FLYING THE SPACE SHUTTLE

electronics today INTERNATIONAL

MAY 1978

$1·25*
NZ $1.50

UFO DETECTOR

VDU Constructional details

SWR BRIDGE

Audio Oscillator

Crosshatch Generator

JVC speaker technology has one aim...

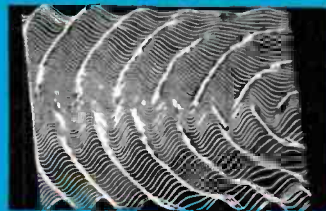
Let's face it, the main task of any speaker is to reproduce sound, faithfully, clearly and with low distortion, if any. The way they deliver what we at JVC call 'The Musical Truth'.

The musical truth is something special in sound. It's an indication that your records sound as good in your listening room as they did at the recording studio. These three computer designed JVC SK series speakers do just that, pure hi fi reproduction.

Our engineers have perfected a computer-assisted way of measuring speaker performance that actually translates acoustic response into visible patterns. This is the unique JVC Phase Moire Propagation Pattern technique. With the use of advanced electronic computers we actually see how speaker units and enclosure interact acoustically. This technique was used in the development of these three JVC SK series speakers.

But do yourself a favour. Listen to the reproduction at your JVC dealer.

PHASE MOIRE PROPAGATION METHOD



Smooth undulating JVC Series Speaker System Pattern.

Poorly designed Speaker System Pattern.

You'll come to one conclusion. That JVC SK-1000, SK-700 and SK-500 speakers are designed from start to finish by engineers, whose aim is to give you pure hi fi reproduction, or what we at JVC call 'The Musical Truth'.

SPECIFICATIONS

	Type	Speakers	Power Handling Capacity
SK-1000	3-Way, 3-Speaker	**Woofer:** 30cm (12") Free-Edge Type. **Midrange:** 12cm (5") Free-Edge Cone Type. **Tweeter:** 2.5cm (1") Dome Type.	85 watts (RMS)
SK-700	3-Way, 3-Speaker	**Woofer:** 25cm (10") Free-Edge Type. **Midrange:** 12cm (5") Free-Edge Type. **Tweeter:** 2.5cm (1") Dome Type.	60 watts (RMS)
SK-500	2-Way, 2-Speaker	**Woofer:** 25cm (10") Free-Edge Type. **Tweeter:** 5cm (2") Free-Edge Type.	35 watts (RMS)

WT14/78

AUSTRALIAN OWNED AND PRODUCED

May 1978, Vol. 8 No. 4

electronics today INTERNATIONAL

Editorial: Les Bell

Publisher: Collyn Rivers

PROJECTS

FEATURES

By using his photographer's skills, and a little help from our UFO detector project, George Hofsteters was able to produce this shot of a UFO hovering over Sydney's Martin Plaza.

NEWS & INFORMATION

A Modern Magazines Publication
* Recommended retail price only.

Registered for posting as a publication — Category B

Interscan Wins Through!

World aviation authorities have adopted a system based on a revolutionary Australian concept as the international requirement for a microwave landing system to be progressively introduced in place of the existing aircraft landing guidance system.

This was announced on 22nd April by the Minister for Transport, Mr. P.J. Nixon, and the Minister for Science, Senator J.J. Webster.

They said the Australian 'Interscan' microwave landing system, developed by the CSIRO and the Department of Transport, and subsequently adopted by the US where it is known as the Time-Reference-Scanning-Beam system (TRSB), was selected in Montreal on Friday, 22nd April by the International Civil Aviation Organization (ICAO) at the Plenary meeting of the ICAO All Weather Operations Division.

The decision meant:

Australian innovative science and technology had proved itself in fierce international competition.

The now internationally accepted system is well suited to Australian future aviation requirements.

Australia is advantageously placed to provide hardware for the new landing system from local resources.

The Ministers said an experimental Interscan system had been undergoing flight trials at Melbourne Airport since 1974.

Microwave landing systems using the TRSB signal format of Interscan should begin appearing at international and major domestic airports across the world during the 1980s. These systems have a key role to play in taking civil aviation through into the 21st century by providing electronic flight paths with a hitherto unobtainable degree of flexibility and accuracy in virtually all weather conditions.

"Australians should feel justly proud of this international recognition of the work of CSIRO and the Department of Transport," the Ministers said.

"ICAO's adoption of the Interscan/TRSB concept, placed before it by the complementary Australian and US submissions, more than vindicates the $5 million backing the Australian Government has provided for its development.

BACKGROUND:

In 1972 ICAO, the world body of government agencies concerned with civil aviation, launched an international competition to find an all-weather approach and landing guidance system suitable for aviation's developing requirement into the 21st century. Australia, the US, Britain, France and West Germany decided to develop systems for consideration.

The Australian Interscan system resulted from collaborative research by CSIRO's Division of Radiophysics and the Department of Transport.

The Australian electronics industry has been working with the Commonwealth and built the experimental system used at Melbourne Airport. by 1974 due to the efforts of CSIRO and the Department of Transport, the US Department of Transportation's Federal Aviation Aministration elected to adopt the TRSB concept embodied in Australia's Interscan.

Thus the US and Australian submissions to ICAO became complementary. Subsequently the U.S.S.R. indicated its support of TRSB/Interscan system.

In 1977 ICAO's All Weather Operations Panel after lengthy technical and economic evaluations adjudged the TRSB/Interscan concept to be superior to all others. The recommendation of this panel was considered by the world wide meeting of ICAO in Montreal in April 1978.

INTERSCAN:

At present aircraft are guided in to land at airports by means of an instrument landing system (ILS) which indicates to the pilot whether the aircraft is left, right, above, or below a single approach path to the airport runway.

The main disadvantage of the present ILS system is that it can provide only one approach path aligned with the runway centre line and at a fixed angle of descent. The signal may also be perturbed by objects such as buildings or taxiing aircraft.

The Interscan concept will allow air traffic control authorities greater flexibility in choosing the path of aircraft during approach and landing to cater for the needs of a variety of aircraft types and increased traffic, as well as providing more scope for noise abatement over sensitive areas of population.

It comprises several ground antennas which generate scanning microwave beams which are intercepted by an aircraft and define its angular position relative to the runway. The Interscan antennas are completely electronic in operation, having no moving parts.

Information derived from the scanning beam combine with range to a ground beacon determined by distance measuring equipment (DME) in the aircraft pinpoints the aircraft's position in space.

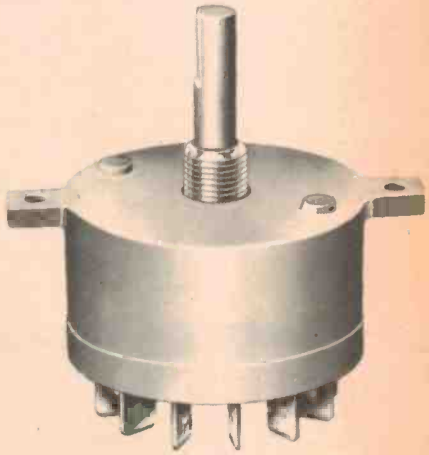
The system is relatively simple, inexpensive and very flexible. It does away with the single, straight pathway at a fixed angle of descent down which aircraft currently approach and land. Instead it provides dozens of 'highways in the sky' from 50 kilometres out. These may be either straight or curved at a variety of angles of descent.

It can also allow aircraft to approach and land in bad visibility with the same flexibility they have in clear weather.

New Rotary Switch

A unique 12 terminal programmable rotary switch capable of multiple switching has been introduced by Melbourne based Swann Electronics Pty Ltd.

Manufactured in Australia for local and overseas appliance manufacturers, the patented 90 series unit provides versatility in design applications.



Applications include appliances such as heaters, air conditioners, fan heaters, ranges and washing machines. Rated at 15 amps, 240 volt AC, internal bridging is available to provide additional flexibility in circuit design. Depending on specification, the switch can be barrel or flange mounted, or supplied with a threaded shank for panel mounting. Further information from: *Swann Electronics Pty. Ltd., P.O. Box 350, Mt. Waverley, VIC. 3149.*

Caller Hung Up

The British Post Office has revealed that it made use of a "special device" to trace the source of indecent and threatening calls to a woman in Lanarkshire, Scotland – after the caller had hung up.

Mr Alistair Duff, in prosecuting, said: "Post Office engineers installed a special device on the telephone. When the woman received her next call from the man, she pressed a button on the device which activated it and held open the line, enabling the Post Office to trace the call back to the man's home".

The man had been making the indecent calls over a period of six months and had threatened to harm the woman's seven year old daughter.

Fibre Optic Microphone

Recent research at University College, London, has developed a microphone which relies on acoustic waves modulating the refractive index of an optical fibre to phase-modulate the light being sent through it. Because of the short wavelengths of light, large phase shifts can be caused by low levels of acoustic power, making microphones possible that are 26 dB better than the human ear, with 180 dB dynamic range.

Midland Charged $3M

Midland International Corp., an importer of Japanese-manufactured CB radios and TV sets, has been assessed US$3.4M in 'dumping duties' by the US Customs Service for its TV imports into the US. Said the company's president: 'That's a hell of a lot of money. You don't have that kind of money laying around in petty cash'.

Intel, IBM Trade

Intel and IBM have surprised the industry by signing a royalty-free licencing agreement under which IBM will get rights to the MCS-48 and UPI-41 microcomputer architectures. Intel, in turn, will receive rights on some of IBM's magnetic bubble technology.

DIY Bomb

A recent report in the NY Times describes how a 22 years old former Harvard student with only 1 year of college physics, and without any help, designed a 'highly credible' series of nuclear weapons. As a result, the chairman of the Senate Govermental Affairs Committee's Subcommittee on Nuclear Proliferation has asked President Carter to tighten controls surrounding nuclear materials of use to potential DIY-bombers.

More National CMOS

National Semiconductor Corp. is expanding its family of CMOS devices with the addition of four new digital integrated circuits.

