireless and Electronics** Scroggie, Butterworth Pty Ltd 1971 ($6.10).
  Basic electronics presented in an easy to read non-mathematical manner. An excellent text. Thoroughly recommended.

- **The Radio Amateur's Handbook** ARRL Publications 1975 ($7.50).
  Published annually, this 660 page book contains good basic theory and an excellent coverage of equipment and techniques of interest to the radio amateur.

- **Electronics It's Easy Vol 1** Electronics Today International 1975 ($2.00).
  Collected series of articles from Electronics Today is a complete introduction to the field of electronics in terms anyone can understand (available early 1975).

REFERENCE TEXTS

- **Radio and Electronic Laboratory Handbook** Scroggie, Butterworth 1971 ($16.80).
  How to set up your lab, the fundamentals of measurement, hints and tips for the serviceman and an extensive reference section. This is such an excellent book that it has been reprinted and updated eight times since it was first published in 1936!

- **Radiotron Designers Handbook** F. Langford Smith, AWA Valve Company Pty Ltd, 4th Edition ($).
  Although old, (pre-transistor) this is one of the standard reference texts. A wealth of basic theory, facts, hints and data, still of value to the designer and hobbyist, are included. Worth considering.

- **Reference Data for Radio Engineers** ITT, Howard W. Sams 1968 ($26.00).
  Nearly 1200 pages of reference data covering the entire field of electronics. Although expensive it contains just about everything you would need in an electronic reference book.

The right Pickering cartridge for your equipment is the best cartridge money can buy.

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XV-15/750E	Elliptical .0003 × .0007	1 ± ½ Gram	10 to 25,000 Hz	4.4 mV	35dB
XV-15/400E	Elliptical .0004 × .0007	1½ ± ½ Grams	10 to 25,000 Hz	5.5 mV	35dB
XV-15/350	Spherical .0007	2 ± 1 Grams	10 to 25,000 Hz	6.0 mV	35dB

Accessory Stylus For L.P. Records	L.P. Monophonic Records	Spherical .001	4 ± 1 Grams	10 to 17,000 Hz	8.0 mV	Monaural
Accessory Stylus For 78 r.p.m. Records	78 r.p.m. Monophonic Records	Spherical .0027	5 ± 2 Grams	10 to 17,000 Hz	8.0 mV	Monaural

Fred A. Falk (Sales) Pty Ltd., 28 King Street, Rockdale, NSW. 2216. 597 1111

Project Building Guide

BASIC BOOKS

Transistor Manual General Electric Co. 7th Edition 1964 ($4.95).
Over 650 pages of transistor theory, circuitry specifications and data. A must for every experimenter.

SCR Manual General Electric Co, 5th Edition 1972 ($3.50)
Nearly 700 pages of SCR theory, circuits, specifications and applications make this book terrific value.

Electronic Measurements Terman & Petit. McGraw Hill 1971 ($10.80).
A standard text of the principles and practice of measurements in electronics.

SPECIAL TOPICS

RCA Solid State Servicing RCA Institute Inc 1973 ($4.65).
An excellent book for the budding serviceman. It describes the common circuits used in a variety of consumer electronic equipment and the techniques of fault isolation. A host of servicing hints are given in this most valuable book.

Colour Television Theory Hutson. McGraw Hill 1971 ($12.50).
One of the best books available on the PAL colour system, it is clearly written, well illustrated and thorough.

Digital Electronics Price Ward. TAB Books Inc 1972 ($7.40).
An extensive coverage of digital techniques from simple gates to computer circuitry. Good value for money.

Digital Electronics for Scientists Malmstadt & Enke. W.A. Benjamin Inc 1969 ($18.14).
A truly excellent book containing an amazing amount of detail on digital principles and equipment. Many practical experiments are described. The reader requires a reasonably sound background in science or general electronics as the pace is swift.

Top Projects from Electronics Today, Electronics Today International ($2).
Volume I is now a collector's item! It can occasionally be found on out-of-way bookstalls. Volume II is still obtainable. Both contain a selection of the most popular projects from Electronics Today.

Pulse, Digital & Switching Waveforms Millman & Taub. McGraw Hill 1965 ($9.50).
If you want to design any sort of switching circuit you will need this book. A very thorough description of each type of circuit is given together with practical design examples. An excellent design aid to the advanced experimenter.

The Mazda Book of PAL Receiver Servicing D.J. Seal. Mazda ($18.50).
A truly excellent book on servicing colour TV sets. Well illustrated with plenty of colour photos.

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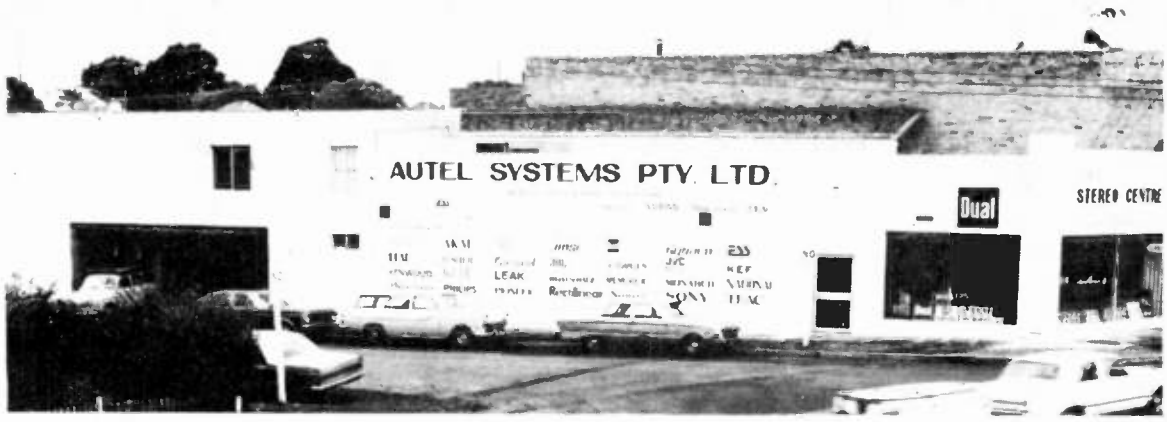

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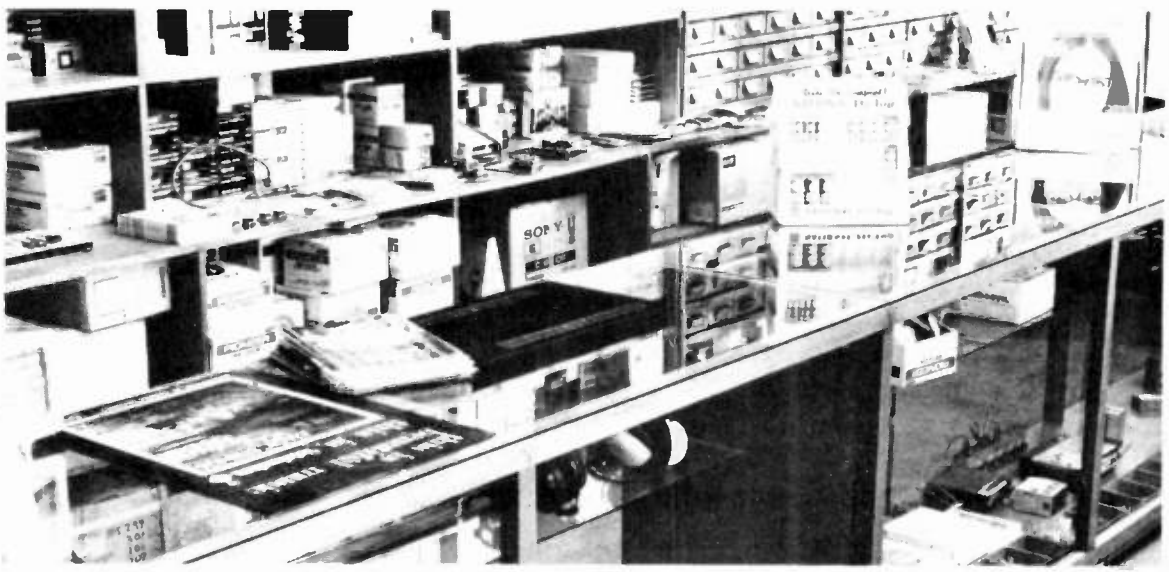

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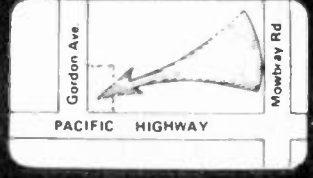

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VIC: Newvatron Sales, Factory 3, Moresby Ave, Seaford. Vic. 3201.
S.A.: K.D. Fisher & Co., 72-74 McLaren St, Adelaide
ACT: George Brown & Co. Pty Ltd. 23 Whyalla St., Fishwick
NZ: Avalon Radio Corp. Ltd., 131-139 Hobson St., Auckland
STATE DISTRIBUTORS:
WA: G. K. Cameron & Co. Pty. Ltd., 246 Churchill Ave., Subiaco
TAS: W. & G. Genders Pty. Ltd., Launceston, Burnie, Hobart
N T.: N. T. Musical & Electrical Wholesale Pty. Ltd., 54 Cavenagh St., Darwin

THE SYSTEME INTERNATIONAL

SI units — how and why they are used — Laurie Cachia explains

THE HOARY ARTIFACTS of antiquity yield but little insight into man's first attempts at scaling quantitatively. As early civilization brought with it the need to construct shelters, tools, weapons ... scalar units began to emerge. The Royal Cubit developed by the Egyptians is the earliest known unit of length and it was standardized in the form of a piece of granite about 510 mm long carrying the inscription of many smaller increments of length. The Greeks and then the Romans also used such a length unit.

The evolution of a multitude of units of measurement had a heyday in the Middle Ages. In England the inch, foot and yard were conceived, yet almost unbelievably, independently of each other. The inch was based on the length of three grains of barley laid end to end. The foot was the length of the foot of the reigning monarch and apparently took on new dimensions with each succeeding reign. The yard is reputed to have been the distance from the nose of the king to an oustretched thumb and later took on different lengths on a series of "standard" metal bars. Such was the precision of the basic blocks of a system that carried on to the present day.

The metric system was originated by the French as early as 1670 and by 1875 it had found acceptance by 17 nations who signed the international "Treaty of the Metre". The system has units subdivisible and multipliable by decimal factors, based upon the metre and the kilogram. Today all but a handful of nations use such a system.

AN INTERNATIONAL SYSTEM

Over the years many systems such as the centimetre-gram-second system (cgs) or the metre-kilogram-second system (mks) have come into prominence only to be later discarded. Both these systems recognize only three basic units and are metric, i.e. decimal, in structure. In fact the mks system gave birth to the now internationally accepted Systeme International (SI), or International System of Units which is based on the metre- kilogram-second-ampere (MKSA) and are standardized by:—

1. Metre (m), — length. The metre is the length equal to 1 650 763.73 wavelengths in vacuum of radiation corresponding to the transition between the levels 2_{p10} and 5_{d5} (orange-red line) of the krypton 86 atom, excited at the triple point* of nitrogen, 63.15 kelvin. *(The Triple Point is the temperature of equilibrium between the solid, liquid, and vapour status.)

2. Kilogram (kg) — mass: The kilogram is the unit of mass and it is equal to the mass of the international prototype of the kilogram.

3. Second (s) — time: The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of cesium 133 atom.

4. Ampere (A) — electric current: The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed one metre apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newtons per metre length.

To the four base units the supplimentary units of temperature, luminous intensity, plane angle and solid angle have been added and are defined by:—

(a) Kelvin (K) — temperature. The kelvin is the unit of thermodynamic temperature and is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water.

(b) Candela (cd) — luminous intensity: The candela is the luminous intensity, in the perpendicular direction, of a surface of 1/600 000 square metre of a black body at the temperature of freezing platinum under a pressure of 101 325 newtons per square metre. (The candela is considered to be a base unit of luminous intensity, although it is not completely a physical unit, as it involves the wavelength sensitivity of the average human eye.)

(c) Radian (rad): Plane angle subtended by an arc of a circle equal

in length to the radius of the circle.
(d) Steradian (sr): Solid angle subtended at the centre of a sphere by a portion of the surface whose area is equal to the square of the radius of the sphere.

Permittivity and permeability of free space are of special interest to electronic and electrical engineers.

Permittivity of free space E_o is a derived quantity and is expressed as the ratio of electric flux density D_o to electric field strength E_8 and has a value of 8.8542×10^{-12} farad/metre. Permeability of free space is also a derived quantity and is expressed as the ratio of magnetic flux density B_o to magnetic field intensity H_o and has a value of $4\pi \times 10^{-7}$ henry/metre.

The unit for pressure, N/m^2 has now also been given the name pascal, Pa = n/m^2. Electrical conductance which used to be stated in mkos is now stated in siemens, symbol S.

For the sake of completeness it should be mentioned that another supplimentary base unit has also been recognized in the SI system. This unit, the "mole", symbol "mol", is the unit of "Amount of Substance" but is not often used by electronic engineers.

THE DERIVED UNITS OF THE INTERNATIONAL SYSTEM

PHYSICAL QUANTITY	SI UNIT	SYMBOL
Area	square metre	m^2
Volume	cubic metre	m^3
Frequency	hertz	Hz
Density	kilogram per cubic metre	kg/m^3
Velocity	metre per second	m/s
Acceleration	metre per second per second	m/s^2
Force	newton	N ($kg\ m/s^2$)
Pressure	newton per square metre	N/m^2
Work (enery), quantity of heat	joule	J
Power (mechanical, electrical)	watt	W (J/s)
Electrical charge	coulomb	C
Permeability	henry per metre	H/m
Permittivity	farad per metre	F/m
Voltage, electromotive force	volt	V
Electric flex density	coulomb per square metre	C/m^2
Electric field strength	volt per metre	V/m
Assistance	ohm	Ω
Capacitance	farad	F
Inductance	henry	H
Magnetic flux	weber	Wb
Magnetic flux density	tesla	T (Wb/m^2)
Magnetic field strength	ampere per metre	A/m
Magnetomotive force	ampere	A
Magnetic permeability	henry per metre	H/m
Luminous flux	lumin	lm (cd sr)
Luminance	candela per square metre	cd/m^2
Illumination	lux	lx (lm/m^2)
Temperature	kelvin	K

HOW THE UNITS ARE WRITTEN

(a) SI unit symbols are written in small letters *except* when the unit has been named after a person. See table for example.
(b) Units written in full are *always* shown in small letters, whether named after a person or not. e.g. newton, kelvin, watt.
(c) A space should be left between number and symbol.
(d) Do not use commas to denote thousands and thousandths, but leave space instead.
(e) No full stop should be used after the symbol.
(f) Double prefixes are considered inappropriate e.g. 4 nm and not 4 mμm.
(g) Symbols are never shown in the plural e.g. 10 kg — not 10 kgs.
(h) Express quantities in the range 0.1 to 1000 e.g. 15 kg and not 15 000 g.
(j) No comma or space should be used if the quantity is only expressed in four figures. ●

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7405	Hex inverter*	.20
7406	Hex inverter buffer/driver*	.35
7408	Quad 2-input AND gate	.22
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7420	Dual 4-input NAND gate	.20
7430	8-Input NAND gate	.20
7440	Dual 4-input NAND buffer	.20
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7447	BCD-to-7 segment decoder/driver	1.00
7448	BCD-to-7 segment decoder/driver	.80
7450	Expandable dual 2-wide 2-input AND-OR-invert gate	.20
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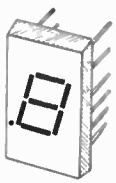

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COUNTER DISPLAY KIT—CD-2

This kit provides a highly sophisticated display section module for clocks, counter or other numerical display needs.

The RCA DR-2010 Numitron display tube supplied with this kit is an incandescent seven-segment display tube. The .6" high number can be read at a distance of thirty feet. RCA specs. provide a minimum life for this tube of 100,000 hours (about 11 years of normal use).

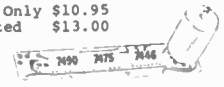
A 7490 decade counter IC is used to give typical count rates of up to thirty MHz. A 7475 is used to store the BCD information during the counting period to ensure a non-blinking display. Stored BCD data from the 7475 is decoded using a 7447 seven-segment decoder driver. The 7447 accomplishes blanking 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

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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.

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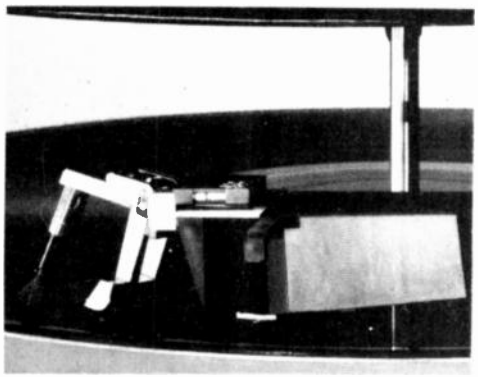

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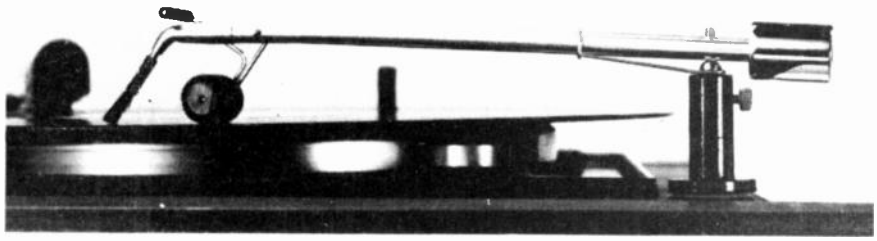
Reduces record and stylus wear and improves reproduction without the application of a liquid. Deluxe Model 42

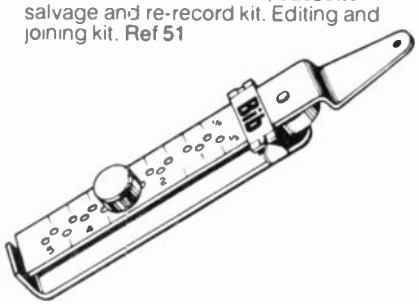
Record Care Kit
This popular priced kit contains GROOV-KLEEN automatic record cleaner to remove dust from grooves whilst playing, stylus cleaning brush, record duster and 2 record handlers. Ref 59

Recording Tape Splicer
For use with ¼"-6.3mm recording tape of any thickness. Invaluable for accurate tape editing. Model 20

AT16



Cassette Care Kit
Contains headcleaner, cassette salvage and re-record kit. Editing and joining kit. Ref 51



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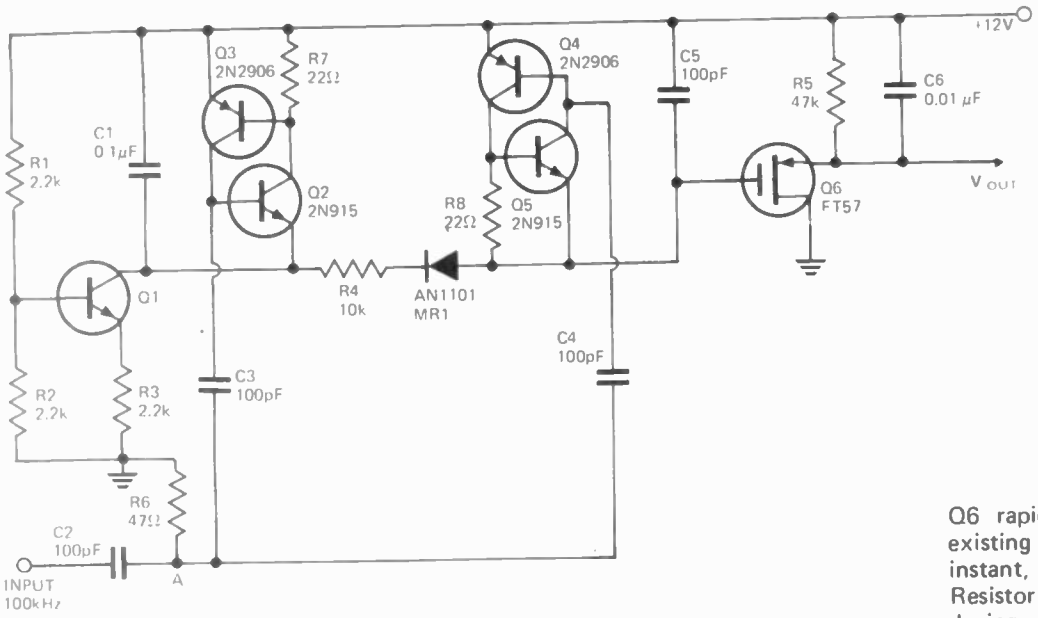
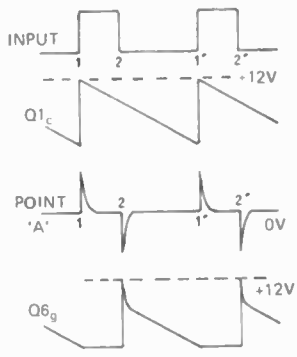
How to get the best Stereo and Mono reproduction and recording. Ref 53

INCREMENTAL FREQUENCY DETECTOR

Circuit's dc output is directly proportional to frequency of input – by Laurie Cachia





A MOST useful circuit is one that produces a dc output voltage that is directly proportional to the frequency of the input signal. In the circuit shown here, the output voltage versus input frequency characteristic is linear and changes of <1% in the period of oscillation can be readily resolved.

The enhanced accuracy of the circuit is due to the nature of the waveform at the gate electrode of Q6. Reference to Fig. 1a will show that the potential at the gate of Q6 is steady for a considerable portion of each cycle. The current through Q6, therefore, has a chance to stabilize and develops a steady potential across R5/C6.

The current generator Q1 charges C1 at a constant rate and the potential at the collector falls linearly with time, taking with it the gate of Q6.

The input waveform is differentiated by C2 and R6 and the waveform at point "A" is as shown in Fig. 1a Therefore at instant "2" of the input waveform, a negative going pulse is fed to the base of Q4 via C4, Q4 conducts and since its collector is connected to the base of Q5, Q5 also conducts. The collector of Q5 is connected to the base of Q4 and conduction of Q5 drives Q4 further into conduction. The effect is cumulative and ends in the discharge of C5 and the gate of Q6 being taken to +12V. Both Q4 and Q5 then cease to conduct and the gate of Q6 rapidly returns to the potential existing at the collector of Q1 at that instant, and continues falling with it. Resistor R4 serves to isolate $Q1_c$ during the conduction period of Q4/Q5.

At instant "1" (and 1' etc.) of the input waveform a positive pulse is fed via C3 to the base of Q2. Transistor Q2 conducts causing Q3 to conduct which in turn causes Q2 to conduct harder. Again the effect is cumulative and ends in the discharge of C1 and the collector of Q1 being taken to +12V. MR1 is now reverse biased and the gate of Q6 retains a steady potential until Q4 and Q5 are again brought into conduction.

The cycle of operation then repeats.

The amplitude of the potential at the gate of Q6 during period 1-2 of the input waveform is proportional to the duration of period 1 – 1' of the input waveform and hence to the frequency of the incoming signal. Any change in the frequency of the signal is therefore translated into a change of potential at the gate of Q6.

Transistor Q6, which is a FET having an input impedance of the order of $10^{10}\Omega$, is connected in the common source configuration to give a low impedance output.

The main application of the circuit is in the field of telemetery where the accuracy achieved compliments the accuracy of the transducers.

Other uses are feedback control of systems employing sinusoidal or square waveforms and in analogue counting of cyclic events. ●

UNDERSTANDING COLOUR TV

by Caleb Bradley B.Sc.

Line and field synchronization

LINE SYNC PULSES occur at the start of every scanning line and are used to time the line scan circuit. This consists of a line frequency (15 625 Hz) oscillator which drives magnetic deflection coils mounted on the display tube. The line deflection waveform, provided by a high power output stage, is sawtooth shaped i.e. a smoothly increasing current to sweep the scanning spot from left to right followed by a rapid return to the starting value to cause an almost instantaneous right-to-left flyback to the start of the next scanning line.

How do the line sync. pulses control the line scan? Although it is possible to apply them as trigger pulses to the line oscillator (the same way the timebase oscillator in an oscilloscope is triggered), a flywheel sync. circuit is more usually used to obtain better results from weak or interference-prone signals. The basic arrangement is shown in Fig. 36.

The line oscillator is a tuned circuit type containing a voltage controlled reactive element to allow control of phase. The idea is similar to the voltage controlled oscillator in the decoder (last month) except that since the working frequency is too low for varicap diodes to be useful the voltage controlled element is usually a transistor whose conduction during each cycle is arranged to simulate an inductor.

The 'flywheel discriminator' is really a simple driven clamp. A sample of the line scan waveform is applied to it via C1. Also applied are the line sync. pulses which are differentiated by C2. The leading edge of each pulse causes both D1 and D2 to conduct. This clamps the instantaneous value of the waveform from C1 to 0 V. The waveform is fully integrated by R1/C3 to give a dc voltage which controls the phase of the line oscillator. Clearly the value of this voltage depends on which part of the feedback waveform is clamped to 0 V.

When the line scan is synchronised correctly, the clamp operates at A in Fig.36. Should the scan begin *later* than required, point B is clamped instead. Since more of the waveform is now above 0 V the voltage on C3 moves positive. If the reactance control is arranged so that this increasing voltage *advances* the line phase the error will be rapidly corrected and the clamp point return to A. Conversely, leading scan phase (clamp at C) is corrected by decreased voltage on C3.

This simple arrangement achieves excellent performance because the steep flyback slope C-A-B gives very high phase-correction gain. The integrator R1/C3 gives the circuit its phase inertia or 'flywheel' property. For example the line scan is unaffected if an occasional sync, pulse is lost or distorted due to interference.

Since the line oscillator is tuned close to the correct frequency by a stable L-C circuit the pull-in range of the flywheel sync. circuit can be made small. In terms of phase gain, this means a high gain at dc with the first low-pass pole at a low frequency, obtained by giving R1/C3 a long time constant. This gives relative immunity to any interference which may get through the sync. separator. In colour the accuracy of the line scan is vital because of the several timed functions derived from it.

FIELD SYNCHRONISATION

The field scan requires a sawtooth shaped current drive to the field (vertical) deflection coil on the display tube. This causes the scanning spot to be deflected from top to bottom of the screen at a comparatively slow rate (taking 20 milliseconds during which there are 312½ line scans) followed by a fairly quick flyback to the top for the next scan.

Since the field sync. pulse is obtained by integration in the sync. separator it is less susceptible to noise than the line pulses and this allows simple

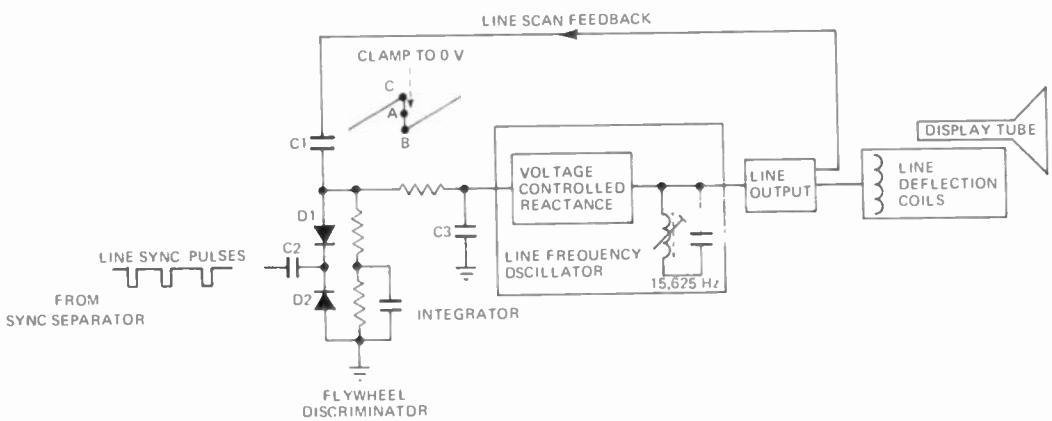


Fig. 36. A modern field scan circuit using an SCS (silicon controlled switch) oscillator.

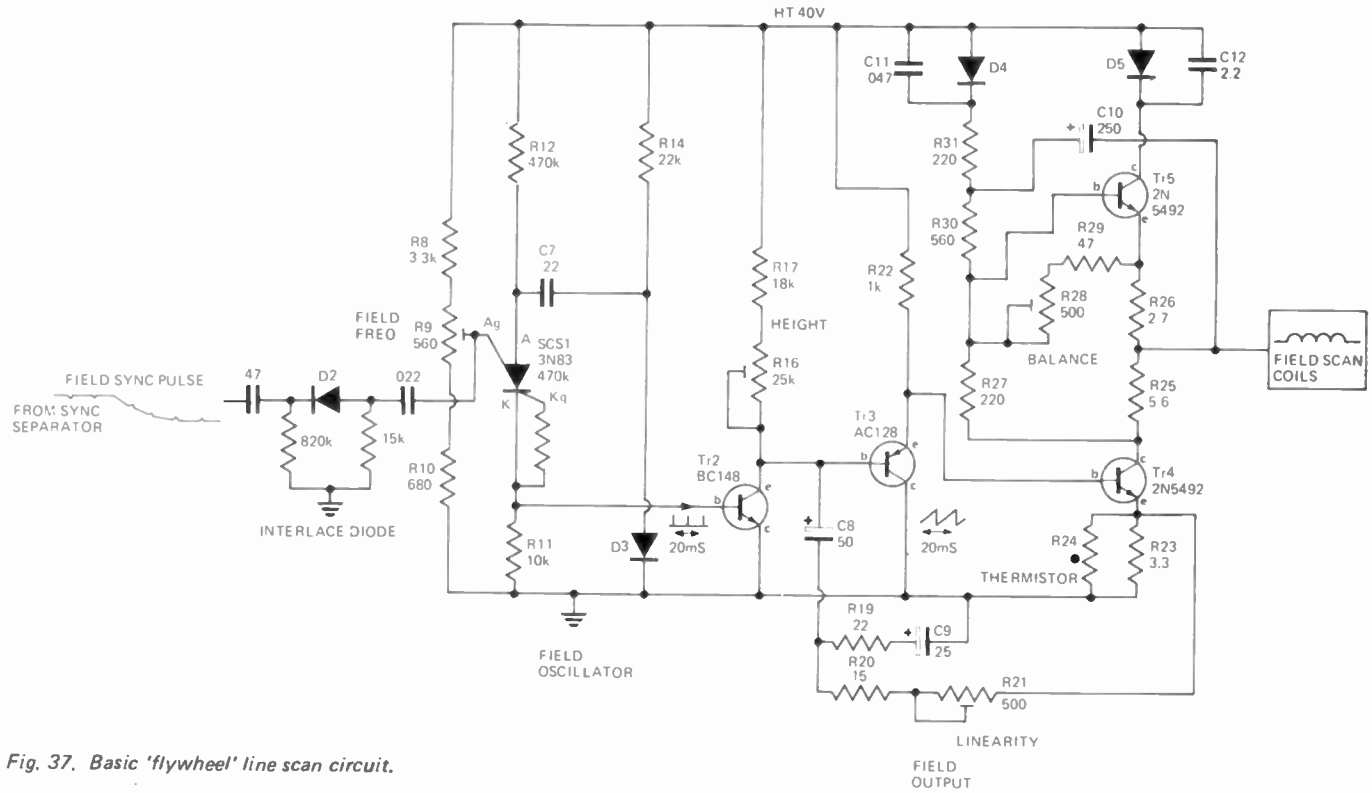


Fig. 37. Basic 'flywheel' line scan circuit.

synchronisation by direct trigger of the field oscillator. This drives the field output stage which provides the sawtooth waveform for the field scan coil. Various well known oscillator circuits are used such as multivibrators, blocking oscillators, etc. Recently a simple circuit using a silicon controlled switch (SCS) has become popular. This is a four-layer diode device with internal regeneration which resembles a thyristor (SCR) but has an extra electrode ('anode gate') which gives new means of triggering. Like the thyristor it has two states: 'off' state i.e. no conduction, followed after the trigger condition is met by the 'on' state where anode to cathode current flows. A modern field circuit is shown in Fig. 37.

CIRCUIT OPERATION

In Fig.37 the trigger condition for SCS1 occurs when the anode voltage exceeds the anode gate voltage. Regard the anode gate voltage as fixed by the divider R8/R9/R10. At the start of the scan SCS1 is off. Current from R14 keeps D3 conducting so the right hand side of C7 is held near 0 V. The anode voltage of SCS1 rises as current from R12 charges C7. After 20 MS this voltage reaches the anode gate voltage and SCS1 is triggered on. It now discharges C7, current having to flow through R11 and R14 (since D3 blocks). When the discharge current decays below the holding current for SCS1 it turns off and the next cycle begins. Thus the scan period is set by the time constant R12/C7 and the flyback period is set by the shorter time constant R14/C7.

Synchronisation is achieved by applying negative-going field sync. pulses to the anode gate. The anode voltage required to trigger SCS1 is thereby much reduced so each flyback is initiated by a sync. pulse. The preset R9 is only needed to set the free-running frequency in the absence of a signal. The diode D2 stabilises the triggering point and thereby ensures accurate interlace of successive fields.

FIELD OUTPUT

The field scan sawtooth is produced by C8 charging via R16/R17. The field-rate pulses developed across R11 in the oscillator briefly turn on Tr2 which rapidly discharges C8. The resulting sawtooth at Tr2 collector is fed via emitter follower Tr3 to the output transistors. These operate – despite first impressions – in Class A.

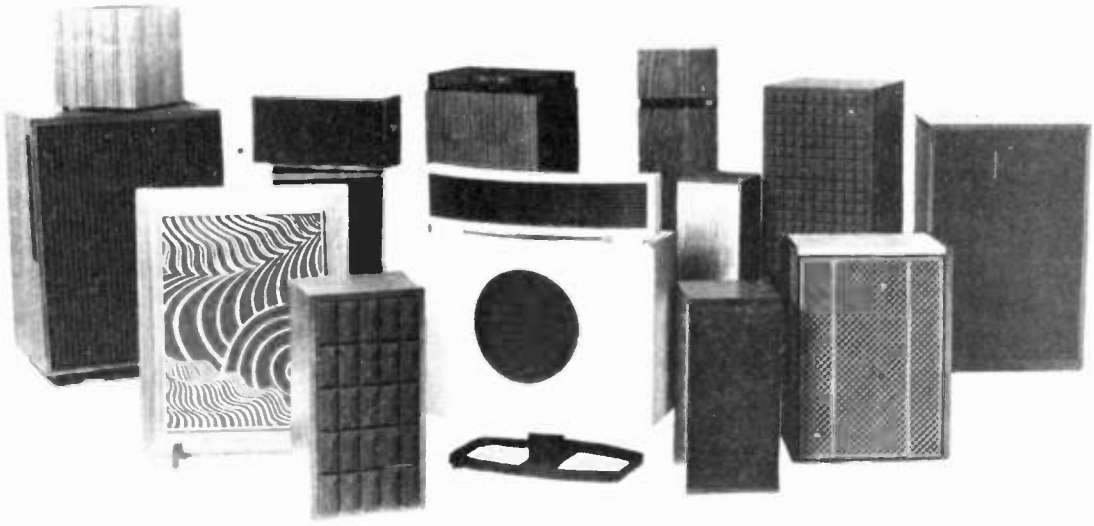
At the start of the scan Tr3 is bottomed with its emitter near 0 V. Hence Tr4 is off and no current flows in R23. About half h.t. voltage is present at the junction of R25 and R26. The values of R27, R28, R29 are chosen so Tr5 is conducting when Tr4 is off. During the scan Tr4 draws increasing current and the voltage developed across R25 progressively reduced the conduction of Tr5. When the flyback begins, Tr4 is cut off by Tr2/Tr3 clamping its base to 0 V. The energy stored as current in the scan coil causes the emitter and base voltage of Tr5 to rise; when they reach h.t. the diode D5 cuts off and the scan coil 'rings' with C12 to produce a large positive half-sinewave. The voltage across the coil then gradually decreases into the next scan as Tr4 conducts again.