Available now, the new devices include the CD4512, an 8-channel data selector; the CD4514/4515, two 4-bitlatch/4 to 16 line decoder (high and low versions); and the CD4543, a BCD to seven segment decoder (LCD). Pin and functionally compatible with similar devices now on the market, the new units are also priced competitively, says Jack Rutherford, Managing Director of N.S. Electronics. In 100-up quantities the CD4512 is $0.98 each, the CD4514 only $3.50, the CD4515 is $3.50 and the CD4543 which is $1.94.

FRG-7 Owners Guide

Dick Smith has introduced a guide to the Yaesu FRG-7 Short Wave Receiver which, according to Dick, "continues from where the instruction booklet with the set leaves off".

The six-page guide was written specially for Dick Smith by noted short wave correspondent, Arthur Cushen M.B.E.

It describes the step-by-step procedure for tuning stations on known frequences, provides information on International short wave and amateur bands to listen to, explains the 24 hour clock and G.M.T., lists transmission times and frequencies for broadcasts for the major short wave transmitting countries of the world and concludes with a run-down on short wave listening as a hobby.

Dick Smith is offering this useful guide FREE with each Yaesu FRG-7 receiver sold through his eight electronics stores or by his mail order department.

Dick's April Fools Day Joke

This year Dick pulled off his greatest prank ever – and it had Sydney newspaper, radio and television station's switchboards buzzing all morning.

He towed a 14 metre long "iceberg" into Sydney Harbour at dawn on Saturday April 1st. The "iceberg" was actually a barge covered with framing, white plastic sheet and foam, but in the morning mist it looked surprisingly like the real thing.

The word spread quickly around Sydney and soon the iceberg was beseiged by boatloads of newspaper reporters and TV cameramen who didn't take long to realise they had been "had". Dick's secret was out and Sydney's biggest April Fools joke was over.

Electronic Sight

Kurzweil Computer Systems of Cambridge, Mass., have developed an electronic sight system which combines a photodiode array, via a NOVA 312 minicomputer, with a speech synthesizer to form audible signals which represent a visual image of a letter or symbol.

Travelling Clock Radio

Equivalent in size to a pocket calculator, Toshiba's new QR-2000 travelling clock radio can be set to remind the owner of appointments and it can be carried in a suit pocket, brief case or handbag. The small AM/FM radio incorporates a digital clock with backlit LCD display. As well as an alarm, the radio has a 'sleep' button which turns the radio off an hour later.

Further information is available from *Toshiba-EMI (Australia) Pty. Limited, 16 Mars Road, Lane Cove, N.S.W. 2066.*

News EXTRA

3D Laser Replication

First publication of details concerning a far-reaching scientific and industrial innovation has occured with the issue of United States Patent 4,078,229 on March 7, 1978.

Arthur C. Clarke, author of "2001: A Space Odyssey," and inventor of the orbiting communications satellite, has recently described the subject of this patent before the Congressional Clearinghouse on the Future:

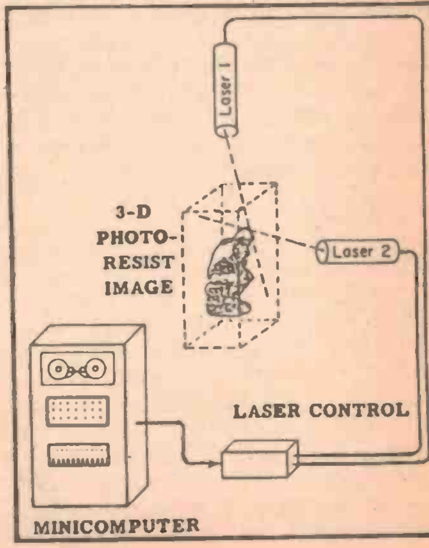
"the Replicator . . . this is a machine that can make a copy of anything in its three-dimensional form, in all its details. Suppose we could manufacture an object all in one operation. It would put all the mechanics out of work, all the machine tools. I discussed this twenty years ago in a book called "Profiles of the Future," never imagining it would come to pass in my lifetime. Imagine my astonishment when I learned that the first patent for the replicator had been put out by a company in California called OMTEC . . . "

Commercial development of the complete Replicator system is being negotiated by a group of manufacturing licensees with the co-operation of the Battelle Columbus Laboratory, developers of the first Xerox copying machines.

Late last year Dr. Carl Verber, physicist at Battelle, described at a meeting of the Society of Photo-Optical Instrumentation Engineers work he has carried out toward development of a system of related three-dimensional television. In ordinary television the light and dark areas of a scene are converted by the TV camera to a description or plan in the form of radio waves. On the television screen this plan controls the sweep of an electron beam across the surface of the phosphor-coated tube. The electron beam "draws" the two-dimensional scene by moving the resulting spot of fluorescence over the screen so rapidly that the eye sees a whole picture.

The three-dimensional television is built around a transparent box containing a gas which fluoresces only when hit by two different colors of laser light. This light is supplied by two fine laser beams which under computer control intersect within the box, and can be scanned together so that they always intersect. Because both colors are required to make visible fluorescence, the result is a spot of light – fluorescence – at the intersection. Just as in the two-dimensional TV, the 3-D TV display makes a three-dimensional picture by rapidly moving this spot inside the box so that the eye sees the whole pictures, but three-dimensional pictures. US Patent 4,041,476 for this 3-D television system was issued to OMTEC Replication in August of 1977.

The Replicator operates on a principle similar to that employed for 3-D television. In this case the computer and laser-control apparatus are adapted to project the intersecting beams into a reaction chamber containing special liquid plastic or a photoactive solution of metal salts. These liquids are unreactive to beams of either red or blue laser light, but they do react to the unique effect of the beams combined at the intersection. Depending on the 3-D plan/description source, the "picture" which forms in three-dimensions (actually a shape or



sculpture) can originate in blueprints, a computer-program engineering design, or it can be a reduced or enlarged duplicate made from data transmitted from anywhere in the world.

Wherever the two-beam intersection is moved within the Replicator chamber, a part of the product "crystallizes" out – much like rock candy from a heavy sugar solution – except that in this case the shape is determined by the movement of the laser-beam intersection. The finished articles in photo-resist plastic can be directly used as models or patterns in manufacturing or precision investment casting, or negative images can provide molds for low-temperature casting. Injection molds and dies are obtainable from the model by conventional techniques such as electroforming or plasma-arc deposition of metals. Overall, these methods promise to cut the time involved in making critical industrial components from many months to a few days.

Using the fully developed Replication systems the manufacture of a product will be directly under the control of the design engineer, eliminating stages of drafting, blueprinting, modeling, and many separate steps of machining and assembly. The effect is as though a single machine is capable of making in a single operation complex shapes – carburetors, gears, turbine blades and aircraft parts – without transfer between specialized lathes, milling machines, drills, thread-cutters, or other machine tools. Instead of being stored in the inflexible form of blueprints, design data stored in the computer is instantly adaptable should a design fault later become evident. Tape cassettes containing perfected designs for auto parts or machinery could become international articles of commerce. Use of Replication machines in Third-World countries, combined with modern casting and molding technology, could go a long way toward reducing the need for a building-up of an extensive machine tool infrastructure before industrialization.

In the developed world, further evolution of this technology could lead to plastics materials capable of being recycled repeatedly in new useful Replicated products, created from raw materials obtained by known methods of decomposition of plastic waste. Housewives could select designs for utensils, furniture, or other articles from televised catalogues, with manufacturing instructions for the Replicator being distributed over telephone lines.

"Profipower" Microphone

The new "profipower" dynamic microphone is the top model of Sennheisers' full line of soloist microphones, and has especially been developed to meet the demands of the professional musician. The trade name given this microphone is to indicate that the microphone features certain properties which are described as "power" by professionals: unusually high dynamic range together with the highest possible safety against feedback through an excellent frequency independent directional characteristic.

Since a musician's microphone has to be extremely insensitive to handling noise the "profipower" has been equipped with a temperature-independent damping suspension to protect the transducer system against noise. A built-in low-frequency roll-off filter prevents extremely low-frequency interference reaching the transducer. With this model a microphone is available to the musician featuring excellent low frequency response but at the same time reducing handling and shock noise.

An integrated pop-screen prevents pop-noise and accentuated sibilant sounds.

The "profipower" is delivered with a 3-pin Cannon connector XLR 3. The electrical impedance at 1000 Hz is 200 Ω, the minimal recommended load impedance is 1000 Ω. The microphone is delivered with a 5 m connection cable fitted with a 6.3 mm jack plug for direct connection to musicians' equipment.

Thumbwheels a Problem?

C & K Components Inc. of the USA have released a small booklet entitled "All you should know about thumbwheels . . . and never asked" for free issue to interested customers.

This is a 6-page publication explaining basic fundamentals associated with thumbwheel switches. The approach is light and makes for entertaining reading.

For your free copy contact C & K in Sydney (at *P.O. Box 101, Merrylands, 2160*) or Interstate Agents.

Walkie-Talkie US Extension

Although the FCC had set a sales cutoff date of September 18th for 27 MHz walkie-talkies, this has now been extended to December 31st. General Electric Co and Fanon/Courier Corp both claimed they needed the extension to sell large inventories of the 27 MHz units. Seems to us that recent publicity over the walkie-talkies in Australia could also be involved in their pleas.

New Office Recorder

Cassette tape recorders have become an essential item of office equipment, especially with secretarial costs rising and the need to economise on labour costs.

However, one problem with many tape recorders on the market is the relatively short life of batteries, which can become a major obstacle in recording long business conferences.

To overcome this probem AIWA have just launched on the market a compact portable cassette recorder which provides 12 hours continuous recording on a single set of batteries. This compares with three to four hours on most other tape recorders.

The new set is ideal for businessmen and secretaries as it also provides a special speed control facility which means that when a businessman is recording he can increase the speed by 10%; and conversely when a secretary is typing back the tape she can slow the speed by 10%.

The AIWA cassette recorder can operate from three power sources (AC, DC and car battery) and has an in-built anti-rolling mechanism which assures stable cassette play from any position or while in motion.

It has a quick cue and review facility which automatically traces the voice back to a particular point of a businessman wishes to correct material he is dictating.

Other features include a digital tape counter; mechanical pause control and auto-stop mechanism; new slide-type ejection for quick cassette removal; and convenient "one push" recording mechanism.

It sells in Australia for $149.

VTR Leader Logic

The engineering supervisor of the Australian Film and Television School, Ernst A. Hadenfeld, has devised a system for electronically generating a leader for video tape recordings in a way that is fully automatic.

A video tape leader must provide accurate aural and visual timing cues both prior to recording and also on replay. It should also be consistent with international recommendations on timing sequences.

In the Hadenfeld system the sequential elements of the leader are switched automatically by digital logic circuitry which is triggered when the RECORD button of the video tape recorder is depressed.

A switch on the front panel of the leader generator module allows the operator to select one of two The TAPE LEADER sequence, lasting 95 seconds, controls the switching of separately generated test signals and program identification for the front of each new roll of tape. The second is the shortened TAKE LEADER sequence of 25 seconds providing an accurate countdown and take identification for each take on the roll.

Mr Hadenfeld will give a paper on the system to the Sydney division of the Institute of Radio and Electronics Engineers at the Australian Film and Television School at 6.30 pm on Tuesday, 27 June, 1978. Visitors are welcome to IREE meetings and refreshments will be available from 6.00 pm.

Anyone seeking technical details of the system and who is unable to attend this meeting should write to *The Australian Film and Television School, Box 126, Post Office, North Ryde, 2113.*

ETI/Unitrex Calculator Contest

You're all getting too smart for us to fool you – hardly anyone got the wrong answer for the March contest. The correct answer is that the tea contains the same amount of coffee as the coffee contains of tea, and the winning entry was submitted by Steve Gagan of East Kew, Victoria, who mathematically proved it to us.

And so to this month's problem. Normally, in our office, to decide who does those particularly boring jobs (like checking the contest entries to see if anyone has enclosed queries or other letters), we toss a coin. Now, this is fair enough, but after I had won the toss six times in a row, young Simon was beginning to wonder if perhaps I wasn't using some kind of mathematical trickery to swing the odds my way. 'O.K.', I said, 'I'll tell you what. You toss two coins and I'll toss one. If you have more heads than I have, you win. If you don't, you lose. How's that?'.

'Good', said Simon, 'that sounds better to me'. The question is, was this entirely wise of young Simon?

Seal an empty envelope,write your answer on the back of it, with your name and address, and send it to: Unitrex Calculator Contest (May), ETI Magazine, 15 Boundary Street, Rushcutters Bay, NSW 2011. The closing date is 16th June.

Phone-Line TV

Visicom (A/asia) Corp. proudly announces being appointed exclusive Australia/New Zealand/Papua New Guinea distributor of Robot Research Corp. (USA) Phone-Line TV and Professional Slow Scan TV.

Visual information can be transferred in 8½ seconds using a standard TV camera, Robot PLTV units, and TV monitor over regular Telecom or private telephone lines. A permanent record of transmitted data is recorded and stored using an inexpensive cassette recorder and retrieved as required. An extensive range of options and accessories are available. Visual information can be exchanged via almost any two-way radio with little or no modification to the radio equipment using Robot Professional Slow Scan TV (SSTV) equipment. Applications of Robot PLTV and Professional SSTV include military, medical, commerce, scientific, education and security.

Visicom (A/asia) Corp. was recently formed specifically to market Robot equipment and cannot be found in any telephone or other directory as yet.

Inquiries may be directed to: Visicom (A/asia) Corp., Marketing Division, P.O. Box 2058, Cairns, Queensland, 4870.

Antarctic Trip Winner

Mr. A.J. Rothwell, of Chapman, ACT, is pictured drawing the winning entry in the Dick Smith South Pole competition conducted recently.

With Mr. Rothwell is Bob Johnson, Manager of the Dick Smith store at Gore Hill, Sydney.

The lucky winner was Mr. A. Commadeur of Warragul, Victoria. From all reports Mr. Commadeur enjoyed his flight which was conducted in February.

Errata

Linear Capacitance Meter, ETI 136, March 78. Some errors slipped through the system and appeared in this project. In the parts list, R4 is omitted – it should be 120R. On the circuit diagram, R7 should be 1k, R8 should be 10k, and the battery polarity is shown reversed. The orientation of IC2 shown on the component overlay is incorrect – for a 78L12 the flat should face to the right of the drawing, while for a 7812 the flat metal back of the TO-220 pack should face to the left. The markings on the printed circuit board are correct. R7 to R12 and the pilot lamp connect to the point marked '+12V' on the overlay. The common connection to switch S3 should be taken from the point marked 'red terminal' on the overlay.

Dual Power Supply, ETI 581, Jan 77. Some readers have had problems with failure of low powered regulators when using loads connected between the positive and negative outputs. This is caused by one filter capacitor discharging before the other on switch-off and the load pulling the output of the regulator into reverse voltage. This can be prevented by adding diodes (1N4001, 1N914, etc.) across the outputs to limit any such voltage to 0.6 V.

The Strange Case of Circinus X1

AN INTENSIVE RESEARCH PROJECT by Australian astronomers using all of the country's major optical and radio telescopes, has the secret of one of the southern sky's most mysterious objects.

THE ENIGMATIC BEHAVIOUR of Circinus X-1, the first cosmic X-ray source to be found in the constellation Circinus, 30,000 light years distant, has defied explanation since it was first detected by NASA satellite-borne X-ray telescopes in 1971-72.

Dr Raymond Haynes, an astronomer with CSIRO's Division of Radiophysics who, with four colleagues, Drs Ian Lerche, David Launcey, Jim Caswell and Paul Murdin, has proposed an explanation for the odd behaviour of Circinus X-1, says it has been found to be not one object but two — a tiny, incredibly dense neutron star in elliptical orbit around a massive supergiant sun.

Approximately every 16 days, after travelling 320 million kilometres, the neutron star hurtles across the face of the supergiant. Tidal forces exerted by the neutron star pull a million billion tonnes of hot, gaseous matter off the supergiant at each pass.

The fiery tide rains down onto the surface of the neutron star, creating a massive three-day outburst of radiation which is detectable by radio and optical telescopes in the southern hemisphere.

Co-operative effort

Circinus X-1 yielded its secrets only after collation of an enormous amount of data from combined observations made with CSIRO's 64-metre Parkes radiotelescope, NASA's 64-metre radio-telescope at Tidbinbilla, Sydney University's Fleurs synthesis and Molonglo radiotelescopes, the Anglo-Australian Observatory's 4-metre optical telescope and the UK Schmidt optical telescope.

Dr Haynes said the co-operative work provided the clues necessary to a detailed understanding of the strange behaviour of Circinus X-1.

Every 16 days and 14 hours, the X-rays are cut off and radio flares are detected at intervals of about 18 hours. The increase in brightness is due to a swelling of the supergiant's size as the tidal attraction of the neutron star grows stronger.

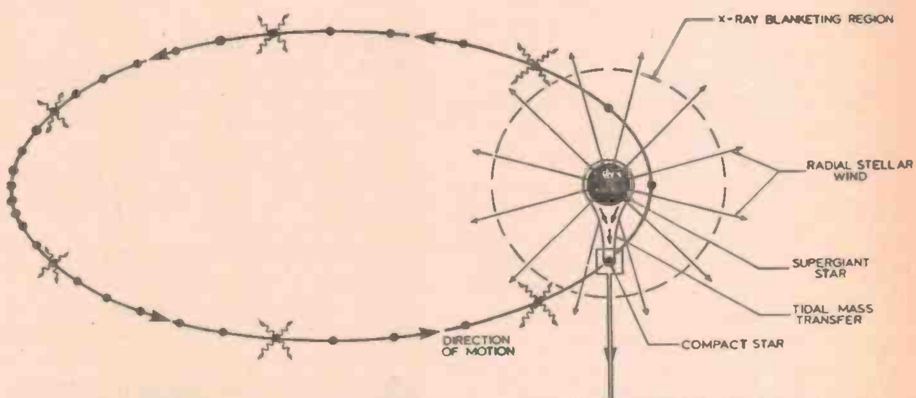
The first radio measurements of a point source near the positional of Circinus X-1 were obtained by CSIRO and Sydney University researchers in 1974-75, using the Parkes and Molonglo radiotelescopes.

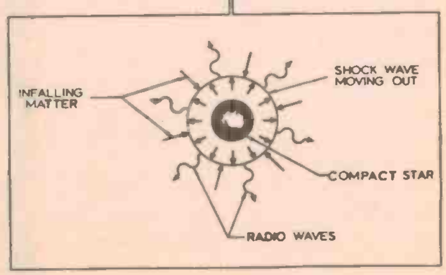
About the same time, an Anglo-Australian Observatory team at Siding Spring discovered a massive supergiant with an extremely red spectrum near the same position.

Evidence linking the radio source, X-ray source and visible supergiant was obtained in two ways.

First, a CSIRO-Sydney University team using the Fleurs synthesis radio-telescope confirmed the radio source coincided with the position of the supergiant.

Then CSIRO scientists discovered the radio source flared up in intensity every 16 days, shortly after the X-ray source turned off.





The cycle of events. The neutron star is shown in orbit around the supergiant star. The dots represent equal time intervals of approxlmately half a day. The compact star accelerates as it approaches the supergiant and swings around it, taking 16.6 days to complete the cycle. It is inside the X-ray blanketing region for about three days (not to scale).

The Strange Case of Circinus X1

Recent radio observations by CSIRO and Sydney University researchers using the Parkes and Tidbinbilla radiotelescopes and the Fleurs synthesis radiotelescope defined the pattern of radio flaring at different frequencies, allowing them to deduce how the radio waves are generated.

Dr Haynes says that during the neutron star's close encounter with the supergiant, the supergiant's stellar wind completely blankets the neutron star's characteristic X-ray emissions.

Only after the compact star has moved away from its supergiant companion does the blanketing effect thin out enough to allow the X-rays to "shine" through and to be detected by X-ray satellities.

Black Hole?

Although the evidence is strongly suggestive that the smaller object is a neutron star, Dr Haynes says there is a possibility that it may be one of the elusive "black holes" predicted by cosmologists.

Such theories predict any star larger than 10 solar masses will undergo complete collapse under its own gravity, so that all matter is crushed to a single point, a "singularity" from which nothing, including light, can escape — a "black hole".