The bootstrap capacitor C10 provides correct base drive for Tr5 and prevents unwanted direct currents in the scan coil.

Without correction the waveform at Tr2 collector would be exponential rather than linear and this would result in compression of the lower parts of the picture. Correction is achieved by feedback from the output stage emitter resistor R23 via parabola-shaping network R19-R21/C9 placed in series with the 0 V return of C8. Many sets have a second field linearity control which affects the very top of the picture only. This acts by differentiating the The thermistor R24 is a simple means of stabilising the picture height against temperature and supply voltage changes.

NEXT MONTH:

the shadowmask tube
and how to drive it.



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PART 18

Generating non-sinusoidal waveforms.

THE UNIJUNCTION TRANSISTOR

The unijunction transistor, UJT for short is a three terminal semi-conductor device somewhat akin to the normal transistor. The exception is that by appropriate choice of the manufacturing placement and thickness of material, it has entirely different characteristics between the currents and voltages of its three terminals. It becomes a device in which a current flows once it is triggered on. It features a stable triggering voltage Vp, a very low value of firing current Ip, a negative resistance region (where a rise in voltage between terminals is related to a fall not a rise in current) and a high current carrying capacity once it has been pulsed on. As there are 50 different kinds we can only give a general impression of their operation here. The symbol is shown in Fig. 1.

When the emitter, E, is reverse-biased no current can flow between B_1 and B_2 bases. When V_E rises sufficiently it alters the state between the bases and, quite sharply, I_{B2} commences to flow. This is seen by studying the representative static emitter characteristic curve given in Fig. 2.

Until V_E rises to close to Vp (the actual value depends upon the standing value of V_{BB} and ranges typically from 3 V to 20 V for V_{bb} of 4 V – 30 V) I_E remains virtually zero. After the I_{EO} value, emitter current can be absorbed and V_E drops back exhibiting a negative resistance region. In the unijunction, therefore, the equivalent of the collector-emitter current, flow of normal transistors takes place between the emitter and base 1; base 2 acting as the input that decides at which point the circuit goes into the conduction state.

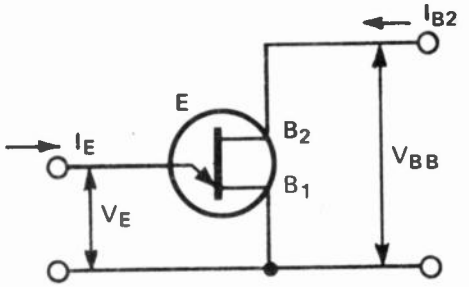


Fig. 1. The basic unijunction symbol.

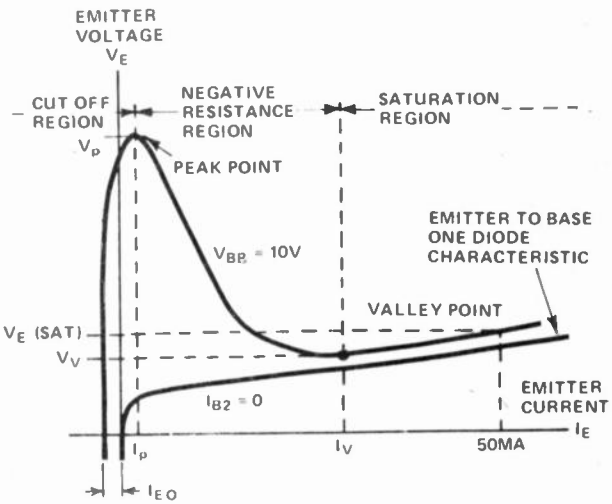


Fig. 2. The unijunction characteristics.

A BRIEF description of how a cathode ray oscilloscope operates was given in part 4 of this course. There we saw how a sweep generator is used to provide a signal that causes the spot to sweep across the screen thus tracing the waveform. A television receiver uses the same principle as indeed, does a television camera also. This effect is achieved by steadily increasing the voltage applied to a deflection plate (or deflection coil in a TV system). When the spot reaches the limit of travel needed it is swept back again, by reversing the voltage change, so that it eventually arrives back at the original level. If the rise and return of such a waveform are both at the same rate the resultant waveform is triangular; if the waveform returns to the starting point virtually instantaneously – it is a saw-tooth. Sweep times required vary from hours down to a few nanoseconds depending upon the particular application.

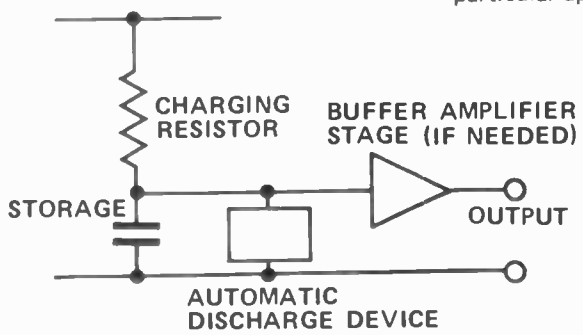


Fig. 1. Functional block diagram of basic relaxation oscillator.

A common use of saw-tooth-like signals is in the modulation of tones – eg, the rise and rapid fall of modern police sirens. The tones used in some telephone systems and in organs and electronic music synthesizers are other well known examples of the application of saw-tooth waveforms.

Most simple sawtooth generators are based upon what is known as the relaxation principle. In this method a capacitor is charged (Fig. 1) though resistor, R, which limits the current and hence the rate of rise of voltage across the capacitor. When the voltage across the capacitor reaches a preset limit, some form of device is actuated that discharges the capacitor back to its initial point. Inductors could also be used in a similar manner but the use of capacitors is more usual. Once the capacitor is discharged the device becomes inoperative and the voltage rises again to repeat the cycle. The simplest form of relaxation oscillator

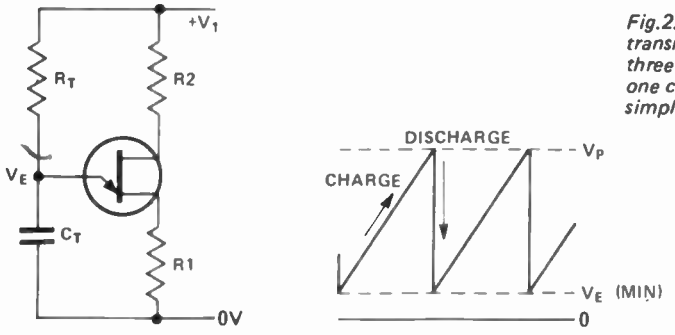


Fig.2. The unijunction transistor together with three resistors and one capacitor makes a simple sawtooth generator.

uses no more than a capacitor, a resistor and a neon lamp as the device to discharge the capacitor. The details of this method were given in Part 7.

As with most of electronic technique (and life in general) the simplest method is not necessarily the best. The neon method requires a high voltage supply, by today's standards, and the charge and discharge slopes are exponential rather than straight linear rises and falls.

Improvement can be made by making the charge process more linear, that is, by using a method that gives a purer integration. The first steps toward improvement are to use a much smaller part of the exponential charge curve of a capacitor, for this will be more linear, alternatively we can provide a more linear charge technique. These methods however, usually call for a more sensitive trigger to discharge the capacitor, that is, an active trigger element. Whereas it is quite feasible to use transistors as discharge elements the more practical method, usually employed in relaxation designs, is based upon a device known as the unijunction transistor.

The unijunction transistor has three terminals labelled base 1, base 2 and emitter. The emitter to base 1 resistance of a unijunction is normally very high, however, when the emitter is raised to a voltage known as the peak point, emitter to base 1 resistance drops to a very low value. This property may be used quite effectively to discharge a capacitor once it has reached the peak point voltage of the unijunction.

In the circuit of Fig. 2, capacitor C1 charges through R_T from source V_1 therefore, no emitter to base circuit is made. When V_E reaches the peak emitter voltage V_p of the unijunction (decided by the circuit values R_1, R_2) the unijunction changes state and the emitter to base-one resistance falls to a low value. This discharges C_T through R_1. When the voltage has fallen to V_E(min) the emitter to base 1 discharge circuit becomes a high resistance again and the cycle repeats. Provided R_1, R_2 have small values compared to R_T the oscillation frequency is given by

$$f = \frac{1}{R_T C_T \ln\left(\frac{1}{1-\eta}\right)}$$

where η is the intrinsic stand-off ratio quoted for the unijunction device. It has values typically around 0.6.

If V is kept large compared with V_P the capacitor is charged from a more constant-current source improving linearity. With this technique the linearity, however, still has an error of 10% or so. Using a separate, even-higher charging voltage further improves linearity but at the expense of a more complex supply. Another method is to use a transistor in the charging path to provide constant-current flow to the capacitor.

A much superior circuit is given in Fig. 3. The capacitor C_2 and the output buffer stage improve the linearity by stabilising the voltage across the charging resistor feeding the 100 ηF capacitor. Components R_1 and C_1 are added as an integrating compensating network that further improves the linearity of the charge process. Variation in R_1 is provided to trim the wave shape rise characteristic from concave through linear to convex. As shown, the circuit generates a 1 kHz sawtooth. Note the ability to provide two anti-phase signals and the input that enables the system to be started in synchronism with an external event – as is required to trigger, say, a CRO trace upon demand.

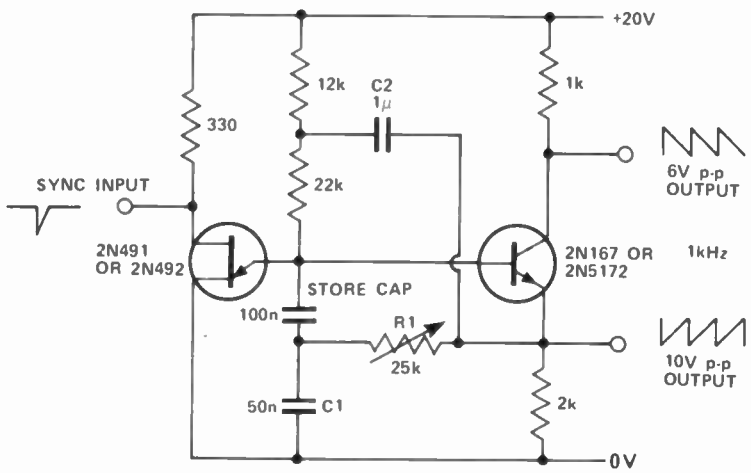


Fig.3. This generator adjusts the sawtooth to a high degree of linearity.

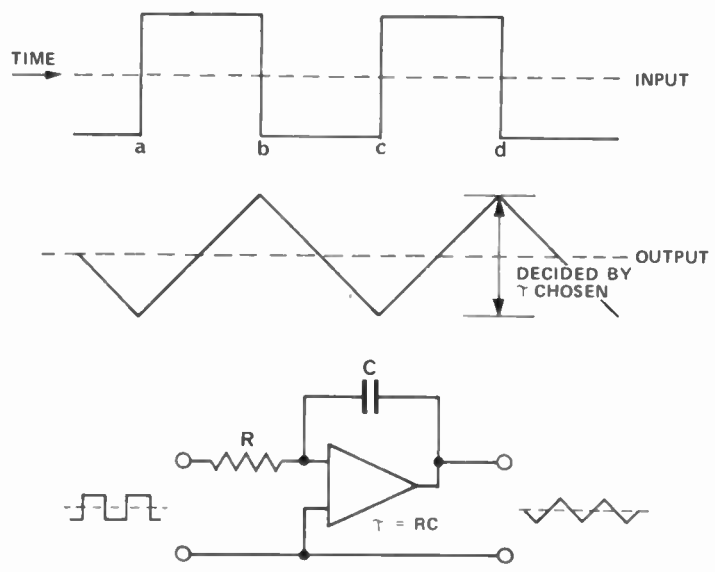


Fig.4. A symmetrical triangular wave may be generated by integrating a square wave.

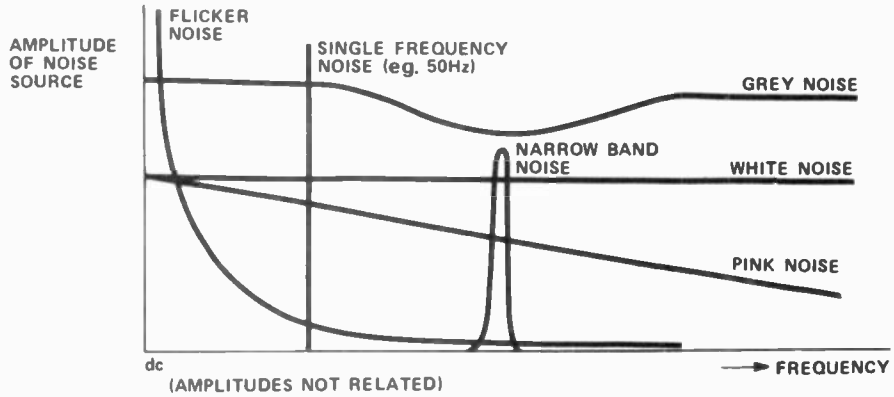


Fig.5. Frequency spectra of commonly encountered noise sources.

NOISE GENERATION

So far we have said little about noise, that generally unwanted signal that must (usually) be kept to a satisfactory minimum in circuit design. Indeed, it might seem strange that we should sometimes want to *generate* it, when the usual aim in design is to eliminate it.

By appropriate design, relaxation oscillators can be made to provide sawtooth, triangular and pulse wave shapes. They are also the basis of timing circuits – for the time-constant of the capacitor and the trigger relaxation level effectively defines a time interval.

Yet another way to produce a sawtooth is to generate a number of sinewave signals of chosen frequencies and amplitudes covering the spectrum of the sawtooth. These can then be combined to produce the sawtooth. This method is suitable for synthesizers or other precision generators but would normally be prohibitively expensive – over ten generators would be needed to provide a reasonably accurate waveshape.

A symmetrical triangular waveform may be generated by starting with a square-wave source and integrating it with an op-amp type of integrator. This is shown diagrammatically in Fig. 4. At point 'a' the integrator output starts to rise in the positive direction. When the square wave reaches 'b' the integrator input reverses and the output starts to fall until 'c' is reached. It is, however, not fundamentally possible to have different rise and fall times if the amplitude is to be held constant: different rates require different integration time constants for both directions of signal change.

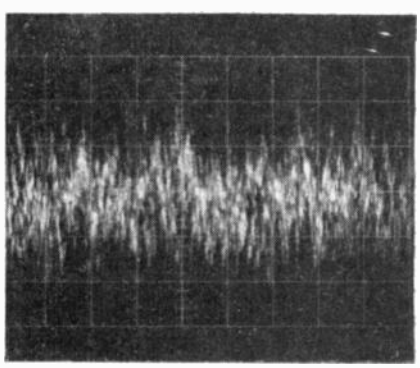


Fig.6. How random noise looks on a CRO screen.

Although noise may be any unwanted signal and, therefore, can consist of any combination of an enormous variety of waveforms, the noise usually referred to will be what is known as random noise. Random noise is a signal that has the interesting, but frustrating property that one cannot predict the exact level of signal at any particular instance. We can only characterise it by the use of random statistics that will tell us, if we know the type of noise, the *chances* of certain levels occurring at a given time.

Various kinds of noise are termed white, pink and grey. Each is typified by the nature of its frequency spectrum. White noise, the usual one considered (but in reality not always the one that really occurs) has equal energy at all frequencies. The energy level of the signal will be the same at 1 kHz as it is at 100 kHz. There is equal noise energy at all frequencies with white noise. In practice noise energy may fall off uniformly with rising frequency (pink noise), or it might not be quite white in that there may be variation in energy at various points of the spectrum (grey noise).

Unwanted white noise mainly arises due to thermal agitation in resistors. This effect is called Johnson noise. It is a basic effect that can only be reduced by reducing resistance values, or by operation at lower temperatures.

As noise exists at all frequencies, reducing the band-width of a system reduces the total noise power occurring at the output.

Another noise phenonemon is known as excess or flicker noise. It is also sometimes called 1/f or hyperbolic noise. This is noise that rises in level as the frequency is reduced. It occurs in all semi-conductors. It is usually less than the resistor-generated white noise (above 1 kHz) so is not a problem at high operating frequencies. The various types of noise are depicted by a representative plot of their frequency spectra as in Fig. 5. In contrast to noise of the random kind the spectrum of induced 50 Hz hum is a single line. Random noise, usually presumed to approximate white noise, appears as shown in Fig. 6 on an oscilloscope screen. Audibly it sounds like hiss because the ear is most sensitive to frequencies in the 1.5 – 6 kHz region, thus the ear subjectively attenuates frequencies above and below these rough limits.

The amount of noise generated internally in an electronic system is a limiting factor. The noise performance is usually specified as the *noise figure* of the system. Noise figure is the ratio of signal-to-noise at the output to signal-to-noise at the input expressed in decibels. Thus a noise figure of 2 dB is much better than one of 6 dB.

One way of ascertaining the noise contributed by a system is to measure the total output power of the system under test with a suitable driving (wanted) signal and then without the test signal. The residue is noise power. The usual method of stating noise power is as the RMS level of the random process.

In another class of tests, noise of a known level and character is added until the noise output of the system is doubled. The amount added then equals the amount internally generated.

White noise generators can be built using a wide-band amplifier to raise the signal level of Johnson resistor noise. This method, however, is seldom used in practice due to the comparatively lower noise output from resistors compared to other alternatives.