Stars with a mass less than 10 times that of our own sun will eventually collapse under their own gravity into tiny, incredibly dense objects only a few kilometres across in which the spaces within and between atoms no longer exist — neutron stars.

Dr Haynes said astrophysicists were excited by the discovery because their co-operative efforts had not only forced Circinus X-1 to reveal how it "ticks", but had also allowed its future behavior patterns to be predicted.

Two of these predictions had already been verified, adding to the evidence of the supergiant-neutron star pairing.

Dr Haynes said Australian astronomers would now co-operate with the Hartebeestoehoek Radio Astronomy Observatory in Pretoria, South Africa, in further investigations of the unique object in efforts to confirm other predictions about Circinus X-1. The discovery also promised to be a major topic for discussion at a high level symposium involving Australian, Russian and American astronomers in Sydney on Monday 17th April.

Flying the Space Shuttle

The Space Shuttle will be the first spacecraft to actually fly on re-entry to Earth's atmosphere.

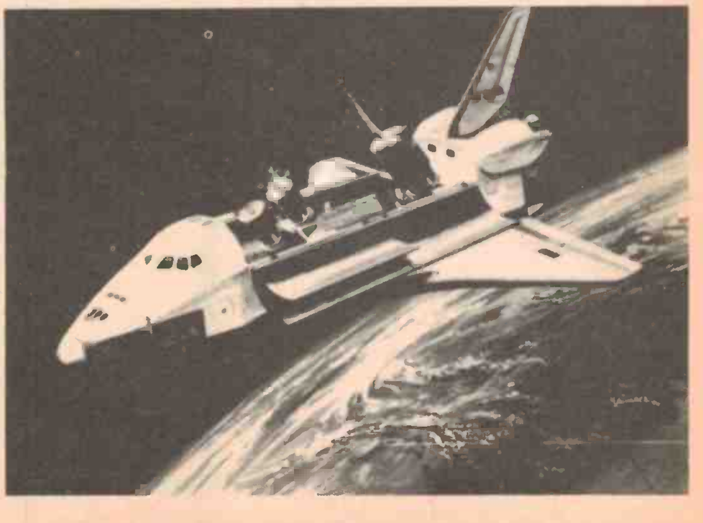
THE WORLD'S FASTEST glider, which was built by the combined efforts of 50,000 people in 47 States in the US, has now flown five times. On 12th August last year, the Space Shuttle 'Enterprise' was carried,piggyback style,on a specially modified 747, to a height of 8,540 m where the two craft started a descent to 7,350 m, at which point they separated, and Enterprise flew for the first time.

The first free-flight test of the Space Shuttle, watched by 60,000 people marked the commencement of the final phase of months of testing at Edwards Air Force Base in the Mojave Desert of Southern California. At the end of January 1977 the Shuttle was moved from its assembly facility at Palmdale, along 58 km of specially widened roads to Edwards AFB, for the first Approach and Landing Test (ALT).

The Space Shuttle is the first of a new breed of spacecraft which is designed to be reused. Previously, the technology available meant that each spacecraft could be used only once, but for any long-term program of space research this is extremely wasteful. Everything was built to the highest standards and then used only once. The Space Shuttle changes this. The Space Shuttle Orbiter vehicle is designed to land intact in the same manner as an aircraft, and the solid rocket boosters used to provide the enormous thrust at takeoff are also reusable. In fact, a Space Shuttle can be launched as quickly as 160 hours after landing from the previous mission, although a two-week ground turnaround is the goal in actual use.

The Shuttle is launched vertically, attached to an external tank which contains the ascent fuel burnt by the Orbiter's main engines, and two solid rocket boosters. At lift-off all the engines fire in parallel, the SRB's each generating 11,800,000 Newtons of thrust and the three Orbiter engines each generating

The 747/Shuttle combination fly over California. Note the aerodynamic tail fairing on the Shuttle.



The Shuttle can be used to carry up to five satellites.

2,100,000 N. The two SRB's are jettisoned once they burn out and are recovered after a parachute descent. The external tank is jettisoned before the Orbiter attains orbit.

The orbital maneuvering system is used to make any adjustments to the orbit or any maneuvers that may be required during the mission. The jets for this system are mounted near the nose and in pods on the upper rear of the fuselage. These jets can pitch, roll or yaw the Orbiter.

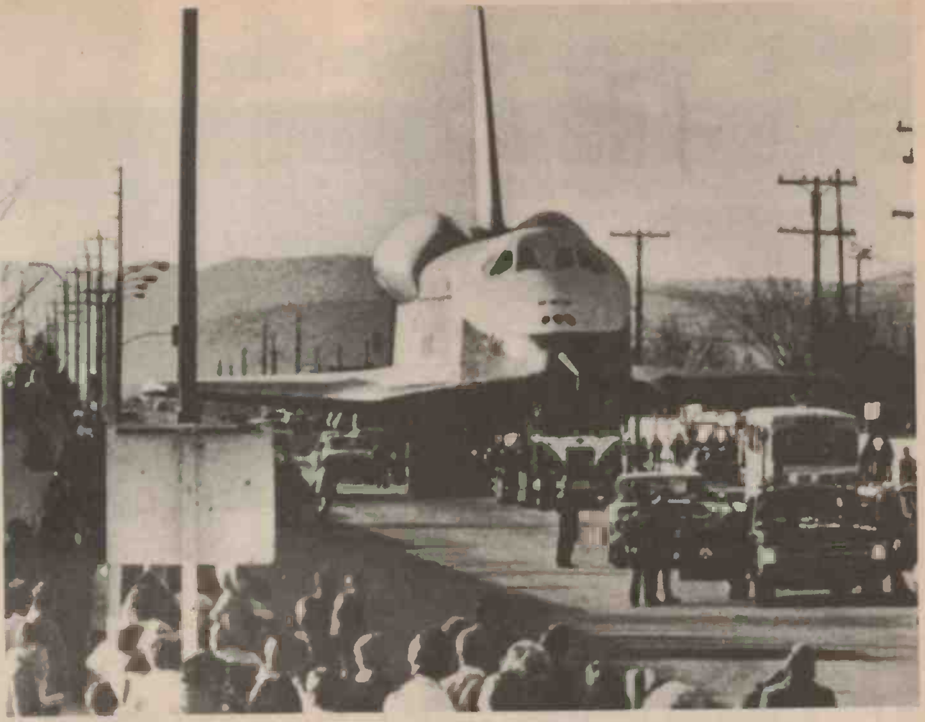
The Orbiter is designed to carry a crew of seven (early missions call for four), including scientific and technical personnel and a payload up to 18m long and 5m in diameter. Because of the low g forces at launch, only 3g and less than 1.5g on re-entry, space flight is no longer limited to intensively physically trained astronauts - now experienced scientists and technicians can have access to zero g, vacuum conditions.

Payloads up to 29,500 kg can be placed into orbit by the space shuttle. These can range from small satellites to fully equipped scientific laboratories, and not only can the Space Shuttle launch payloads into orbit, it can also retrieve them and return them to earth and service or refurbish satellites in space. The versatility of the Shuttle's cargo bay opens up whole new areas, such as space manufacturing.

Upon completion of the various mission duties, the crew will prepare the Orbiter for re-entry - this is when the Space Shuttle really flies. The Orbiter, since it moves in the two media of air and vacuum, has two separate maneuvering systems. One is the orbital maneuvering system referred to above, and the other is a set of aerodynamic control surfaces that act in much the same way as conventional aircraft.

There are seven aerodynamic control surfaces on the Orbiter. Four of these are on the rear of the wings and are called 'elevons' - they combine the effects of elevators and ailerons. The fifth surface is at the bottom rear of the fuselage between the wings, and assists the elevons in controlling the pitch of the craft. It also protects the rocket engine nozzles from buffeting in the airstream during re-entry. The two remaining panels are on the rear of the vertical tail and can be used as a rudder or spread apart to form a 'speedbrake' by increasing the drag. This is used to limit the airspeed during landing.

At low speeds these surfaces act in a conventional manner. However, at supersonic speeds above Mach 1.5, the effect of some of the control surfaces is reversed, or not the expected one, which makes flying in a conventional manner impossible! To get round this problem, the Space Shuttle, unlike most



58 km of road was specially widened to move the Space Shuttle.

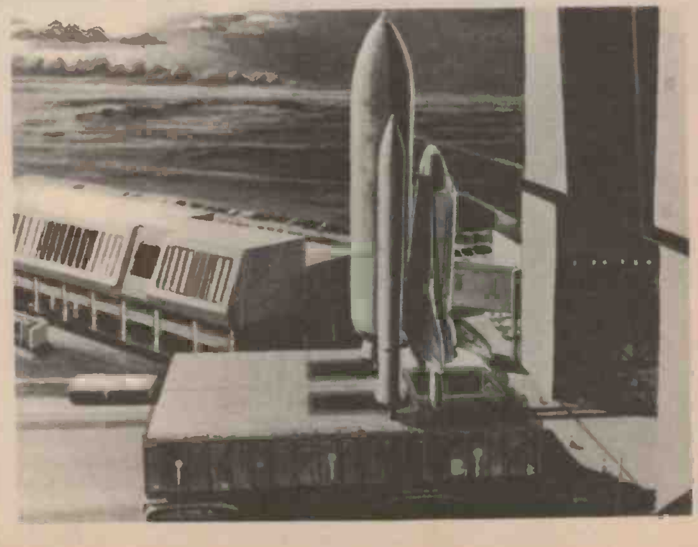
aircraft, which use mechanical or hydraulic links between pilot and controls, uses a digital 'fly-by-wire' Flight Control System. This is based on three on-board IBM System/4 Pi AP-101 computers which monitor their own operation to provide a measure of fail-safe redundancy.

The Flight Control System (FCS) can be operated in three modes: Direct (DIR), Control Stick Steering (CSS) and AUTO. The mode can be selected separately for pitch, roll/yaw, speedbrake and body flap controls.

In DIR mode, the pilot grips a small stick called the Rotational Hand Controller and ordinary pedals. Movements of these inputs to the FCS produce movements of the control surfaces in the same way as a conventional aircraft would respond - at subsonic speeds, at least. Above Mach 1.5 things go haywire - the result is like trying to ride a bicycle with your hands crossed, and only with considerable training can the pilot avoid making involuntary, incorrect movements of the RHC stick.

In the AUTO mode, the FCS takes inputs from star sensors, inertial measurements units, rate gyros, accelerometers, and air data sensors, and compares this with the desired trajectory, automatically making corrections to keep on the path. In fact, the Orbiter can land itself from orbit completely automatically, with the only pilot inter-

The Shuttle is dwarfed by its external fuel tank at launch.



Flying the Space Shuttle

vention required being landing gear extension and operating the brakes on the runway!

In the CSS mode, the Flight Control System interprets between the pilot and the control surfaces. The pilot uses the Rotational Hand Controller and pedals, but the FCS accepts these inputs as rate commands in pitch, roll or yaw - in other words, the way the pilot wants the Orbiter to move. These commands are compared with inputs from the rate gyros and accelerometers, and generates control signals to implement the pilot's commands. In this mode the FCS automatically takes account of the reverse effects produced by the aerodynamic surfaces at high airspeeds.

Re-entry

The Orbiter starts re-entry at a high angle of attack, around 30 to 40 degrees, so that the bottom of the wing and fuselage are exposed to the airstream. The under surface is covered with a high-temperature structure of reinforced carbon-carbon on the leading edges and special silica tiles over most of the other surfaces to maintain the airframe within acceptable temperature limits.

Unfortunately, because of the high angle of attack, moving the RHC to the left in the DIR mode causes the Orbiter to roll to the right. This is because the right elevon is deflected downward, but this causes drag, and turns the vehicle to the right. This increases the lift on the left wing, so it lifts, causing the right roll. In the Control Stick Steering mode, though, this problem is taken care of by the Flight Control System, and the pilot simply moves the stick the way he wants the vehicle to go and it responds in the correct way.

The angle of attack must be carefully controlled to avoid overheating problems during the descent. To accomplish this, the Shuttle banks at up to 80 degrees, and so flies on a curved path. This would take the Shuttle away from its target and so, several times during the re-entry, the bank angle is reversed, and the vehicle starts turning back towards its target. This maneuver is complicated by the fact that, because of the high angle of attack, the rudder is virtually in a vacuum, and so these turns are executed by rolling the Shuttle.

Approach

Finally, the Orbiter is down to a speed of Mach 1.5, and begins to fly like a conventional aircraft. It is now at a height of 21,000m and about 50km from its landing field. From now on, things are straightforward as the pilot closes in using conventional electronic navigation equipment like TACAN and Microwave Scanning Beam Landing System. As he turns to the final glidepath, the pilot will use the speedbrake on the tail to lose both speed and height. During this phase of the landing, the speedbrake is normally open at 45^{o}. If the Orbiter is high, the pilot will open the speedbrake and steepen his descent; if low, he will close it and fly a shallower glidepath.

The Orbiter makes final approach at 540km/hr and at an angle as steep as 24^{o}. At 600m, the pilot starts to pull up, or 'flare', and at 300m, the landing gear is dropped. The vehicle touches down at 350km/hour; at this point it is losing 9km/hr of speed every second and stalls at 280km/hr, which is why the land is at such high speed.

The Approach and Landing Test

were designed to check out the performance of the Shuttle during this phase of the mission. They were also designed to check the performance of that now-famous 747/Space Shuttle combination which will continue to fly, delivering Orbiters to the launch site from the production line and landing sites.

First Flight

The first flight of the Space Shuttle took place on 12th August last year. At 8 AM, the 747 Shuttle Carrier Aircraft with its piggyback Orbiter took off on time - the only problem had been a fault in one of the AP101 computers, but that unit was quickly replaced.

At 8.47 the pair were at 8,539m, and the Boeing started a 7^{o} dive. At a speed of 280kts, and a height of 7,346m, the Boeing pilot informed the Shuttle crew that they were ready for separation. The crew, Haise and Fullerton, fired the separation bolts and lifted away, rolling to the left while the 747 dropped to the right. Following a pair of right and left rolls to put some distance between the two craft, Haise tried a practice flare and some banking maneuvres. This gave the computers at Johnson Space Centre the opportunity to calculate any deviation from the predicted lift/drag ratios, information which would allow a more accurate landing. In fact, the JSC ground controllers muffed it by assuming that the Orbiter was in level flight, whereas it was actually climbing, so they concluded that the lift/drag ratio was lower than predicted.

Fullerton then took the Orbiter into a 90^{o} right turn, with the vehicle responding well, and about 20 seconds later Haise performed the second 90^{o} turn. At this point Haise could see the runway, and noticed that the Orbiter was too high, with excess speed. Opening the speedbrake to 36^{o}, the Shuttle was still accelerating, so Haise opened the speedbrake to 45^{o} and decided to overshoot the original landing point by several hundred metres. By this point, it was becoming painfully apparent that the Shuttle was behaving as originally predicted, and that the calculated excess drag was an error.

Haise could not open the speedbrake beyond 45^{o}; this was a mission constraint to avoid steep glideslope angles. Performing a flare at 270m, Haise touched down 600m beyond the expected touch down point at a speed just over 360km/hr. The overshoot was no problem, as runway 17 at Edwards AFB is 11km long, but with the wheels on the ground, Haise opened the speedbrake to 90^{o} and the nose wheel came down. The flight had lasted just 5 min 23 sec.

Photos clockwise from top left: The Shuttle/SCA assembly lifts off; 1 second after separation; a technician holds a red hot piece of the silica heat insulation in his bare hand; touchdown; the Shuttle approaches, tagged by an observation aircraft; our prize for Mickey Mouse look-alike of the month goes to the Space Shuttle. Pictures courtesy of NASA.

The first three flights were made with a streamlined tail fairing covering the dummy rocket engines at the tail. The fourth flight, on 12th October, was made with the fairing removed, giving a slightly reduced lift/drag ratio. Otherwise, the vehicle did not behave significantly differently.

A final flight on 26th October ended with a clumsy landing, but in every respect the tests were successful. Frankly, the fact that a craft as large and as complex as the Space Shuttle Orbiter can fly at all is a tribute to the advances that have been made since the Orville brothers flew on 17th December, 1903, and the men who made those advances.

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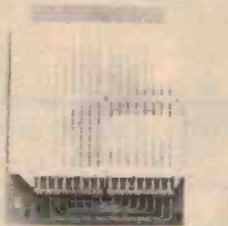

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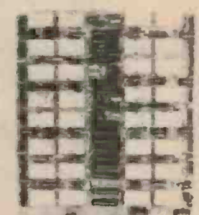

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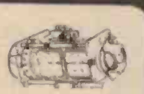

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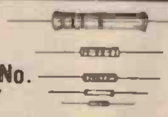

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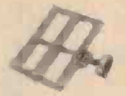
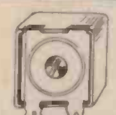
CAT. No. CP 88



SONY 9 BAND SELECT ROTARY-SLIDE SWITCH. 9 position 12 pole. This was used on the Sony S.W. A.M. radio model CRF 5090. Normal retail $27.00. This is a fantastic multi-purpose switch and must be seen to be believed. **Only from us at $10.00 each P&P $1.00.**

CAT. No. CP 89



TRIMMING CAPACITOR by JACKSON BROS. High grade type with ceramic body. Screwdriver adjustment. Capacity 450 to 2000 pf. Size 23 x 23 mm. **50c each or 5 for $2.25. P&P 40c for 5.**

CAT. No. CP 90

FERRITE POT-CORE H.F. CHOKES, (adjustable). These have been made by Philips to stringent specifications. Fully wound in the following frequencies. 1296, 1698 and 4818 mH. Also a tapped version at 19.5 — 20.7 mH/215 mH. **A 'giveaway' at 50c each or 4 assorted for $1.75. P&P 1 off 30c or 4 for $1.00.**

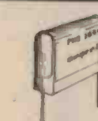
CAT. No. CP 91

POLYCAP & RESISTOR PAC. 10 each of the following: Philips polcapacitors 0.82 uF and 0.01 uF 160 V tubular foil — Resistors, wire-wound types, 3 and 120 Ω in 10 W, 22 Ω 5 W, 220 Ω and 3.9K Ω in 4 W. A total of 70 resistors and caps. Normal retail value around $20. **Our Crazy 'Giveaway' price $6.00 post free.**

CAT. No CP 92

CLARE MERCURY WETTED RELAY (type HGRX5011). Coil resistance — 1.1 K Ω plus 1.1 K Ω must operate voltage 8.77 V max. Operating voltage 49.8 V (peak efficiency) switches 2 amp 500 VDC (or 100 W) change-over contacts. This is a super-sensitive relay. Cost over $13.00. **S.E's price only $1.00 each or 5 for $4.50 P&P 30c each or 5 for $1.00.**

CAT. No. CP 93



A.E.E. MYLAR 'MINIPRINT' CAPACITORS. Top grade epoxy resin encapsulated, type PHE280. Capacity — 0.1 uF 400 V. These are one of the best capacitors made in Australia. **Just 10 for $1.00.P&P 30c.**

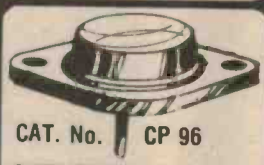
CAT. No. CP 94

PYE PLUG-IN-RELAYS. Miniature type 2C/202A. Twin 1 K Ω coils. Will normally operate on 18 VDC. When coils are connected in parallel will operate on 12 VDC. 2 pole change-over with 2amp contacts. Complete with base. **Only $1.50 each or 4 for $5.50. P&P 40c each or 4 for $1.00.**

CAT. No. CP 95

DUAL AIR-SPACED TUNING CAPACITOR. Complete with trimmers. Size: 40 mm x 40 mm x 32 mm deep. Spindle size: 15 mm x ¼''. Extremely well made by Sony Electronics. Only **$2.25 each P&P 60c.**

CAT. No. CP 96



POWER TRANSISTOR. Fairchild type 8149. SIM to 2N3055 except that Vcb is 60 instead of 100. **A real nutty price at only 60c each or 10 for $5.50 P&P 10 for $1.00.**

CAT. No. CP 97

SILICON NPN POWER TRANSISTOR. Fairchild type AX8141B in TO66 case. Used for 12 V auto regulators. Vce 25 Hfe. Min. 15 at 4 amps. 25 V. Icb: 200 uA. **5 for $2.00, tremendous value P&P 60c.**

CAT. No. CP 98

PHILIPS DYNAMIC MICROPHONES. Model IBB9002/BB. IMP. 500 . Sensitivity 0.3 mV/ubar (-70 dB). Supplied complete with stand and shielded lead. Only $5.85 each. P&P 60c.