For example, a Zener diode generates much more intense internal noise than does a resistor. Two simple noise generating circuits are given in Fig. 7. One, Fig. 7a, will provide white noise suitable for audio work. Capacitor C_2 (if added) filters the output reducing the noise level as the frequency rises – thus providing pink noise. The other, Fig. 7b, is suited to VHF work as the bandwidth extends beyond 150 MHz. Resistor R is adjusted to pass about 6 mA through the circuit. Capacitor C_2 should be a ceramic capacitor. Output

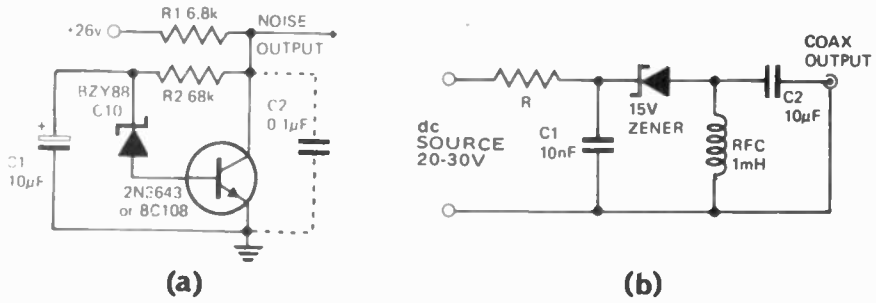


Fig.7. Two noise generators. (a) noise generator suitable for audio work. (b) for VHF use.

via a coaxial cable, in this case, is essential to preserve the bandwidth of the signal.

Another noise source sometimes encountered relies on the variation of contact resistance in an electro-chemical cell – this produces a good signal at relatively low frequencies. It is also possible to approximate noise in certain cases as a binary (that is, two-state only) signal that switches between states in an apparently random fashion – such generators are called pseudo-random binary sequence generators, PRBS for short. These generate their signal by virtue of specially connected ring-counters, a technique we will study later in the series. The output of these can be averaged with a CR filter to provide analogue noise.

NON LINEAR AND NON-REPETITIVE ANALOGUE WAVE SHAPES

The waveform producing circuits considered so far generate sinewaves or linear ramps. In some instances the need may be for a special shape other than those producable by standard circuits. If you are lucky the distortion of some oscillators may be the waveform needed – the exponential rise of single relaxation oscillators can sometimes suit the non-linear characteristics of CRO tube deflection systems.

Provided the cyclic frequency needed is not too high, that is, up to about 10 kHz, it is possible to make use of an optical-disk generator. In this method a transparent disk, on which is placed a mask of the required signal shape rotates at a controlled speed. Light passing through a portion of the disk is integrated by a photo-detector and collection system providing an output proportional to the degree of masking at each point. Figure 8 shows disks suitably masked to provide random noise, sawtooths and heart beats. This method is admirably suited to the generation of very low frequency complex waveshapes – down to 0.001 Hz but suffers from the possible disadvantage that the waveshape period is rigidly related to frequency. It is not possible to retain a fixed cycle time with changing repetition rate.

Given a mini-computer facility it is possible to generate any waveshape as a repetitive event, or as a "one-shot" event, by controlling the signal flow with time. In hybrid computer operations (those combining analogue with digital methods) the mini-computer operates switches that gate voltages to the output. Each change in the circuit alters the rate of rise of the output, that is, the instantaneous slope is controlled. It is, therefore, possible to create a waveshape by successive linearisation of the originally smooth curve into one made up of a string of different slopes joined end to end. The number of stages used decides the degree of accuracy of generation.

It is also possible to generate unusual voltage-versus-time functions using diodes in conjunction with op-amps. Figure 9 shows the schematic diagram of an analogue, op-amp set-up that generates an output voltage as would come from, say, a potentiometer driven back and fourth by a badly worn mechanical linkage. It also simulates gear backlash and a crude approximation to magnetic hysteresis. All resistors are equal and the integrator time-constant is very small. As it rises from zero there is no change in I_o initially, as there is no current flow into the integrator because of the reversed-biased state of the diodes. When the input reaches, say E_2 a diode conducts, starting the integrator which operates until the output causes the same diode to cut off. If e_i now decreases, the output is held high since the integrator cannot discharge until e_i falls to a value which causes the other diode to conduct. The functional relationship between input and output that results is that depicted in Fig. 9. This example shows how seemingly difficult-to-produce functions can in fact often be quite easily produced using op-amp techniques. The batteries are included to set the voltage at which the diode conducts. The need for batteries may be eliminated by using Zener diodes in place of the simple diodes used in Fig. 9.

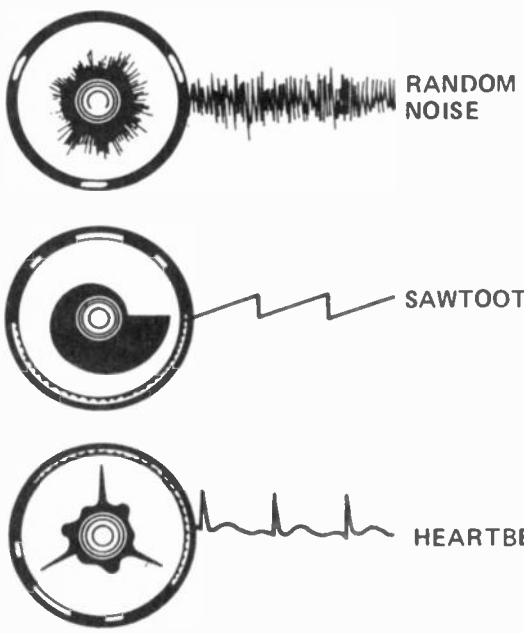


Fig.8. Complicated wave shapes may be generated by opto-mechanical methods. A specially masked disc, as it rotates, is used to vary the amount of light transmitted to a photocell.

SQUARE WAVES

Square and rectangular waves are most important in digital circuitry because they have signal levels that can be only one of two definite states. (the transition times being considered negligible). They also are used as the starting point for generating pulse trains in which the signal consists of narrow pulses. Three main methods are used to generate square waves. Two start with sinewaves, converting them to square waves, the other generates the square wave directly from a dc voltage.

If a sinewave of the same frequency as the squarewave needed is greatly amplified, the slopes of the sinewave at the zero crossing point are raised more toward the vertical. Also if the amplifier is overdriven the upper and lower limits of the original sinewave will be clipped. A crude square wave results. A more positive clipping

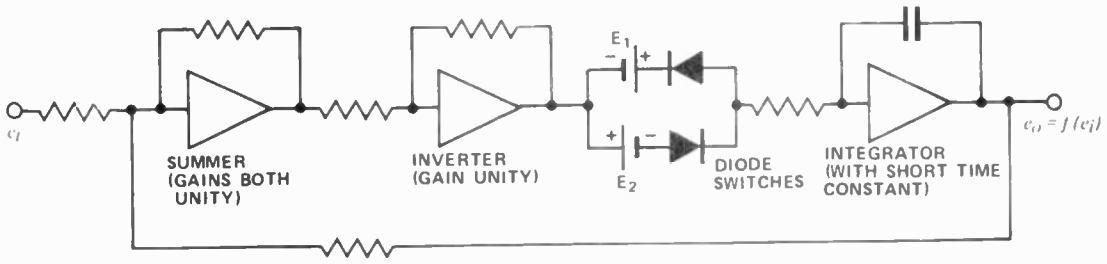
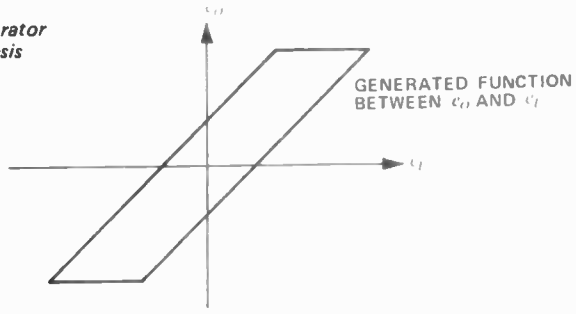


Fig.9. Special diode function generator for simulating backlash or hysteresis characteristics.



process uses two oppositely connected zener diodes placed across the output, as is shown schematically in Fig. 10. If the process is repeated two or three times a quite reasonable square wave results with fast rise-times and clean tops.

A second way, originating from a sinewave, uses a special circuit called a Schmitt trigger. In this circuit, another of the basic family of digital circuits, the output is either low or high depending upon whether the input-voltage level is above or below (respectively) a preset input level. Although the input can exist at any analogue level the output will always be only in one of two states. To produce square waves a sine-wave is fed into the Schmitt trigger which is set to trigger at the point where the symmetrical sinewave passes through zero. The result is a square wave, if the trigger level is exactly at zero, or rectangular if above or below. The advantage of this method is that very low-frequency square waves can be generated.

A typical Schmitt trigger circuit (Schmitt first described this two-state circuit in 1938) is given in Fig. 11. For the values given the output swings from its high value of 12 V to a low value of 1.0 V when the input passes through 1.8 V on the way up. The output swings back again as the input goes through 1.0 V on the way down. The difference between the up and down trigger levels is known as hysteresis (or backlash). Design methods exist that enable the trigger level, backlash and output swing to be set as required. To produce symmetrical square waves from a sine-wave source, with this circuit, the sine-wave would have to have its dc zero placed at 1.5 V. The 150 pF capacitor is added to reduce the impedance of the 1.8 k resistor at high frequencies, that is, whilst the circuit is switching. It is called a "speed-up" capacitor.

As well as being a convenient way to produce square waves, the Schmitt trigger also provides a mechanism whereby a hesitant effect is made positive. Take for example the case where daylight is used to operate a street lamp. As the light falls to around the operating point a relay-switch would chatter on and off with minor changes, until the average light level had fallen below the critical region. By adding a trigger circuit with reasonable amount of backlash, the relay is made to switch on the first time the light falls below the preset level. The relay cannot again change state without a significant rise occurring in light level.

The third way to produce square waves is to generate them using another digital circuit building-block, the free-running multi-vibrator or astable as it is also called.

There are three main types of multi-vibrator — astable, monostable and bistable. The astable automatically switches continuously between two states, thereby producing a square or rectangular wave signal. The monostable is normally in one state, and is triggered by an input signal into its second state. It stays there for a predetermined time before automatically toggling back again thus producing a fixed-length, single, square pulse. The bistable (or flip-flop), toggles from one state to the other with each successive input control pulse. It thus gives one output pulse for every two input pulses.

Each type can be used to produce "square" wave signals — the astable as a free running source, the monostable and the bistable as sources initiated by a train of pulses or changing levels.

Basically each type of multi-vibrator is formed from two common-emitter stages that are coupled together with impedances as shown in Fig. 12. This provides positive feedback from one stage to the other causing the device to always be in one state or the other — never between states for any length of time. This kind of impedance — resistors, capacitors or a mixture — determines the kind of positive feedback applied, and hence which of the three functions is generated.

Free-running astable — here the impedances are identical in both sides and are capacitors. Bias, or charging, resistors are added to each base as shown in Fig. 13. A suitable circuit for generating a 1 kHz square wave signal is given in Fig. 13a, Figure 13b is another circuit that will flash a small lamp at 1 Hz. Astable design is reasonably easy and is fully explained

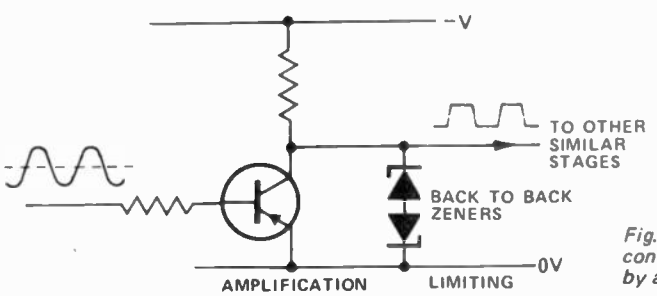


Fig.10. A sinewave may be converted to a squarewave by amplifying and clipping.

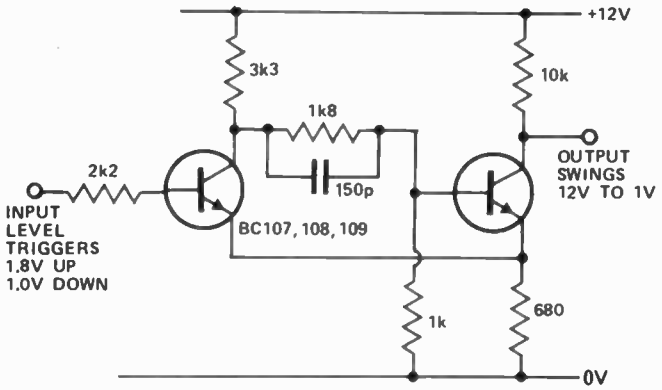


Fig. 11. The Schmitt trigger circuit.

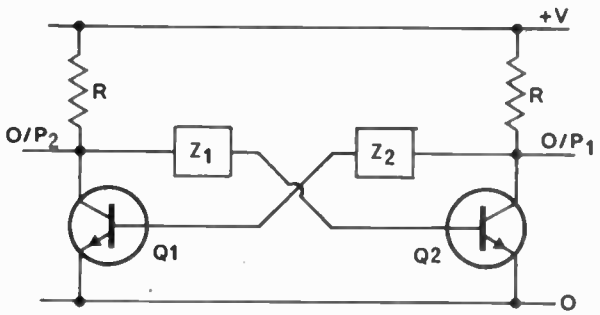


Fig. 12. The basic arrangement of the multivibrator family of circuits.

in numerous books, especially those devoted to digital circuitry. The period of the square wave produced is given approximately by T = 1.4RC (refer Fig. 13a) from which the frequency f = 0.7/RC. The other main requirements needed is to ensure that the transistors are capable of handling the current demands of R_L when switched on. The output can be taken from either collector – the two are said to be complementary, that is, when one is high the other is low. Alternately the load can be wired directly into the collector circuit as shown in Fig. 13b.

If the base resistors are fed from an independent source the frequency can be varied by external means. This produces a voltage-to-frequency convertor, or, voltage-controlled oscillator VCO. Referring to the approximate period

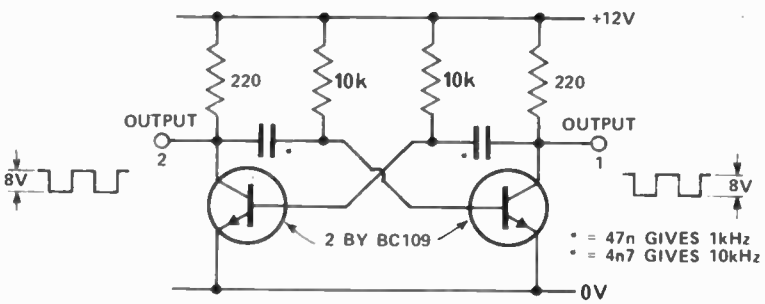
$$T = 2RC \ln \left(\frac{1 + V_{cc}}{V_{bb}}\right)$$

If the VCO is fed with a sawtooth signal the frequency output sweeps in synchronism – the well-known police siren sound.

Monostable or one-shot – if the requirement is for a train of pulses of uniform envelope height and width yet of variable repetition rate, then a monostable driven by a pulse train of the required frequency is the answer. A monostable has one transistor base connected as the astable above, the other is resistance coupled. Figure 15 shows a monostable set to provide a 20 μs wide pulse for a very wide variety of pulse inputs. Monostables are often used to reshape pulses back to a standard shape; they also serve to introduce a finite time delay because the initial input pulse can be regenerated later in time from the trailing edge of the monostable pulse. Thus the input pulse is delayed by the time duration of the monostable pulse width. An approximate value for the pulse duration is given by T = 0.7RC.

The circuit given in Fig. 15 features a second voltage rail. This ensures that the off-state transistor, which ever it is at any one time, is adequately switched off. It is, however, possible to design monostables that operate between only two lines – this has been the trend with semiconductor designs.

Bistable or flip-flop – this is the basic element used in digital computer counting as it produces an output pulse for every second input pulse, thereby dividing the input frequency by two. These have the two stages connected with resistors in both sides. Initially the circuit will start in either state – a set voltage is applied to the SET or RESET input thus conditioning the circuit to the initial plate required. Input pulses or step voltages applied to both sides will cause the unit to change state at each input pulse. Figure 16 shows a typical simple design of flip-flop. The need for a negative voltage rail has been avoided by adding an emitter resistor.



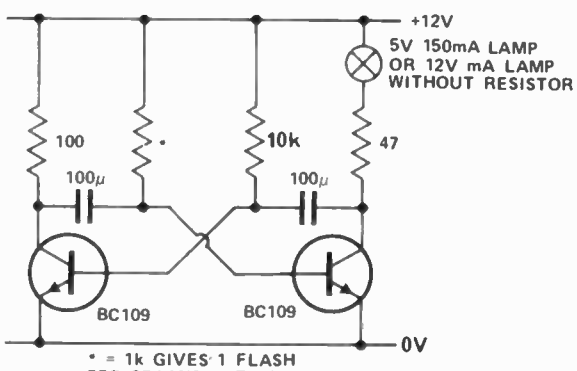


Fig. 13. Free running astable circuits. (a) 1 kHz signal source. (b) Circuit for flashing an indicator lamp.

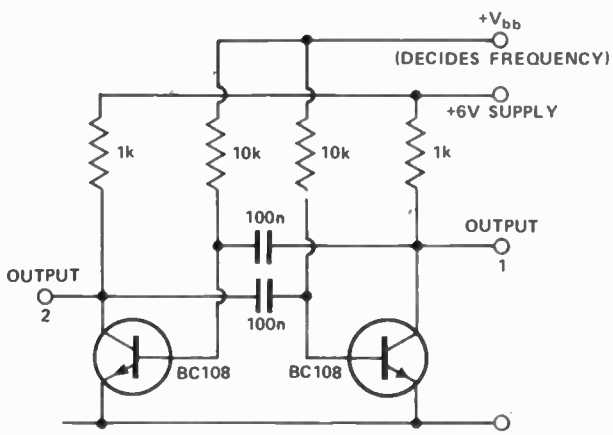


Fig. 14. The output frequency of an astable can be varied by altering V_{bb} – it becomes a voltage-controlled oscillator VCO.