CAT. NO. CP 99

T.V. GAMES CHIP AY-3-8550. Complete with 2 joystick controls. 6 games and scoring. Supplied with full data. **Value packed at only $24.00. P.C. boards to suit $3.50. P&P $1.00.**

CAT. No. CP 100

HEAVY DUTY CONTROL KEY SWITCH. On-off-on change-over. Suitable for 250 VAC 10 amp. Supplied with 2 keys. **All new at only $4.95 P&P 60c.**

CAT. No. CP 101

CAR RADIO FRONT PANEL & KNOB KIT. Will fit most car radio and cassette players. Size of panel 195 mm x 60 mm. Dist. between holes 145 mm. Size of aperature 113 mm x 50 mm. **Crazy at only 95c each P&P 40c.**

CAT. No. CP 102

7442 I.C. 16 pin D.I.L. BCD -decimal decoder. Lowest in the country. Only **65c each or 5 for $3.00 P&P 30c.**

CAT. No. CP 103

EDGE METER. 50-0-50 mA. (plus/minus 500 uADC). Top brand. Model EW-40. Dimensions: Overall 57 mm x 22 mm. Panel Cut-out: out 43 mm x 15 mm **A real knock-out price at only $6.50 each P&P 75c.**

CAT. No. CP 104

100 SILICON NPN TRANSISTORS. In metal TO18 can. Unmarked and slightly below specs. Similar to BC107/108/109. Guaranteed all useable. **Only $2.50 per 100. P&P 50c.**

CAT. No. CP 105

EM SERIES DIODES. 10 each of EM406 (600 V 1A) and EM408 (800 V 1A). **Only $2.00 for 20. Outstanding value. P&P 30c.**

CAT. No. CP 106

INDICATOR PANELS. With red and green bezel lamps (18-24 V) complete with lamps. Size: 90 mm x 50 mm. **Only 50c each or 5 for $2.25. P&P 30c each or 5 for $1.00.**

CAT. No. CP 107

4 POLE DOUBLE THROW (ON-ON-ON) TOGGLE SWITCH. Miniature type with paddle handle. Model No: 7411. Only **$2.00 each or 5 for $9.25. P&P 30c each or 5 for 75c.**

CAT. No. CP 108

MICRO-SWITCH. Heavy duty type made by Honeywell. Type No: BE-2R-T4-J. Normally open and normal closed switch. Suitable for 25 A 125 or 250 VAC. Size: 48 mm x 17 mm x 20 mm deep. Pin plunger. **Only from us at $1.75 each or 10 for $16.50. P&P 30c each or 10 for $1.00.**

CAT. No. CP 109

DISC CERAMIC CAPACITORS. 20 0.01 uF 2.5 kV plus 20 0.02 uF 1.6 kV plus 20 470 pF 2.5 kV. All top grade caps. **The 60 for only $5.00 P&P 60c worth more than treble.**

UFO Detector

Unit detects electromagnetic disturbances often held to be associated with UFO's.

EVERY YEAR MANY thousands of people see objects in the sky which they cannot explain in terms of their previous experience. In this sense the existence of unidentified flying objects (UFO's) is not a matter for debate — people see flying things they cannot identify, thus, by definition, these things are unidentified flying objects.

The vast majority of sightings are caused by various objects or phenomena perceived in an unusual manner: cloud formations, meteors, satellites, planets, an unusually bright star, temperature inversions, etc. There is also a substantial number of hoax devices.

Most people are satisfied if presented with a rational explanation for what they have seen.

But a minority are not — they are 'conspiracy theorists' who deny totally the principle of Occam's Razor. Faced with 99 probable explanations for an unusual happening — and just one explanation which complies with a previously accepted set of concepts — they will inevitably choose the odd one out.

No explanation or proof will convince the dedicated conspiracy theorist to think otherwise — a classic example of this is the oft-repeated story that the results of the USA Department of Air Force UFO Investigation 'Project Blue Book' have been suppressed. This is not really true. The Blue Book Project Files were declassified in 1970, and the USA Department of Air Force Office of Information state that the files are available to *all bona-fide researchers and media representatives.*

The conspiracy theory was well summed up by Salvador Freixedo at the UFO Conference in Acapulco (April 1977). 'The basic appeal of ufology (for the masses) is that it is a belief system rather than a field of scientific investigation'.

A further large number of classic cases quoted by ufologists has been well and truly debunked by Philip Klass (a technical journalist working with Aviation

Fig. 1. The UFO Detector, attached to the solenoid.

Week and Space Technology magazine).

Klass's book ('UFO's Explained') thoroughly demolishes the most classic cases and provides evidence which casts major doubt on those few remaining. Consider for example the often quoted 'UFO landing' in Socorro, New Mexico in 1964. It now turns out that the 'landing' was set up as a publicity stunt by the local mayor, who just happened to own that bit of land where the UFO 'landed'.

It is perhaps significant that no serious challenger has ever taken up the USA's National Enquirer's offer to pay one million US dollars for proof that UFO's are unnatural phenomena emanating from outer space.

A small minority of ufologists should however be taken more seriously. These are dedicated people who investigate reported sightings as thoroughly as they are able. Unfortunately most of their investigations tend to be 'unscientific' in the sense that they lack the rigorous discipline which truly scientific investigation demands. Nevertheless, it is to the movement's great credit that they realise their investigational limitations and are currently doing their best to check out as thoroughly as they can a number of previously accepted classic sightings.

In fact magazines such as the authoritative US publication 'UFO' currently feature exposes of previously 'proven' situations.

In the light of this recent background, Electronics Today International was extremely interested to learn of a UFO magnetic anomaly detector recently developed by one of our contributors.

The basis of this device is that many UFO sightings are claimed to have coincided with major magnetic disturbances. In many reported situations, electrical equipment is claimed to have ceased to operate whilst the UFO was in the vicinity.

Thus, claim some ufologists, it may well be possible to sense the approach of a UFO by detecting abnormal perturbations of the earth's magnetic field.

The unit described here has been designed by Mr. F.C. Gillespie (6 Reginald Ave., Findon, SA), who has considerable expertise in this field.

UFO literature indicates that magnetic disturbances associated with some UFO activity are of such a magnitude that they should be detectable by relatively simple equipment. Naturally the more sensitive the equipment the further away a disturbance could be detected — however an upper practical limit for sensitivity is set in most areas by the generally high level of background noise associated with civilisation — and which, ironically, is often postulated as attracting UFO's to this planet.

It is not at all difficult to detect the magnetic disturbance caused by a light switched on 20 m away — or a car 100 or more metres distant; but one can rarely find a sufficiently magnetic-noise-free environment in which to set up an instrument of such sensitivity.

The detector described here has adjustable sensitivity and in all but the very 'quietest' of areas the sensitivity can be set so that the noise just fails to trigger it. It is only in very rare and remote locations that the detector itself is the limiting factor.

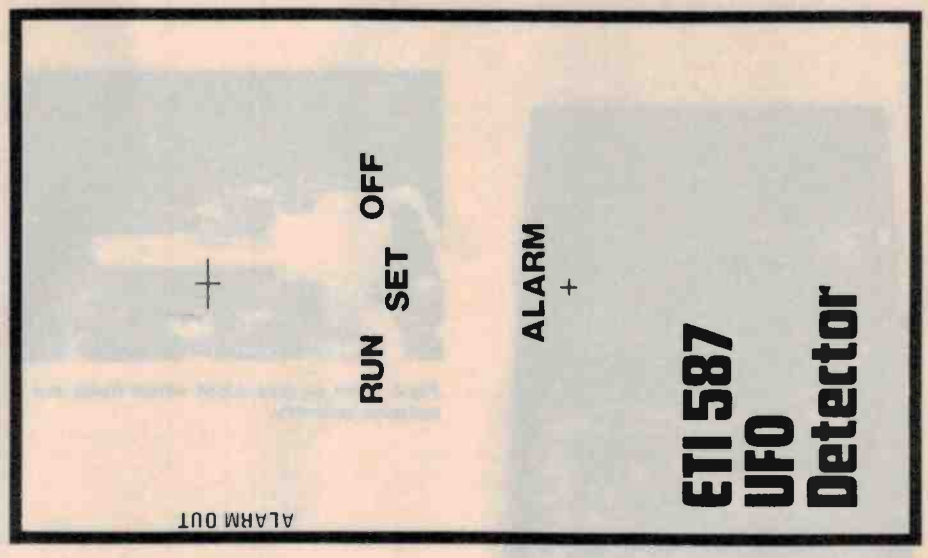
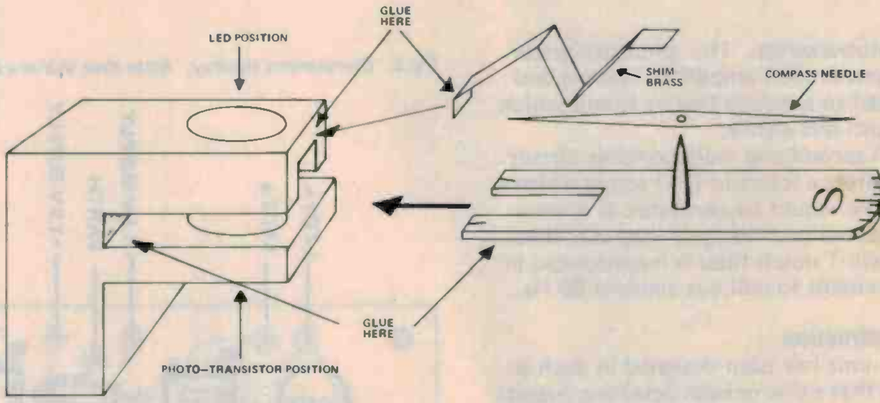


Fig.2.a) Front panel artwork for the UFO Detector (half size). b) Construction of the perspex compass block.

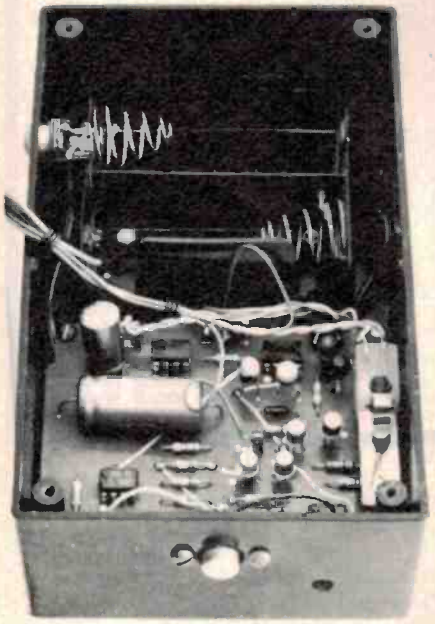


Operating Principles

There is anecdotal evidence that the magnetic disturbances associated with UFO's may be transient in nature or may build up and decay over a period of time or may also be of an oscillatory nature.

For this reason the magnetic anomaly detector has two detecting systems capable of responding to all three types of disturbance.

The simpler of the two systems responds to minor movements of a very sensitive compass. The compass needle is set up so that when undisturbed it blocks the passage of light from a flashing LED, the light output from which would otherwise fall on a sensitive



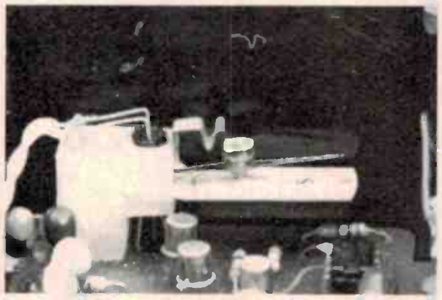


Fig.4. The perspex block which holds the compass assembly.

Fig.3. Internal shot of the UFO Detector.

HOW IT WORKS – ETI 587

Any voltage output resulting from a changing magnetic field around L1 is passed to the two-stage amplifier formed by IC1 and IC2. Fifty Hz background noise is greatly attenuated by the twin-T notch filter formed by the components between L1 and the amplifier. The frequency of the notch is adjustable by RV1.

The gain of the amplifier IC1/IC2 is varied by RV2. Output signals from the amplifier are passed to Q1/Q2/Q3/Q4 which form two latching circuits (each functioning depending on the polarity of the output signal).

The output of the latching circuitry is then passed to IC4. This is a National LM3909 LED flasher. This causes the alarm LED to flash at about 3 Hz.

An external alarm output is also provided.

The compass circuitry is quite straightforward. IC3 is used to extend battery life. Any output from the phototransistor Q5 triggers the latching mechanism thus initiating the alarm sequence.

phototransistor. The phototransistor output is then amplified, latched and passed to a second flasher circuit which in turn sets alarms.

A second and more complex circuit monitors a solenoid (L1) across which a voltage would be generated it it were subjected to a changing magnetic field. A twin-T notch filter is incorporated in this circuit to null out ambient 50 Hz.

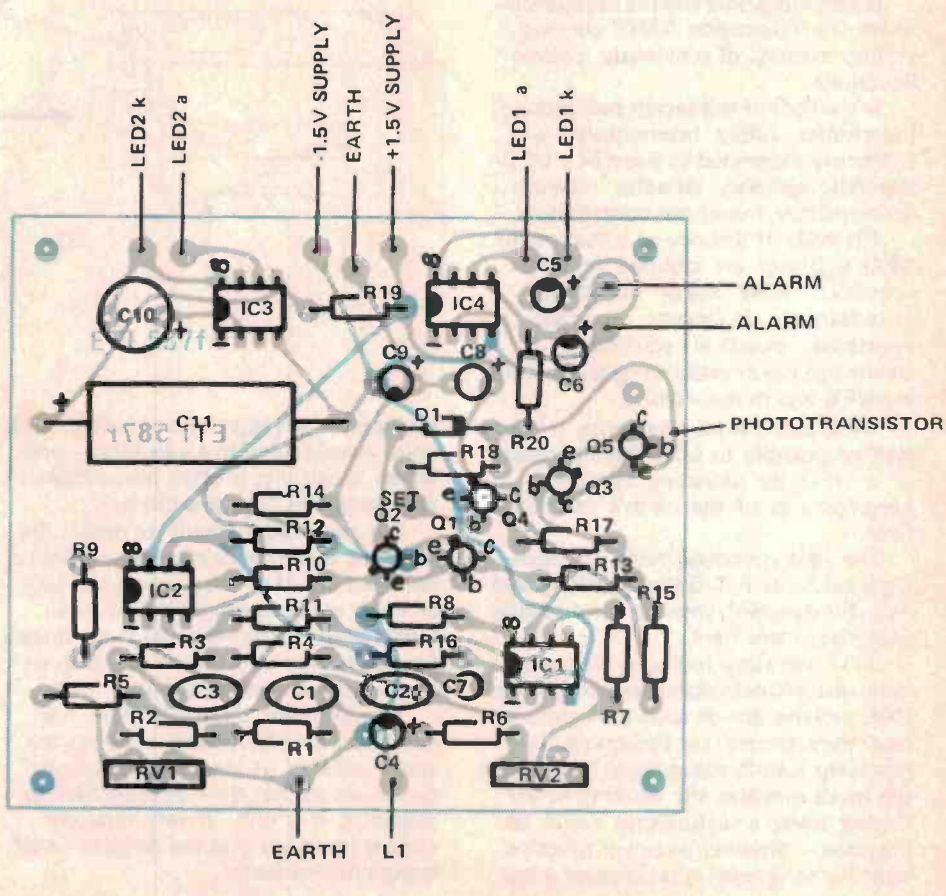
Construction

The unit has been designed in such a way that either or both detecting circuits may be used, or indeed, duplicated if required.

Circuit construction is relatively straightforward, especially if the printed circuit board is used. The solenoid is the actuating coil from a Post Office type 3000 relay (5 kohms). Many people will have such a device in their junk boxes – otherwise it can be obtained from disposal stores or other outlets handling Post Office surplus bits and pieces. The solenoid is located external to the unit and connected to it by a screened cable.

The block holding the LED and phototransistor associated with the compass mechanism is a little tricky to make. It may be built up from pieces of wood or plastic – or if you have the facilities it may be milled out of a block of brass or other non-magnetic material. The main requirements are that the

Fig.5. Component overlay. Note that this is a double-sided board.



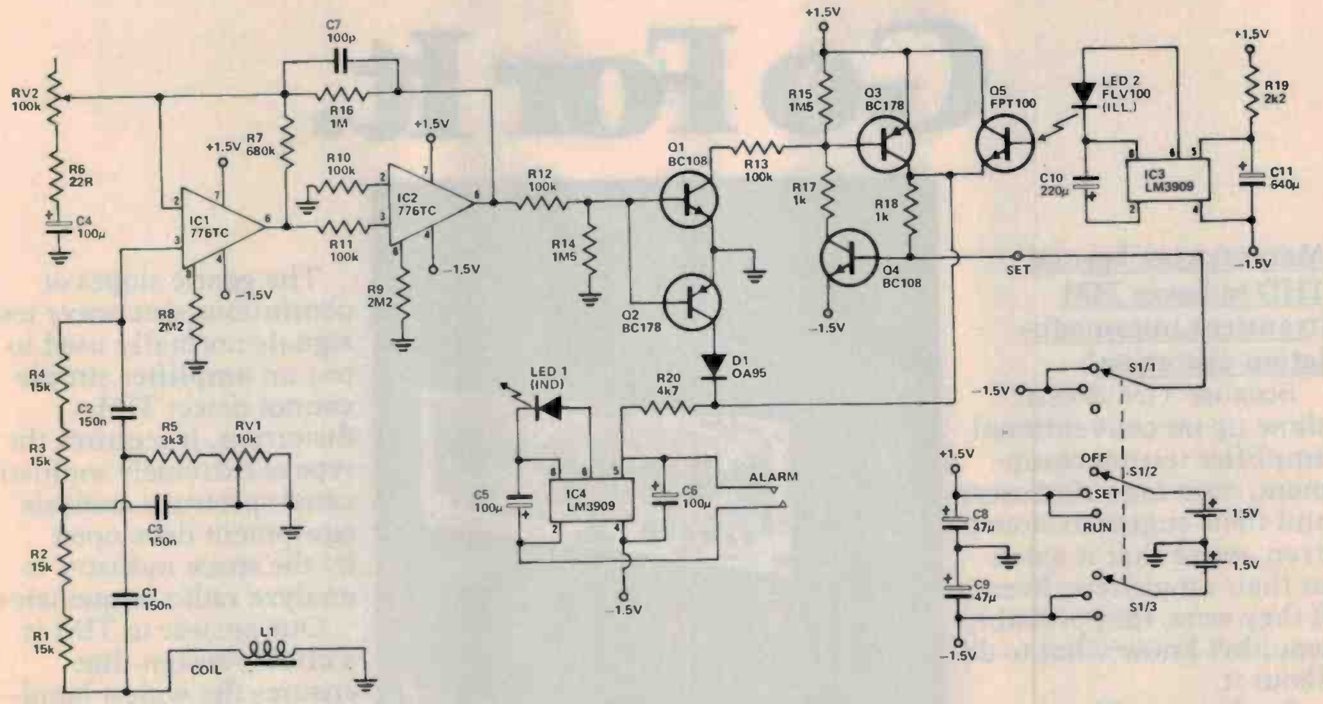


Fig.6. Circuit diagram of the UFO Detector.

LED and phototransistor *must* be very rigidly located and that the compass needle should just — but only just — block the light from the LED. The simplest way to make this section is to rebuild an old compass.