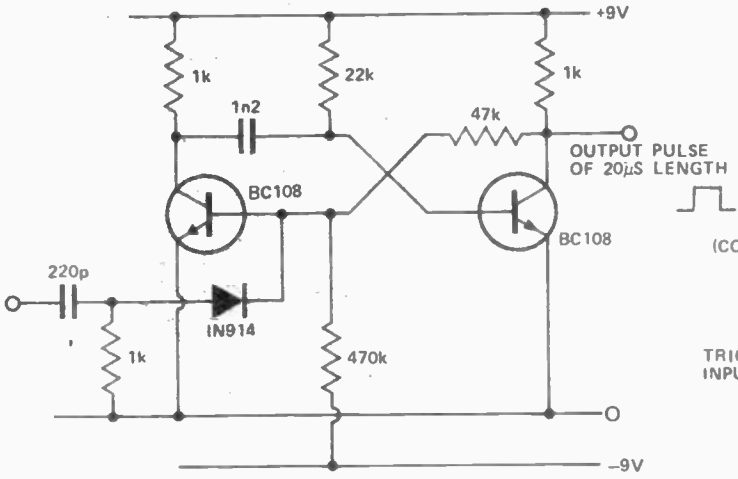


Fig.15. Simple form of monostable – it produces a 20 microsecond wide pulse for each positive going input pulse.

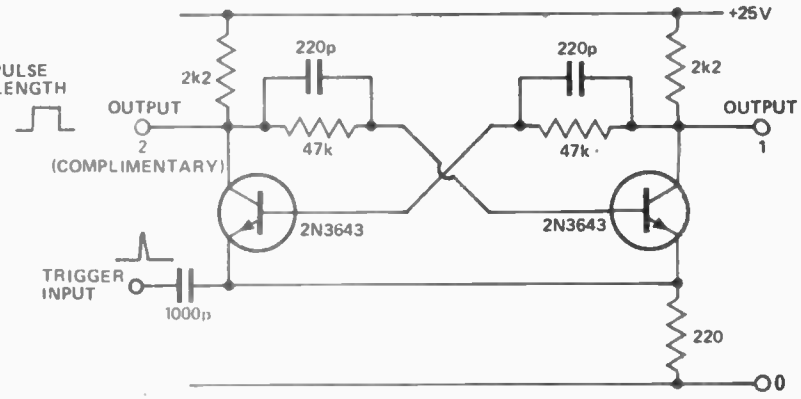


Fig.16 Basic flip-flop or bistable circuit.

Triggering inputs, not shown, can be arranged to drive into the base, emitter or collector in order to provide the toggle action.

Designs come in two varieties – those in which the on-stable holds the transistor well into saturation, and those in which the transistor is never saturated. The latter are capable of faster switching times but need much more careful design. We omit the design of the bistable for that is also well described in texts. It is a rare event, these days, for one to design flip-flops because they are now marketed in IC forms using over 10 transistors to achieve a much more stable and versatile unit at a price less than that of the two discrete transistors needed for the circuit shown in Fig. 16. Monostables and Schmitt triggers are also available in IC form. The latter effect can also be obtained using a linear op-amp with suitable connections.

PULSES

The logical follow on from square-wave generation is that of pulse generation. In Part 7 we described how LR and (more usually) CR networks could produce pulses by differentiating the square wave. The circuits for doing this are shown in Fig. 17. Figure 17d shows the standard differentiation circuit used. It produces signals, as shown in Fig. 17.7, in voltage form from (a) square-wave input waveform. The technique applies equally well for a single pulse requirement. Pulses produced this way alternate in sign. If both pulses are needed it is usually easier to produce two separate trains from anti-phase square waves selecting and combining the pulse polarities needed. This is easier in practice than attempting to invert every second pulse generated by a single differentiator circuit.

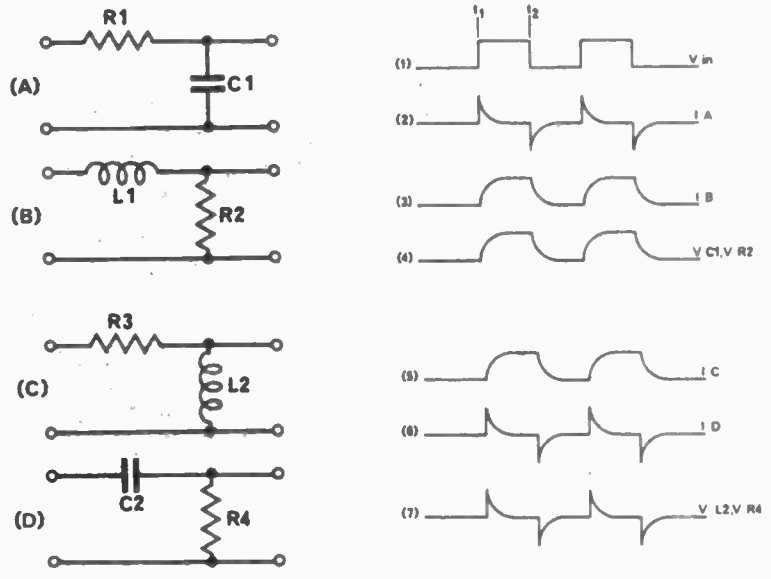


Fig.17. Differentiation or integration may be crudely achieved by means of LR and CR circuits. Short pulses may be produced from square waves by differentiating with circuit (D).

GENERATING EXTREMELY HIGH FREQUENCIES

The upper frequency limit for transistor operation is at present just approaching the gigahertz region (10^9 Hz); beyond this quite different techniques are employed. These techniques use devices such as magnetrons and klystrons, millimetre travelling wave tubes, masers and lasers. Figure 18 illustrates the frequency range over which each of these devices is useable.

In the earlier valve era it was very difficult to generate signals for radar needs (300 megahertz to 30 gigahertz) due to limitation of electron transit time, but late in the 1940's special self-resonating structures overcame this problem by using fields combined with valve concepts to 'bunch' electrons in a beam – typical such devices are magnetrons and klystrons. Such devices are still the best where high-power is demanded: microwave cooking ovens use magnetrons to generate kilowatt power levels for heating purposes.

The travelling-wave tube is another special electron device capable of UHF and microwave frequency amplification. In this tube an electron beam interacts with an electromagnetic wave travelling along the tube; again the electron bunching effect overcomes the transit time limitation. The design and use of these forms of generator are very specialised. Circuitry at such high frequencies is

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7407	.39	7464	.39	74156	1.29
7408	.25	7465	.39	74157	1.29
7409	.25	7472	.36	74161	1.39
7410	.19	7473	.43	74163	1.59
7411	.29	7474	.43	74164	1.89
7413	.79	7475	.75	74165	1.89
7415	.39	7476	.47	74166	1.65
7416	.39	7483	1.11	74173	1.65
7417	.39	7485	1.39	74175	1.89
7420	.19	7486	.44	74176	1.65
7422	.29	7489	2.75	74177	.99
7423	.35	7490	.76	74180	1.09
7425	.39	7491	1.29	74181	3.65
7426	.29	7492	.79	74182	.89
7427	.35	7493	.79	74184	2.69
7430	.22	7494	.89	74185	2.19
7432	.29	7495	.89	74190	1.59
7437	.45	7496	.89	74191	1.59
7438	.39	74100	1.65	74192	1.49
7440	.19	74105	.49	74193	1.39
7441	1.09	74107	.49	74194	1.39
7442	.99	74121	.57	74195	.99
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COHERENT RADIATION

A proper understanding of what is meant by 'coherent radiation' is essential to understanding why devices such as lasers are so important.

There are plenty of devices which produce radiation at super-high frequencies – eg, a hot soldering iron produces infra-red, an x-ray tube produces x-rays and a tungsten filament lamp produces visible light. But none of these sources produce coherent radiation. That is, their output consists of a multitude of separate packets of radiation which, although they may have the same frequency, have randomly different phase. Thus it is only possible to modulate such sources in bulk amplitude. It is not possible to modulate in frequency or phase on a cycle by cycle basis.

Devices such as lasers do produce *coherent* radiation. That is, the radiation is all in step, in terms of phase, and consequently can be modulated on a cycle by cycle basis.

Lasers can provide signal sources ranging from the far infra-red (10^{12}Hz) right through to x-rays (10^{19}Hz). At present no one device can cover this entire range. Some are tunable over a limited part of the spectrum, but most produce a single frequency within this spectrum.

Many laser sources are still in the exotic class and many problems remain to be solved. A major problem still outstanding is detection of such high frequencies. To date the highest frequency detected on a coherent wave by wave basis (that is, not as an incoherent bundle of energy as do most photo detectors) is 88 376 245 000 000 Hz. This is the frequency of the infra-red emission line of the now well developed helium-neon laser. It is just five times lower than visible light. Above that it is still not possible to detect the individual cyclic changes of the coherent sources that now exist.

FURTHER READING

Most books on electronic circuits cover the design of generators. Try "Transistor Manual" – General Electric, 1969.

Application notes for ICs also show how to produce various waveforms.

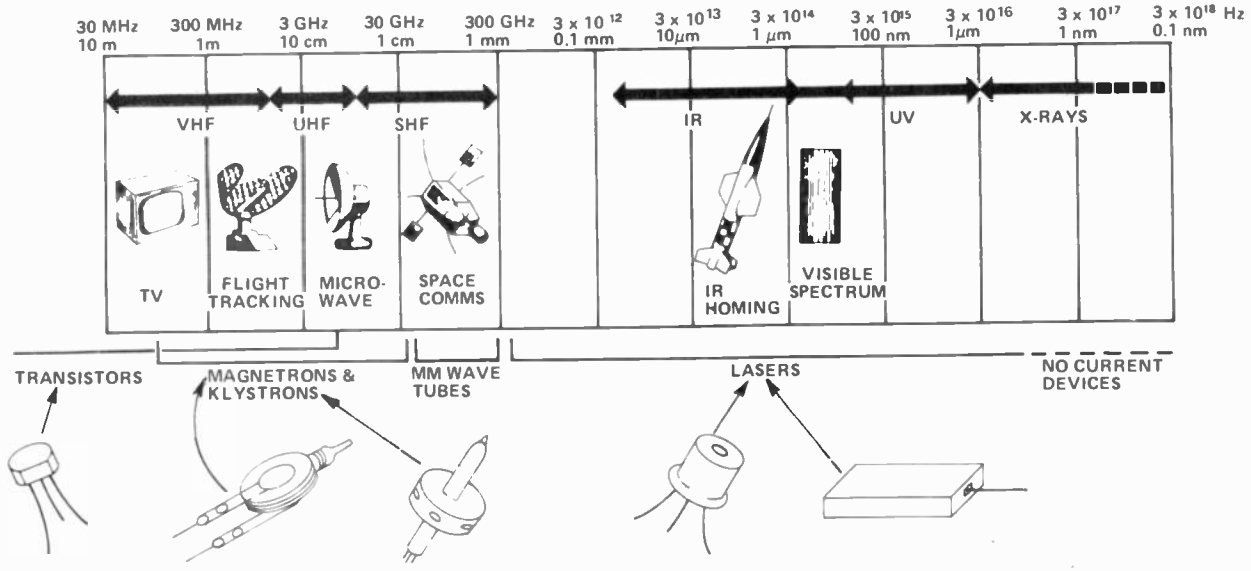
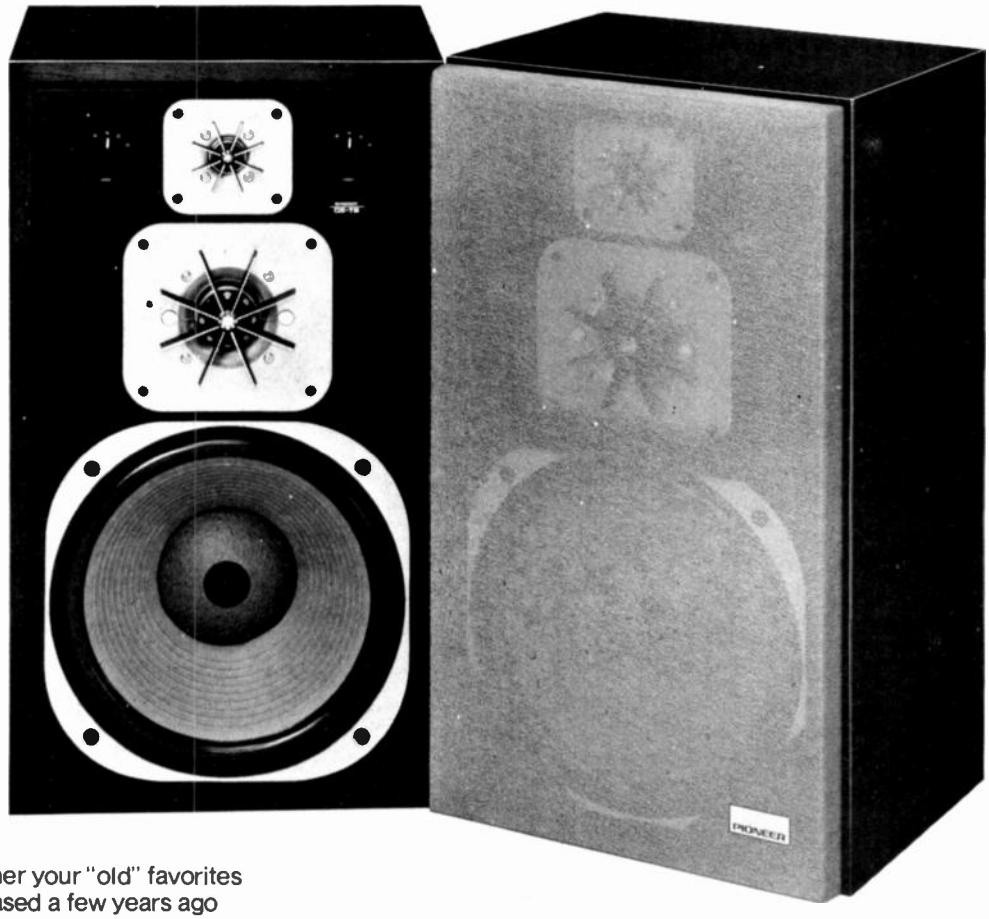


Fig. 18. Chart showing the various regions in the higher electromagnetic spectrum and the devices used in each.

Why you need a space age speaker system to listen to your "old" favorites.



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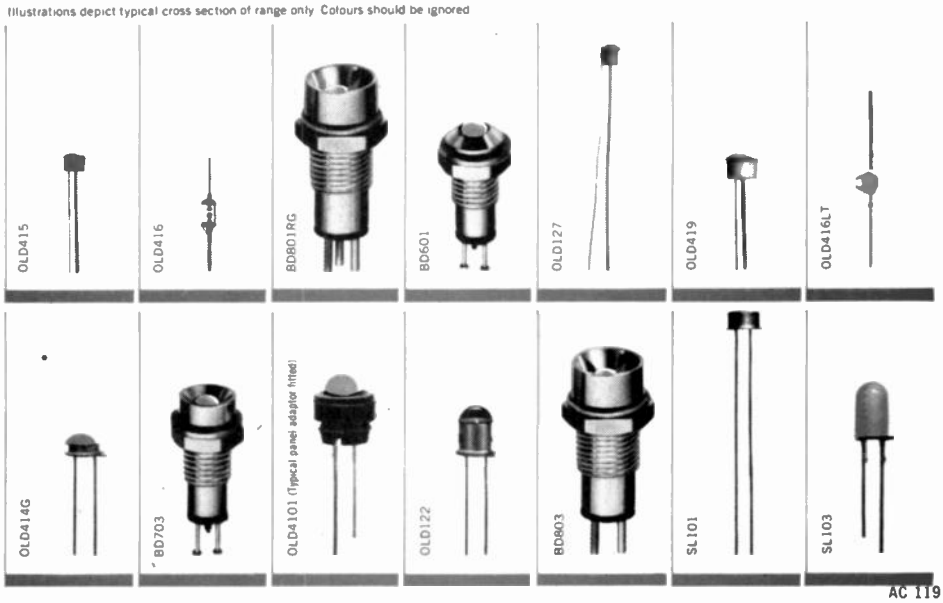

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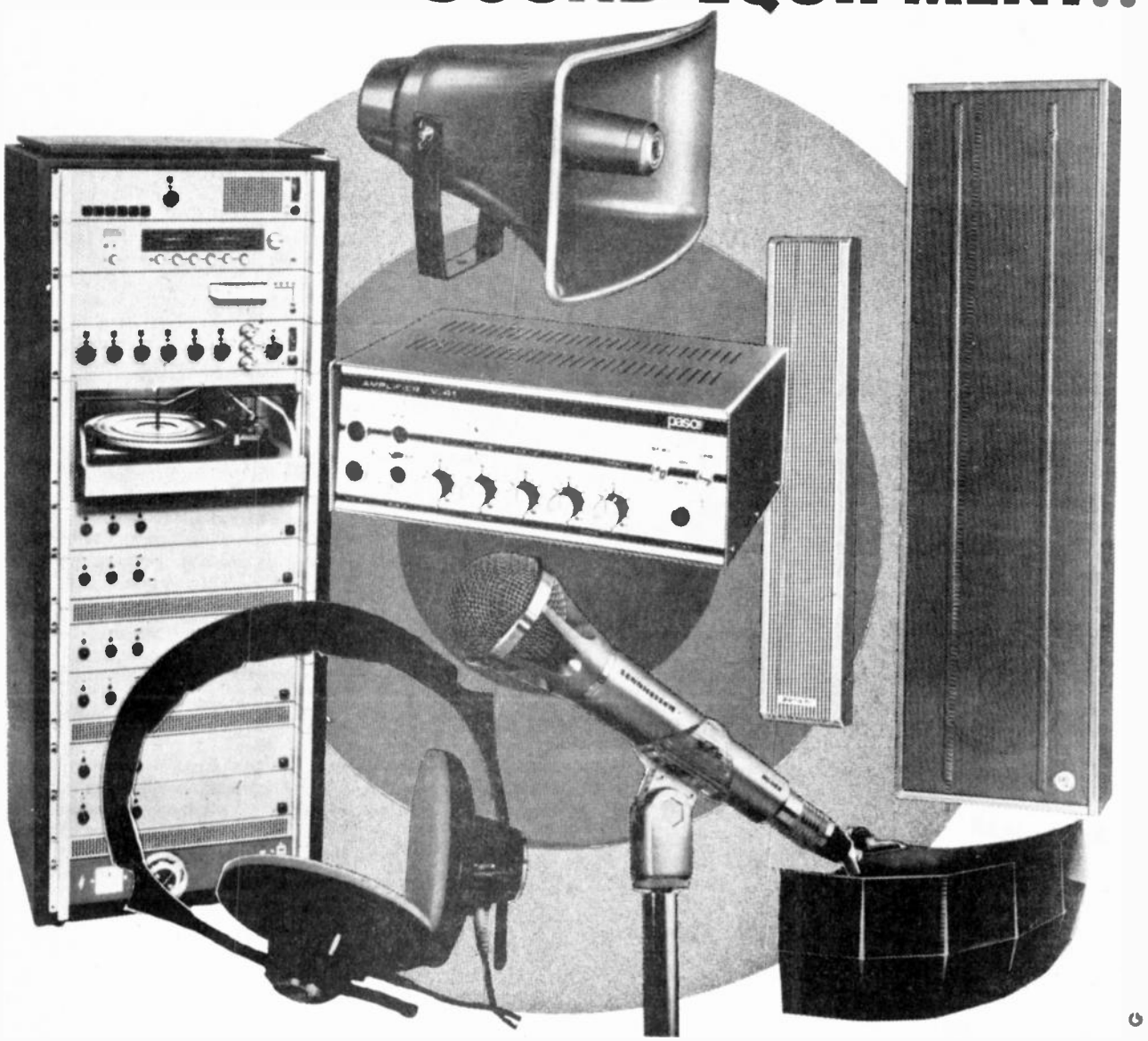

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EQUIPMENT NEWS

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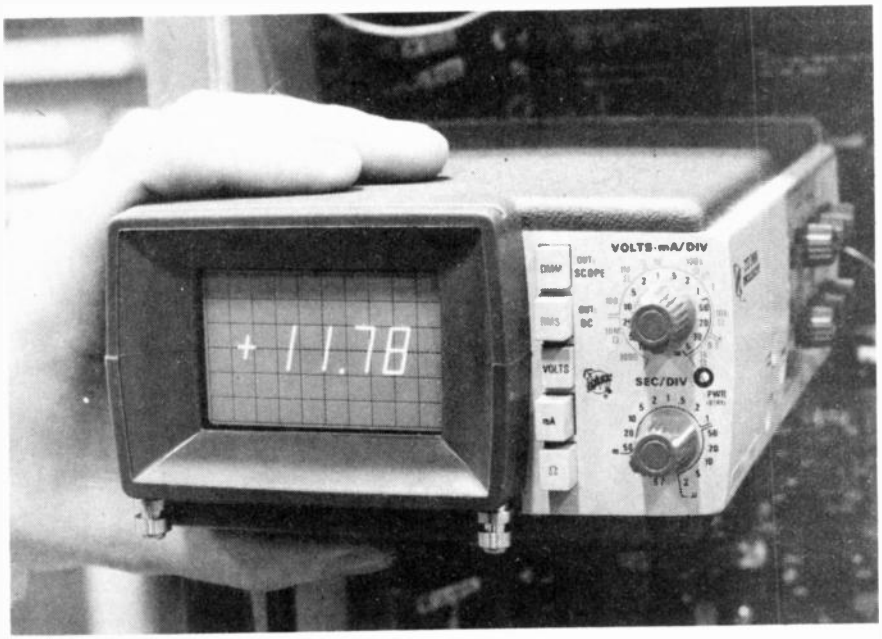


Tektronix' versatile DMM and 1 MHz oscilloscope are designed into one compact instrument. The combination can be carried in a briefcase, tool kit, or on a convenient neck strap. The unit operates from either mains voltage or internal rechargeable batteries. A built-in charger recharges the batteries whenever the unit is connected to the mains.

Typical applications for the unit (Model 213) include servicing computer peripherals, communications equipment, industrial control systems, office equipment, mobile electronics, and hospital equipment. Specific operations include checking critical resistances, adjusting dc supply voltages, checking for supply ripple, measuring supply loading current, checking key waveforms, and adjusting timing relationships. In troubleshooting industrial control equipment such as SCR controllers, the double-insulated case facilitates floating the 213 for displaying control signals riding on elevated voltages.

The DMM and oscilloscope share common power supply, built-in voltage probe, current input jacks, and input attenuators. Readout for both devices is on the 6 x 10 division crt (0.5 cm/div). Selection of DMM or oscilloscope function is quickly made with a single push-push switch.

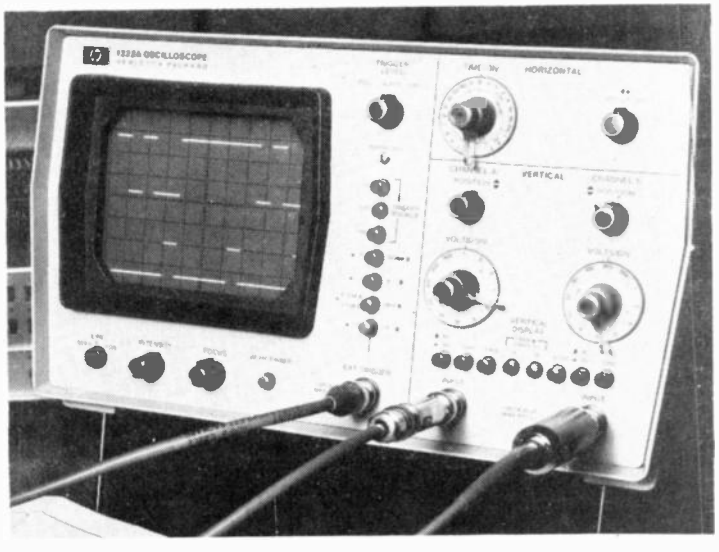
In DMM mode true rms reading capability makes the 213 especially convenient for non-sinusoidal ac measurement applications. Full scale dc and ac voltage ranges extend from 0.1 V to 1000 V. Dc and ac current ranges are 0.1 mA to 1 A and resistance ranges are 1 k to 10 M. For easy readability, the 3½ digit plus sign readout occupies a 10 x 40 mm area on the crt.

In oscilloscope mode the 213 offers a dc to 1 MHz voltage bandwidth with calibrated deflection factors from 20 mV/div to 100 V/div (extends to 5 mV/div at 400 kHz bandwidth). Current waveforms are displayed with deflection factors ranging from 5 μA/div to 100 mA/div. Horizontal sweep rates range from 2 μs/div to 500 ms/div, and a variable sweep magnifier provides up to 0.4 μs/div. Both internal and external triggering provide stable displays over the entire bandwidth.

With both a DMM and an oscilloscope the serviceman can now perform more repairs faster and more efficiently on site.

Tektronix Australia Pty Ltd, 80 Waterloo Rd, North Ryde, NSW 2113.

LOW PRICE LAB QUALITY 15-MHz 'SCOPE HAS 'BUILT-IN' DELAY LINE



New 15-MHz dual-channel (Model 1222A) from Hewlett-Packard has a built-in delay line to make visible the leading edge of traces, a feature of special value in digital applications. The new unit gives the user the option of viewing Channel A with Channel B either added or subtracted (A+B modes). Identical dual channels provide calibrated X-Y displays.

The Model 1222A has 3% vertical accuracy, calibrated 80 x 100 mm display, internal graticule to eliminate parallax, dc coupling, triggered sweep and pushbutton beam-finder. Deflection factor is adjustable from a sensitive 2 mV/cm to 10 V/cm, so the instrument is useful not only for the general run of logic, control, audio and video measurements but also for such low-level uses as receiver tests. Built-in TV sync separation claim H-P assures stable automatic triggering on frame or line for TV trouble-shooting. Calibrated sweep, accurate within 4% makes it easy to diagnose timing problems.

The delay line, advancing the start of sweep with relation to the displayed trace, makes it possible to show the leading edge of the trace, which otherwise would be lost due to transit time. Pulse studies, digital circuit analysis, and many educational purposes often require this capability.

The A+B modes will aid computer and medical electronics engineers to make differential measurements on such equipment as minicomputers and X-ray apparatus.

Hewlett-Packard Australia Pty Ltd, 31-41 Joseph St, Blackburn, Vic. 3130.

TRIPLE-OUTPUT BENCH SUPPLY FOR MOS CIRCUIT DESIGNERS AND EDUCATIONAL LABORATORIES

A compact three-in-one dc supply from Hewlett-Packard delivers an output of 0 to 18 V at up to 1 A and plus or minus outputs from 0 to 20 V, each at 0.5 A. Designated Model 6237A, the unit is designed for use by electronics engineers and technicians who test MOS circuitry and educational laboratories where easy-to-operate multiple-output supplies are needed.

The 0 to +20 V and 0 to −20 V outputs track one another within 1%. They can also be used to obtain a single 0 to 40 V, 0.5 A current. Regulation is 0.01% + 2 mV, with ripple and noise of 0.35 mV rms/1.5 mV p-p. The supply can be powered from a nominal 100 V, 120 V, 220 V or 240 V, 47-63 Hz ac input.

Both the 18 V and ±20 V outputs are protected from overload by fixed current-limiting circuits.

All controls, meters and binding posts are located on the front panel.

Hewlett-Packard Australia Pty Ltd, 31-41 Joseph St, Blackburn, Vic. 3130.

DIGITEC 4-1/2 DIGIT, PRECISION DIGITAL MULTIMETER

DigiTec's new Model 2210 Digital multimeter is a full 4-1/2 digit, bi-polar instrument.

Thirteen pushbutton selected measuring ranges are offered, covering dc volts, ac volts and resistance. Dc and ac voltages are covered in four ranges extending from 1.999 V to 1000.0 V with basic accuracy claimed to be 0.01% rdg. Resistance measurements extend from 1.999 k to 19.999 M with a claimed accuracy of 0.07% rdg. A zero offset control compensates for test lead resistance.

N.I.C. Instrument Company.

BWD OSCILLOSCOPE UPGRADED

The BWD 509B oscilloscope, one of the most widely used in the Australian built BWD range, has now been upgraded.

A new, high sensitivity CRT has enabled the bandwidth to be increased by almost 50%, from the previous dc to 7 MHz to a very impressive dc to >10 MHz-3 dB. The pulse response is claimed to be excellent, and to suit wider bandwidth applications a BNC socket is available as a low cost option for the vertical input. The newly released BWD P32 DuoProbe, with switched 1:1 and 10:1 input, couples directly to this input socket.

Other features upgraded include the calibration of the X5 magnified time base – now 5% accurate up to 200 n/sec/cm – and a 25% increase in the CRT luminous intensity, in addition to the rise time improvement from 50 n/sec to <35 n/sec.

EQUIPMENT NEWS

NEW PRODUCTS FROM A&R SOANAR

A & R Soanar Group announce the introduction of four new products to their extensive range of stock equipment and transformers.

PT9585 ISOLATION TRANSFORMERS Among the many colour TV receivers being marketed in Australia there are a number of models designed for direct ac mains operation which do not have a conventional mains transformer.

To avoid the risk of electric shock to the user and more particularly to those servicemen called upon to repair these sets, the use of an isolating transformer is highly desirable. This is interposed between the mains supply and the receiver and used either as a permanent fixture or as protection for the serviceman during the course of the repair.

The PT9585 Isolation Transformer is totally enclosed in a strong metal casing with integral output socket and carrying handle, and is supplied with a 1.8 metre cord and plug set.

XT8150 DOUBLE INSULATED DEGAUSSING WAND An essential part of every colour TV serviceman's took kit, the XT8150 Degaussing Wand will demagnetise colour receivers which have become magnetised due to the influence of the earth's magnetic field or some extraneous cause.

A magnetised set is characterised by distorted colour balance and loss of colour saturation of the picture which cannot be corrected by the use of the manual controls.

In use, the Degaussing Wand is simply pointed at the centre of the picture tube from a distance of 30-50 mm, switched on and then gently moved, with a circular motion of the wrist, to trace the perimeter of the tube. The wand is then slowly withdrawn to a distance of 3 metres or more from the set and switched off.

PS 241 NICKEL CADMIUM BATTERY CHARGER This is designed to charge heavy duty nickel cadmium batteries of the type used in emergency lighting systems, portable TV sets, amplifiers, electronic flashguns, electric tools and the larger types of portable radios, electronic calculators and tape recorders.

PS 241 is a constant current unit capable of charging 1-10 cells in series simultaneously and is provided with a switch for selecting 6 charging rates between 22 and 600 mA.

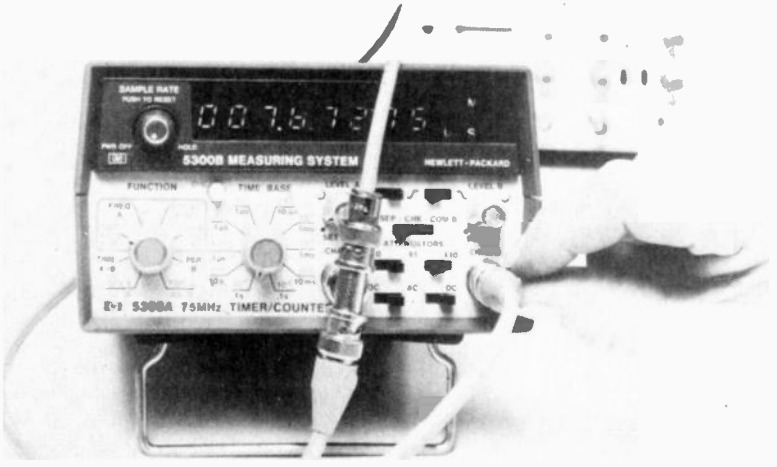
PT 9583 POWER TRANSFORMER Many designs employing linear and digital I.C.s require regular supplies of ±15 volts and a 5 volt rail.

The PT 9583 power transformer was designed for this specific requirement and when used with most series regulators is suitable for operation with a mains voltage of 240 V ± 40 V at 50 to 60 Hz. An electrostatic sheild is provided to minimise interference from mains transients.

This transformer is insulated and tested in accordance with Australian Standard A.S. C126 "Approval and Test Specification for Extra Low Voltage Transformers."

A. & R. Soanar Group, 30 Lexton Road, Box Hill, Vic. 3128.

COMPACT NEW UNIVERSAL COUNTER



Hewlett Packard's new 75-MHz Electronic Counter/Timer (Model 5308A) does more than many full rack-width models, claims the manufacturers. Like other universal counters, it counts frequency, frequency ratio, period, period average, and time interval; it scales and totalises. Beyond those usual abilities, it offers sub-nanosecond time interval averaging, and it auto-ranges to select the range that gives best resolution within a convenient measuring time, 0.11 to 1.1 second. Model 5308A is the first electronic counter to autorange when averaging time interval or when measuring frequency ratio, in addition to autoranging frequency and period change measurements.

The 5308A is a new module in the HP 5300 snap-together measuring system. Mated with the 8-digit Model 5300 B display, the two units form a package only 89 by 160 by 248 mm.

Hewlett Packard Australia Pty Ltd, 31-41 Joseph St, Blackburn, Vic, 3130.

NEW TELEPRINTER

A new lightweight low-noise teleprinter ideally suitable for computer input and print-out should find a ready and receptive market in Australia.

The Extel teleprinter, designed and made in the USA and distributed by Plessey Communication Systems, will fill a need between the slower, noisy electro-mechanical units and the expensive sophisticated line printers.

Eighty percent of the Extel functions are electronic, ensuring less wear and tear and lower maintenance costs.

The teleprinters have a print-out capacity of 30 characters per second compared with ten per second by electro-mechanical models used on Telex equipment.

Plessey expect keen interest in the new, more compact teleprinters from data processing organisations, educational institutions and chemical and science laboratories.

The purely electronic operation of Extel units and the consequent extremely low-noise level makes them ideal for use in areas where high noise levels create problems for operators.

Printing is via a five by seven dot matrix, of magnet-driven needles, directly on to pressure sensitive paper without the use of ink or ribbons. The machines can be adjusted for ribbon print out and can produce up to three copies.

Plessey Communication Systems, Racecourse Road, North Melbourne. Vic.

jensen

THEY SOUND AS POWERFUL AS THEY LOOK

Looks can be deceiving. And size isn't everything. Unless you're talking about a Jensen Speaker System. When the wraps are off a Jensen (as on our Models 4, 5, or 6-left to right) you can see all the power you're looking for.

With 50, 60 and 75 watts respectively, these Jensen Systems can be comfortably driven by the big new amplifiers. Yet they're so efficient they only *need* 10 watts to fill your room with sound.

Of course, the quality of our sound reproduction is power and efficiency.

Jensen's Total Energy Response design reproduces sound accurately with low distortion of all frequencies. And we do it over a 170° angle of dispersion.

Jensen Speaker Systems have another powerful thing going for them, too. Our 46 year reputation for quality. You can't build that overnight.

And that's why Jensen gives every Speaker System a full 5 year parts and labor warranty. We know we build a quality product. And we back it up with a quality warranty.

We encourage you to compare a Jensen Speaker System with any other. The proof is in the product. And we build a better one.

jensen

AVAILABLE FROM

QLD:

Reg. Mills Stereo — Buranda 91-1089

NSW:

Allied Music System — Crows Nest 439-1702.
Allied Hi-Fi — St. Pters 51-7071.
Douglas Hi-Fi — 799-4177.
Magnetic Sound — Sydney 29-3371.
Dynamic Sound — Newcastle 21-188.
Hi-Fi House, Wollongong 286-661.
Pee Jay Sound Centre — Broken Hill 7303.

ACT:

Douglas Hi-Fi — Fyshwick 95-3459.

VIC:

Douglas Hi-Fi — Melbourne 639-321.
John Lewis — Ballarat 323-615.

TAS:

Audio Service — Burnie 31-2390.

WA:

Douglas Hi-Fi — Perth 22-5177.

AUSTRALIAN DISTRIBUTORS:

BJD Electronics Pty Ltd.
202 Pelham St., Carlton, 3053 Vic. Ph. 347-8255
65 Parramatta Road, Five Dock, 2046. Ph: 799-3156.

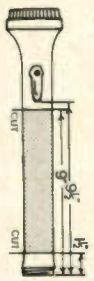
KITSETS

KIT'S KOLUMN

Woof. So much is happening I'm having trouble keeping up. First, we've got a new store opening in Melbourne at Box Hill which should please all the locals who have to trek miles to get what they want. And to all you studious types across the road at the Tech. College — come on in and say hello. Or drop me a line. (I didn't say hand me a line, Alfred E.).

You'll notice in this ad a bit about tools. Expense-account tells me good tools have been hard to come by and I'll have to accept his word for that. Although I've personally noticed no real shortage. However, when he showed me the new range, I saw what he meant. Beautiful solid stuff that should last for years. I only wish I could get eyebrow tweezers as good.

Back to the torch conversion. For all of you who have been following our breathtaking in-depth and fearless investigation of Mom (also known as Yankee doodle) here at last is our special expose of how to cut down your enormous 5-cell flashlight into a more economical 2-cell version, and save yourself 60% on battery refills.



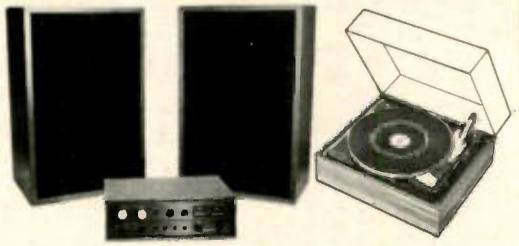
Scribe cutting lines on case as shown in diagram. Cut at switch end first, taking care not to damage metal strap. Cut other end of case. Align cut ends, then cement together. (Metal strap fits between case and pull-out metal ring.) Replace globe with 2.5 — 3V one, add 2 batteries and you're in business.

Had a nice letter from Richard H. Barton of Wellington New Zealand who seems to get marvellous circuit ideas in his bathtub. Love to see you if you're ever in Sydney, Richard. You sound like my type of experimenter.

Talking about New Zealand, and other nether parts of the world, it will be interesting to see where the best project ideas come from for our contest. (See details this ad.) But please, no black boxes — our friends at the APO would never forgive us.

Finally, to Alfred E. Neuman of Gore Hill, our special award of the Kitsets weeping handkerchief. Firstly, for maudlin nationalism, but mostly because he doesn't believe in me. Alf, how could you? (Autographed pic. sent free for S.A.E.) Until next month —

Keep your iron hot, *Kit*



COMPLETE HI-FI SYSTEM: A BEAUTY FOR ONLY $299

Not a kit, nothing to build. Just hook all units up, plug in, and you're in business. System consists of the Phodis C6000 amp which puts out 20W per channel RMS, has twin VU meters, 6 input jacks, 2 output jacks, and more features than we can list here. PLUS the BSR P128 turntable which has diecast platter and is fitted with a Shure M75 cartridge. Your choice of speakers—our 8" -way ready-made system or our kit with 12" twin cone and 1" dome speaker in each enclosure, which are both pre-assembled and veneered. P&P $7

DON'T GUESS USE A METER!

If you're really serious, a good meter is about as important as a good soldering iron. These are all Japanese, and in our opinion some of the best value for money today.

Big daddy. Does just about everything except make coffee. 100,000 ohms per volt DC, 10,000 ohms per vold AC. Claimed burn-out proof. Instruction book, test leads. Has carry-handle, mirror scale. P&P $1.50

$49·50

Mini-pro. Angled scale for easy reading. Test transistors! 20,000 ohms per volt DC, 8,000 ohms per volt AC. Has all the usuals including zero adjust, instruction booklet, leads. P&P $1.

$29·50

Economy master. Fits big pockets, has quarter-circle scale, mirror back. 20,000 ohms per volt DC, 10,000 ohms per volt AC. With leads, instruction sheet. One of our best buys. P&P 75c

$19·50

NOW FULL RANGE OF PHILIPS SPEAKERS

You know Philips. And you know Philips quality. Now we can offer you Philips speakers for virtually any sound system. Plenty in stock. Here's a sampling:

AD1060-T8 1" dome tweeter. **$8.50.** P&P $1.

AD8066-W8 8" woofer. **$12.50.** P&P $1.

AD1256-W8 12" woofer. **$21.50.** P&P $2.

FAME AND FORTUNE ARE YOURS!

As we promised last month, here are details of our new contest where you can win big prizes for your favourite (own design) project. All you do is send us your original project design. Each month, we'll select a major prizewinner and runners-up. Winning projects will bear the entrants' names, and will be on sale as a kit through us. Get more details on the special entry form available from all Kitsets stores. If you can't call, write, and we'll send you one or how many you want. Grand prizewinner gets a full L&G colour plan HI-FI system at the end of the contest. This is your chance to lay your pet projects on us and maybe win a prize and see your name in print. No entry fee. Nothing to buy. Open to anyone. Get off your heat sink and get cracking — you'll never have a better chance!

NEW SQ DECODER KIT

Build this new 31CSQ decoder—incorporating both full logic and wave-matching. Connected between the tape out and tape in on your existing amplifier, and connected to a rear channel stereo amplifier it provides you with a fully decoded SQ sound. Our kit comes complete with all parts, including power supply, and a case about 8" x 2½" x 5½" plus sleek blackface front panel. P&P $2.50

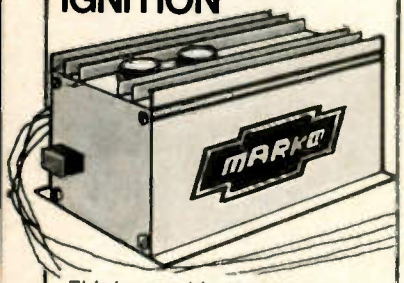
$59·50

SYDNEY: 400 Kent St., Sydney, 29 1005. 657 Pittwater Rd., Dee Why. 982 9790.
ADELAIDE: 12 Peel St., Adelaide, 87 5505. BRISBANE: 293 St.Paul's Tce. Fortitude Valley, 52 8391. MELBOURNE: 271 Bridge Rd., Richmond (Gallery Level, Church St. entrance) 42 4651. BOX HILL: 985 Whitehorse Rd., Box Hill. PERTH: 557 Wellington St., Perth (Opp. new bus terminal), 21 3047.

BE FAST FOR HI-FI SAVINGS!

Ok. Ok. The secret's out. To promote the sensational L&G colour-plan range, we recently set aside a number of tuner amps, turntables and complete systems to sell at vastly under normal prices. We're prepared to extend the offer to personal shoppers, or by mail order if you send for our discount coupon. Once promotional stocks are exhausted, we go back to old prices, so be quick.

Convert your car to ELECTRONIC IGNITION



This is not a kit. No assembling to do. Just hook it up and you've got CDI ignition. Improves fuel consumption, makes plugs and points last far longer. Can pay for itself in less than a year. Easy to check improved performance — simply press red button to change back to ordinary ignition, then press again for CDI. A beautifully finished unit, supplied complete with all necessary hook-up and mounting hardware. Suits all 12V negative earth cars. P&P $1.50.

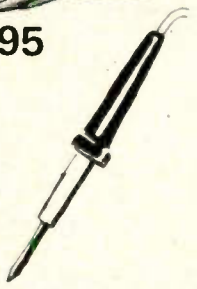
$29·50

GOOD TOOLS AT LOW PRICES

We won't stock rubbish. Based on the theory that there's nothing more frustrating (almost) than tools that don't give good service or accurate performance, we are introducing a new range of tools you can rely on. For instance —

CUTTING PLIERS: Jaw depth 16mm; overall length 130mm. Tool steel with polished head, insulated handles. No. N32. P&P 60c **$4.95**

ROUND NOSE PLIERS: Jaw depth 30mm, overall length 175mm. Finish as above. Will actually pick up a human hair. No. P62. P&P 60c **$4.95**

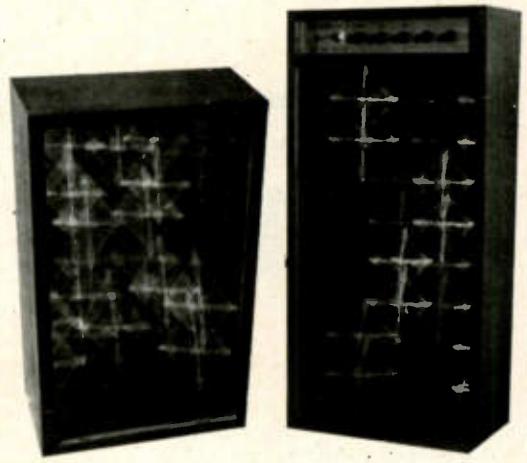


SOLDERING IRONS: One of our most popular has been the famous Weller SP250. This was our special last month, and was gone in a flash. However, we now have new stocks, not at special price, but good buying anyhow at P&P $1. **$10.50**

SEE WHAT COLOUR YOUR MUSIC IS

NOT a kit. These are the spectacular SECO colour organs. Connect to any speaker and the colour lamps flicker and glow with varying brightness in relation to volume, pitch, and rhythm. Why put up with colour TV? Works even with small transistor radios. Leaves fibre-optic lamps for dead. V3050: Domestic unit. 30 lamps, 3 channels, 5 colours. Diamond pattern. 18½" x 11½" x 7 3/8". 3.5kg. P&P $2. **$49·50**

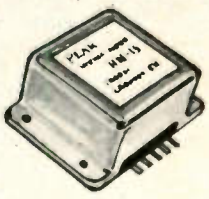
4050X: Professional monster. 32 lamps, 4 channels, 4 colours, individual colour mixing controls and a host of other features. Ideal groups. About 30½" x 15½" x 9 1/8". P&P $3. **$84**



MAY SPECIAL! NIBBLING TOOL $5·95

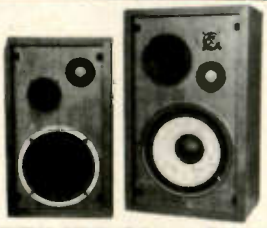
Stop sweating cutting holes with your tired hacksaw. The Hozan nibbling tool cuts any shape or opening by hand in sheet steel up to 0.06mm thick and soft metal up to 1.6mm thick. Squeeze-grip operation. We usually sell this for $7.95. During May, for personal shoppers only, we've reserved a limited number at each store to sell at the make-you-weep price of $5.95 each.

CROSSOVER FOR SPEAKER SYSTEMS



Neat little unit, with holes drilled ready for mounting. Easy to get at tag connectors. Hook up and you're away! 8 ohms impedance; crossover 1KHz & 5KHz. 2-way, P&P 60c. $3.95. 3-way, P&P 60c.

$6·95



STEINTRON AGAIN!

Our direct import—back again at last. Beautiful timber cabinets with louvred fronts. Absolutely superb performance.
V120: 12" woofer; 6½" middle; 1⅛ dome tweeter; 2" super tweeter. Crossover rolloff 12dB per octave; handles 45W RMS; 20-22000Hz. Has tone control. 25¼" x 15" x 11½". P&P each $5. Price each $112.
V100: 10" woofer; 5" middle; 1⅛" dome tweeter. Handles 35W RMS, 20-20,000Hz. 22¼" x 13" x 11½". P&P each $5. Price each $89.

Use this coupon for mail order. Please don't send cash. Remit by Postal Order or crossed cheque, made payable to Kitsets (Aust) Pty. Ltd. Send to P.O. Box 176 Dee Why 2099. For PMG/COD delivery, call 982 7500 (Area code 02) anytime (24 hour service) and tell us what you want. Orders are despatched within 24 hours. Please fill out form carefully and PRINT all details NEATLY. If your order comes in looking like a second-hand pakapoo ticket, we have to hand on to it until you send us a furious letter. And that doesn't do either of us any good.

SEND TO .....

ADDRESS .....

..... P'code ..... Phone .....

A HOW MANY	B NAME OF GOODS AND CODE NUMBER IF GIVEN	C PRICE EACH	D P & P EACH	E SUB TOTAL
	If you want your order sent registered (advisable) add 75c			
	← ITEM TOTAL: add column A.	REMITTANCE TOTAL: Add Column E →		

JMcA2199KS

hi-fi REVIEW

Fabulous +$3000 HI-FI system to win!

Answer a number of questions like these and win a + $3000 hi-fi system — including the fabulous Nakamicki 700 recorder, Cerwin Vega speakers, Fisher AM/FM tuner amplifier, and Elac's top turntable — plus six further magnificent hi-fi prizes! Contest is in April issue of Hi-Fi Review (on sale now).

You would like your speaker to produce more bass. Should you move them:—

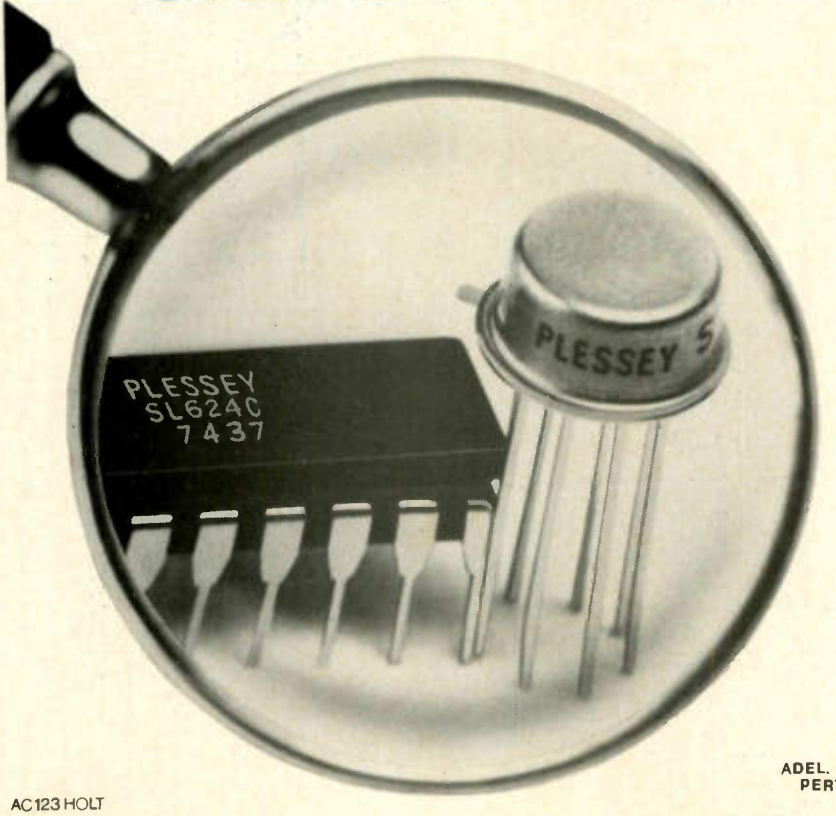
- Into a corner ☐
- Away from a corner ☐
- Nearer to the listeners ☐
- Up from the floor ☐

You would like to obtain about twice the sound level that you currently have from your 25 watt amplifier. What size amplifier must you obtain to achieve this? (Assume speakers can withstand whatever power input is required.)

- 35 watts ☐
- 50 watts ☐
- 100 watts ☐
- 250 watts ☐

Who didn't finish his symphony?

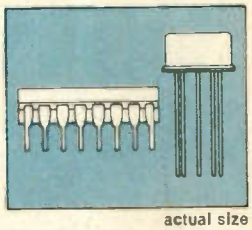
Check the fine print.



Easily recognised as a quality product of the largest European I.C. manufacturer, these new SL600 I.C.'s open up a new world in communication equipment design. This totally compatible range finds use in most types of radio communications equipment including:
RF/IF amplifiers/double balanced modulators/ Vogad and sidetone amplifiers/audio operated AGC's/AM detectors/AGC amplifiers/SSB demodulators/microphone-headphone amplifiers/multi-mode detectors and symmetrical limiting amplifiers.

The SL600 offers an exceptionally wide temperature range, a high degree of speech processing, a minimum of preset components, high performance and efficiency.

Enquiries to the Professional Products Division:



actual size

PLESSEY

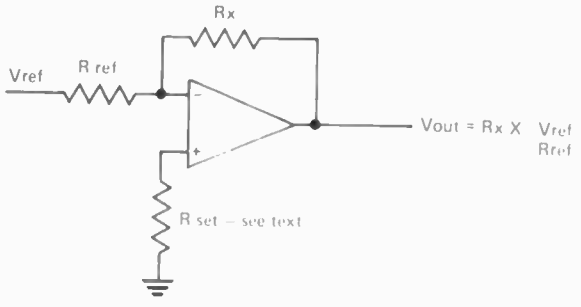
Plessey Australia Pty Limited
Components Division Box 2 PO Villawood NSW 2163
Telephone 72 0133 Telex 20384

MELB. Zephyr Products Pty Ltd 56 7231.
ADEL. K. D. Fisher & Co 223 6294. **BRIS.** L. E. Boughen & Co 70 8097.
PERTH H. J. McQuillan Pty Ltd 68 7111. **N.Z.** Henderson (N.Z.) 6 4189.

AC123 HOLT

IDEAS FOR EXPERIMENTERS

LINEAR INDICATION RESISTANCE MEASUREMENT



The conventional multimeter resistance scale readers from right to left (which can be misleading) and is non-linear, becoming increasingly cramped at high resistances. This is because a constant voltage is applied and by Ohm's Law,

$$R = \frac{V}{I} \quad \text{so} \quad I = \frac{I}{R}$$

However if constant current operation is used (left to right) the meter will read linearly.

Our circuit shows the simplest way of achieving this. The technique may be modified to suit various applications.

For instance it may be built into a multimeter using an M308 op-amp with R_{ref} switchable from 10 ohms to 10 megohms or higher.

A FET op-amp may be used to measure up to 10^{10} ohms.

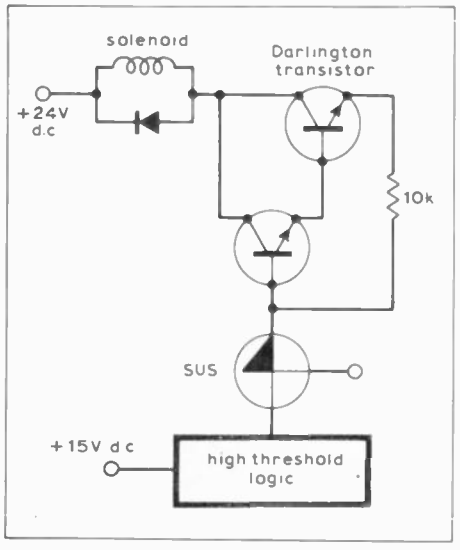
Offset nulling may be needed if very high resistance values are to be measured (see appropriate op-amp data). Resistance R_{set} should theoretically equal the parallel combination of R_{ref} and R_x for maximum accuracy – this is not important below one megohm.

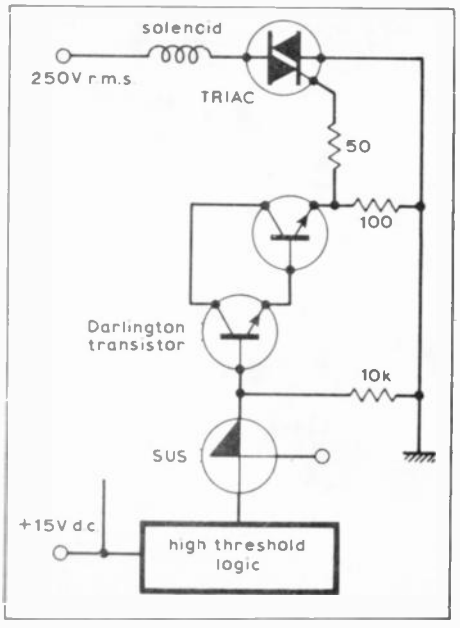
As the output of this circuit goes to maximum voltage if R_x is open-circuit it is advisable to protect the meter movement by a Zener diode.

D. George
Kentown, S.A.

INCREASING THE NOISE IMMUNITY OF LOGIC CONTROL SYSTEMS

In many industrial control systems, the output from logic circuitry is used for simple on/off control of a solenoid. However, the situation is often complicated by the presence of high levels of electrical noise. Although a high input noise immunity of the logic circuitry can be obtained with the use of high threshold logic ICs, such as Motorola Semi-conductors' MHTL range, the power amplifier feeding the output logic signal to the solenoid must be specially designed for maximum noise immunity in both the on and off conditions.





An extremely simple and low-cost solution involving the use of a silicon unilateral switch (SUS) has been proposed by Motorola Semiconductors.

The SUS is connected between the logic circuitry and the output amplifier as shown in Fig. 1 for a dc solenoid, and for an ac solenoid the connection is shown in Fig. 2. With an SUS with a V_s of 8 V and a V_f of 1.3 V, positive-going noise pulses with the solenoid switched off would have to exceed 8 V for a spurious energisation of the solenoid; negative-going noise pulses occurring while the solenoid is on would have to reduce the input to the output amplifier to below 2 V, from between 12.5 and 15 V, for a spurious de-energisation.

An additional advantage is that the regenerative portion of the SUS switching waveform effectively boosts the drive to the inductive load of the solenoid, speeding up the response to control signals.

High-threshold logic, operating from a 15-V supply, produces a logic '0' output of 0 to 1.5 V and logic '1' output of 12.5 to 15 V. Noise amplitudes which increase the '0' level to 6.5 V and reduce the '1' level to 8.5 V can be tolerated.

As the name of this section implies, these pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory.

Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we provide constructional details.

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

FLUKE

This may look like a multimeter... but it's really an autoranging multi-function counter

We've had a lot of comments that our new 1900A multi-function counter looks like our 8000A multimeter. We agree. In fact we planned it that way. Both are attractively styled and designed for user convenience. But inside they're vastly different instruments.

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This may look like an autoranging multi-function counter... but it's really a multimeter

The highly successful Fluke 8000A Digital Multimeter brought a new standard of excellence to the low cost field. Today, with expanded capability, the 8000 brings that standard to increased measurement capability through the addition of new options and accessories.

Choose from many options including rechargeable battery power, digital printer output plus the new low ohms and high current options. High voltage and RF probes and a clamp-on ac current probe highlight the list of 8000A accessories.

The Model 8000A gives you more functions for your money. There are 26 ranges, including five ranges each of ac and dc voltage, five ranges each of ac and dc current, and six ranges of resistance. Like the more expensive Fluke digital voltmeters, the Model 8000A offers reliable, error-free push button control, and is completely self zeroing. The 8000A is available with a rechargeable battery option, Model 8000A-01, providing 8 hours of operation between charges, or a data output option, Model 8000A-02, for data logging applications.

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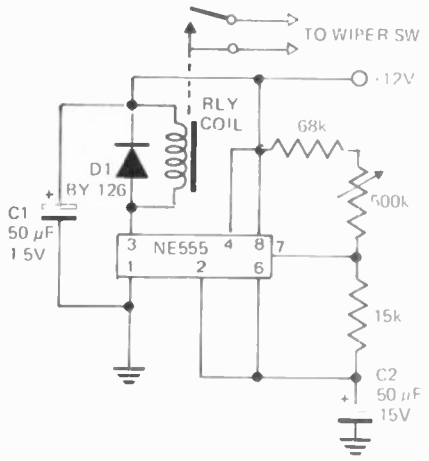
IC WINDSHIELD WIPER DELAY



The ever growing list of uses for that seemingly "super IC" the NE 555 seems endless.

Once again another application has come to light. This time it is a windshield wiper delay.

The free running oscillator of the 555 is adjustable from one cycle every three seconds to one every thirty seconds.

R1 and C1 set the width of the negative going pulse whose time determines the "power on" duration of the wiper motor.

The positive going pulse width is adjustable independent of the negative pulse width by the combination of R1, R2, R3 & C1.

The 555 can drive the relay directly as it can handle up to 100 mA, thus allowing for the use of an inexpensive 12 V relay.

The circuit is usable only with older vehicles with straight forward wiper motors and mechanisms – it cannot be used with permanent magnet motors.

THINGS WORTH KEEPING

The true experimenter is not just an assembler of ready made precision fit parts and components – he makes do with, and adapts, all sorts of bits and pieces to get results. This is particularly true at week-ends when things can't be bought – so the moral is: save the things that most people throw away. Hold on to what has served its primary purpose, and sooner or later it'll serve you again in a new role. Here's a list of some of the things worth keeping, – and why!

Aerosol caps: The polythene caps without an inner sleeve are useful moulds if ever you go in for plastic casting or encapsulation.

Ball pens: The outer tube makes excellent spacers; the inner tube makes a useful screw holder; the brass nozzle provides very small brass tubing which would be very hard to get.

Batteries: The 9 volt transistor radio battery cap is easily removed and makes a good battery connector.

Chipboard: Small scraps are useful for breadboarding projects, and for a base while drilling holes.

Food containers: Plastic trays of food containers make useful etching baths.

Ice Cream boxes: Same as food containers – useful for etching pc boards or aluminium panels.

Jars with screw caps: Storage of nuts, bolts, washers etc. Caps can be fixed to the underside of a shelf and jars screw in. Jar caps on plastic 'spring' make good push buttons on aluminium panels.

Metal: Of all types. Endless uses in construction work – clips, brackets, panels etc.

Perspex: Even small bits provide good insulating mounts for flash tubes.

Pill tubes: i.e. the plastic boxes pills come in. Useful for storage of components.

Plastic sheeting and bags: The thick plastic sheeting on old diaries and desk blotters is useful for insulating cases. Bags help keep parts clean and tidy.

Plastic boxes: Boxes of the margarine type make useful storage boxes, or parts boxes for bench use – when a unit is being disassembled.

Plywood: Very useful for breadboarding work. Use small nails as anchor points. Can be used over and over again.

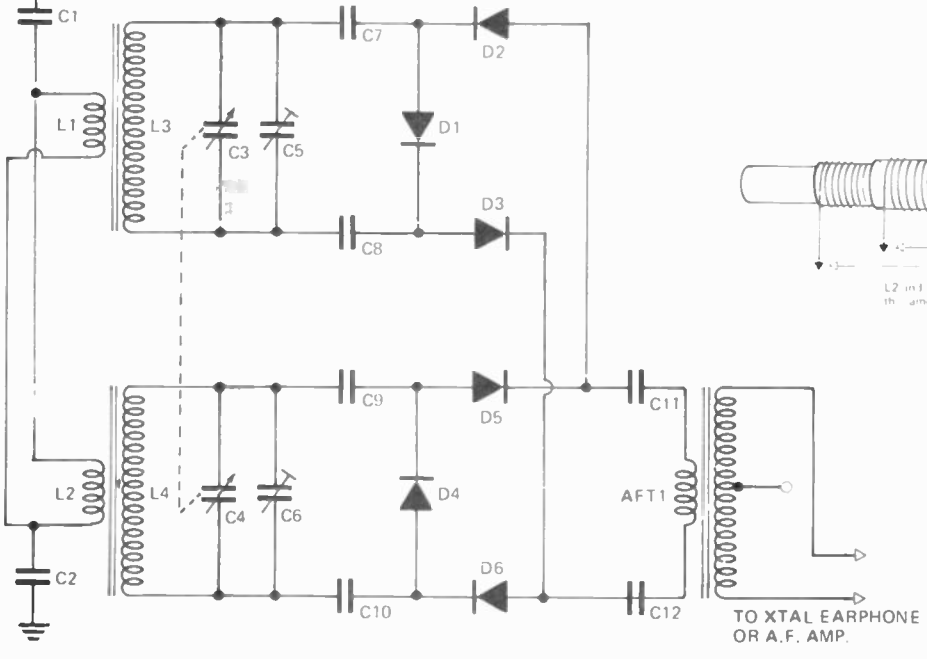
Potentiometers: Long after the track is worn out the spindle and bush are good for axles and bearings, pulleys etc.

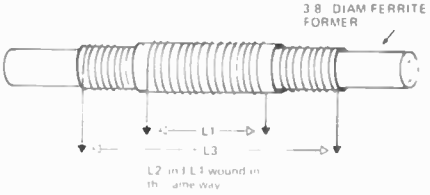
Slide boxes: The plastic of boxes in which slides come from the processors provides good insulating material.

Tin boxes: Metal boxes of all shapes and sizes should be kept – for cases of projects, storing drills and so on.

Transformers: From old valve sets. It's not hard to rip off the high-voltage secondary and replace it with a hand-wound low-voltage secondary. Count the turns on the 6.3 volt winding as you remove it, and work out volts per turn. – A.J. Lowe

HIGH OUTPUT CRYSTAL SET





This ingenious 'crystal' set produces an audio output approximately four times the amplitude of conventional circuits of this type. Two separate but identical tuning coils are used, each wound on a standard 3/8" ferrite rod.

P. Spresser,
Ipswich, Qld.

ADVERTISER'S INDEX

IDEAS FOR EXPERIMENTERS

SCREW STARTER

Fig. 1

Fig. 2

Useful holders for 'starting' small screws can be made from the inside plastic ink tube of empty ball point pens.

Remove the plastic ink tube, clean it if necessary, and cut a V notch in one end. Pass a loop of linen thread through the tube, (a length of fuse wire as a 'pull through' helps in this) – and you have your holder. See Fig. 1.

In use a screw is simply inserted in the loop and the loop pulled up tight – Fig. 2. The screw can now be manipulated into awkward places with ease. For holding screws, from which the loop may be lifted once they're started, it's a good idea to have a few knots in the double thread inside the tube. This increases the friction inside the tube, and there's then no need to maintain tension on the thread.

For holding spacer sleeves, between a pc board and chassis for example, the thread must not be knotted, as the thread could not then be removed. In this case, once the sleeve is positioned and the securing screw started, simply pull one end of the thread and the holder comes free. You then rethread the holder. – A.J. Lowe

FIFTY CENT RUMBLE FILTER

When an amplifier is not fitted with a rumble filter, rumble can often be considerably reduced by switching to mono. This of course eliminates the stereo image.

It is however possible to incorporate a very cheap and simple rumble filter which sacrifices a negligible amount of stereo separation.

The device is effective simply because very little stereo information is apparent at low audio frequencies – such frequencies are virtually omni-directional.

To build-in the filter simply connect together the centre terminals (i.e. the sliders) of the bass tone controls of each channel – via a 'rumble filter' on/off switch and a suitably chosen series resistor.

The series resistor should be selected to provide the optimum balance between rumble cut and retention of stereo image (10 k or so is generally suitable). Connecting wires must be kept short – or shielded.

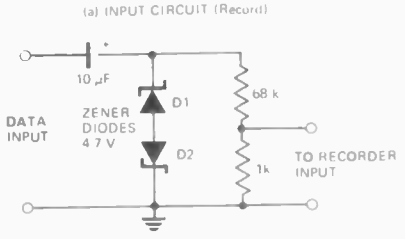
J. Etkins
Doncaster East, Vic.

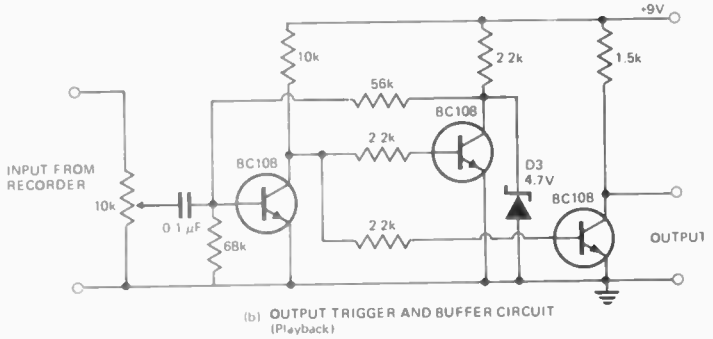
DIGITAL TAPE RECORDER ADAPTOR

The two circuits shown allow digital data to be recorded and replayed on an ordinary domestic recorder.

The input circuitry differentiates the digital pulses which are then recorded. On playback the recorded pulses are fed into a Schmitt trigger whose output is then amplified restoring the required binary data waveform.

The potentiometer RV 1 is adjusted so that on playback only the peaks will actuate the trigger.





(b) OUTPUT TRIGGER AND BUFFER CIRCUIT (Playback)

BETTER THAN BOSE!

That's right. Even though Bose are the most highly reviewed speakers in the industry; even though critics proclaim "Bose is best, big or small, high or low"—now there are two speaker systems better than Bose 901 and Bose 501!

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Introducing the Bose 901 Series Two—it's everything that the original 901 was, and more: • Multiplicity of acoustically-coupled full-range drivers • Flat power radiation • Completely new Active Equalizer design, suited to program source variations never available before, and adapted to a much wider range of room environments (even drapes) • and SYNCOM™ II Speaker Computer quality control testing.

BOSE 501 SERIES TWO

Also introducing the new Bose 501 Series Two — the other speaker with direct and reflected sound, and flat power radiation, at a price far lower than you'd expect to pay.

The new 501 Series Two features: • A new tweeter with double the magnet size of the original 501 and four additional components in the crossover network, for improved high frequency response and power handling capability • and 100% selection and matching of the woofers and tweeters with the SYNCOM™ II Computer—the unique computer designed by Bose and put into operation in August 1973 to achieve a new level of speaker performance.

We invite you to challenge us! Compare the Bose 901 Series Two to any other speaker, regardless of size or price; and compare the Bose 501 Series Two to any speaker up to the price of the 901 Series Two. You be the judge. If we have done our homework correctly, the comparison will be interesting and short!

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NOW A JH MODEL TO SUIT ALL REQUIREMENTS.

Phase II E – complete with arm and cartridge,
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Instrol are also distributors of the magnificent GRADO pickup cartridges

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The JH lightweight turntable utilizes all of the long sought-for advantages of lightness and eliminates the disadvantages of weight and mass. It is a dramatically new product, offering a performance which transcends all previous designs irrespective of price; it is all new . . . new ideas, new features, a completely new and fresh approach to turntable design!

Constructed of aluminium and suspended on the quietest and most friction-free teflon bearing yet devised, the platter requires so little torque, that an extremely small 12-pole hysteresis synchronous motor, which is locked to the mains frequency, drives it at constant speed, regardless of line and load variation. YET, the mass of this platter plus its rubber mat and the mass of the record are perfectly proportioned to the mass of the armature of the motor, to wipe out all speed variation and still permit acceleration to synchronous speed in less than three-quarters of a revolution!

SPECIFICATIONS

Power Requirements: 200 to 250 volts AC, 50 cps, 5 Watts.
Speeds: 33 1/3 and 45 RPM.
Method of propulsion: Belt drive.
Rumble: Unmeasurably small.
Wow and Flutter: Better than 0.04%.
Hum Radiation: Negligible.
Diameter of platter: 12 ins.

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