We suggest that you build the unit in sections checking out each section as it is completed.

No matter how you build the device it is absolutely essential to make sure that the compass assembly is mounted very rigidly — if there is any freedom of movement random mechanical disturbances will be registered as alarms.

Setting Up

The compass circuitry is quite straightforward. Provided it has been made correctly the phototransistor should be blocked by the compass needle when the complete detector assembly has been aligned precisely along the magnetic North/South line. Bringing a magnet or iron bar near the assembly should cause the needle to move slightly, thus allowing light to pass from the LED to the phototransistor, triggering Q3 and Q4, actuating the alarm.

The solenoid circuit is slightly more complex in that the twin-T rejection filter must be adjusted to optimise 50 Hz rejection. This may be done by observing the output from IC2 on a CRO while adjusting RV1 for maximum rejection. If a 'scope is not available, then RV1 must be adjusted so that the circuit is not triggered by 50 Hz — increasing circuit gain via RV2 until the optimum setting is obtained. There is no need to inject 50 Hz into the circuit whilst setting up — in most places there's more around than you'll need!

Once the initial adjustments are made there will be little need to change anything except the sensitivity (gain) control RV2. This should be adjusted so that the unit is just short of triggering under normal conditions.

Local thunderstorms may occasionally trigger the unit but this is inevitable unless you use the unit on low sensitivities.

Well, there it is — the device *will* detect magnetic anomalies. Whether it will consistently detect UFO's is another matter — we were unable to obtain a DIN standard UFO for calibration purposes! Until we do, we refrain from making any claims as to the efficacy of this device!

PARTS LIST — ETI 587

Resistors all ¼ W, 5%

- R1-R4 . . 15k
- R5 . . . . 3k3
- R6 . . . . 22R
- R7 . . . . 680k
- R8,9 . . . 2M2
- R10-R13 . 100k
- R14,15 . . 1M5
- R16. . . . 1M
- R17,18 . . 1k
- R19. . . . 2k2
- R20. . . . 4k7

Potentiometers

- RV1 . . . 10k trimpot
- RV2 . . . 100k trimpot

Capacitors

- C1-C3. . . 150n
- C4-C6. . . 100µ 3.6 V tantalum
- C7. . . . 100p
- C8,9 . . . 47µ 6.3 V tantalum
- C10. . . . 220µ 10 V electrolytic
- C11. . . . 640µ 16 V electrolytic

Semiconductors

- IC1,2 . . . 776TC op amp (or LM4250CN)
- IC3,4 . . . LM3909 flasher (National)
- Q1 . . . . BC108
- Q2,3 . . . BC178
- Q4 . . . . BC108
- D1 . . . . OA95, or similar germanium diode
- LED1. . . Red LED with mounting clip
- LED2. . . FLV100 (or NSL100)

Miscellaneous

- L1. . . . Solenoid (e.g. the coil from a 5k PO3000 type relay).
- S1. . . . . 3 pole 3 position 'F' switch

Magnetic compass, 40 mm maximum needle length (e.g. 'An Outdoor Must' No. 120).

Input and output plugs and sockets, pc board ETI 587, dual battery holder for two 'C' cells, two 1.5 V 'C' cells, 1 knob, case 155 x 90 x 45 mm (approx) internal, coax cable, shim brass, perspex, glue, black paint, wire.

Ultimately It's Marantz.
Go For It.

Marantz goes beyond THD to lower TIM (transient intermodulation distortion).

Because TIM doesn't show up on conventional amplifier testing equipment, most manufacturers and their engineers aren't even aware that it exists in their amplifiers. Even if they were, they probably wouldn't know what to do about it.

But because Marantz builds for the music and not just the specs we know how destructive TIM can be to pure sound reproduction. And we've developed a revolutionary new circuit design to eliminate it.

The reduction of TIM can be the single most important element in making an amplifier sound better. For instance, two amplifiers with identical total harmonic distortion (THD) specifications should sound the same when compared... but the one with low TIM will sound audibly better! That's because TIM adds an unnatural harshness to the music. It's not only detrimental to pure sound reproduction, but it can have an emotional effect that you experience as "listening fatigue."

TIM is caused by an improper design of "negative feedback circuitry," by other manufacturers. Every modern amplifier uses it to lower THD. But *excessive* negative feedback coupled with an insufficient slew rate* can lead to gross internal overloads under the constantly changing transient and sound levels of music. That distortion is TIM.

The gentle slopes of continuous sine wave test signals normally used to test an amplifier simply cannot detect TIM distortion. It requires the type of extremely sophisticated spectrum analysis equipment developed by the space industry to analyze radio frequencies.

Our answer to TIM is a circuit design that ensures the widest bandwidth and the lowest obtainable THD *before* negative feedback is applied. The Marantz 170DC Stereo Power Amplifier (the 1152DC and 1180DC also use this circuitry), for instance, needs only 1/100th (− 40 dB) the amount of negative feedback commonly required by other amplifiers to yield the same low THD figures.

Incredibly, Marantz amplifiers with low TIM design can deliver flat frequency response from 0 Hz to 20 kHz *without* the use of negative feedback. And this same circuit design provides the optimum slew rate for minimum TIM and maximum reliability.

Result: Marantz reduces TIM to an inaudible level, which means you get clear, clean sound from all your records and tapes. Think of Marantz with low TIM as a window to the original performance.

If you truly want the best reproduction of musical sound available anywhere—and are willing to spend a little more to get it—then go for it.

Go for Marantz.

*The maximum change of voltage per unit time.

marantz.®
We sound better.

For further information and literature, please contact:
SUPERSCOPE (AUSTRALASIA) PTY. LIMITED, P.O. Box 604, Brookvale, NSW. 2100. Telephone: (02) 939-1900

SOUND

NEW SPEAKERS FROM TECHNICS

Following the successful introduction of Technics Linear Phase speakers in Australia about a year ago, Haco Distributing Agencies has announced the availability of two new models to augment the range. These are the models SBX1 bookshelf speaker system and the SB-007 a miniature variant of the Technics SB-7000, the original Linear Phase model.

The SBX1 is the first of a range of three Linear Phase models with full timber cabinets to be released this year. It is a two-way two-speaker system and is already available from hi-fi dealers. Two other models in the range are larger three-way speaker models, and they will be released later this year. Recommended retail price of the SBX1 is $139.

The SB-007 is exactly half the size of its predecessor, the SB-7000, although it has the same features and can handle 50W RMS. Its great advantage is price, which at $299 recommended retail, is also about half the RRP of the larger model, which is $599.

Above: the SB007 Linear Phase model with, in the background an SB7000.

NEW Technics

Right: the new SBX1 appears slightly more conventional.

Philips Motional Feedback Speakers. A step closer to sound perfection.

At Philips, striving for perfection is one of our hallmarks. Now, after years of exacting research in our European laboratories, we've come very close to the ultimate in Hi-Fi reproduction. We've developed a very compact way of reproducing low frequencies that's simply known as MOTIONAL FEEDBACK.

A piezo-electric crystal built into the cone of the woofer converts the acceleration of the cone into an electrical signal. The acceleration of the cone is linearly translated back to the original signal driving the loudspeaker. This signal is fed back to the input of the amplifier incorporated in the enclosure and compared with the original signal, thus enabling the loudspeaker to be immediately corrected at the slightest deviation. In this way, the acoustical behaviour of the woofer can be completely controlled.

This has the following advantages:

1. The resonant frequency is registered as a deviation from the original signal and corrected.
2. Unwanted vibrations (distortion) are reduced.
3. The correction signal forces the loudspeaker to produce the extremely low notes clearly.
4. It becomes possible to use smaller loudspeakers and smaller enclosures for reproducing undistorted low notes at a very high sound pressure level.

Specifications — Model 544
Volume: 15 litres; 9 litres acoustic
Total power of amplifiers: 60 Watt, cont. sine wave power
Frequency response: 30-20,000 Hz
Treble filter: continuously variable, 0-18 dB per octave, –3 dB at 7,000 Hz
Cross-over frequencies: electronic cross-over at 500 Hz, passive cross-over at 3,000 Hz
Input sensitivity: continuously variable 1-23V at 100 kohm
Amplifier for woofer: 40 W cont. sine wave power
Amplifier for squawker and tweeter: 20 W cont. sine wave power

Specifications — Model 541
Volume: 8 litres; 4.5 litres acoustic
Power of amplifier: 30 Watt cont. sine wave power
Frequency response: 35-20,000 Hz
Cross-over frequency: 1400 Hz
Input sensitivity: 1 V at 10 kohm, for connection of pre-amplifiers
7.5 V at 100 Ohm, for connection of low power amplifiers
19 V at 100 Ohm, for connection of high power amplifiers

All specifications are subject to alteration without notice.

PHILIPS

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We want you to have the best PHILIPS

DV 505 DYNAVECTOR

DYNAVECTOR'S LOW MASS/HIGH MASS ARM

THIS ARM HAS stirred up a great deal of interest since it was first announced by its designer Dr. Tominari of Onlife Corporation, Japan. Unlike most modern arms, it's a heavy beastie, and at first sight looks a most improbable device.

But the weight is for a purpose. Dr. Tominari designed the DV-505 on the understanding that a cartridge should be held in a fixed position relative to the record groove, and the easiest way to ensure this is to use a large mass to hold it in place. This prevents the small motions of the stylus, especially at low frequencies, from shifting the entire system.

The high mass idea is a good one if one works on the assumption that records are perfectly flat. But of course records aren't flat, and the effect of playing a record with a high mass arm, especially with a high-compliance cartridge, is for surface undulations and ripples to cause vertical stylus motion relative to the pickup. This gives rise to substantial sub-audible noise, and at the same time renders the system liable to poor tracking performance, mainly through the inertia of the system.

Tominari reasoned therefore that while high mass was definitely desirable in the horizontal plane, as we'll explain in a moment, it definitely isn't desirable in the vertical plane. Thus the problem was to provide high horizontal mass and low vertical mass. This was done by using a very heavy arm, pivoted for horizontal motion only at the pedestal. The vertical pivot was positioned at the end of the main arm and this carries a small offset sub-arm, complete with its own counterweight for balancing and applying tracking force.

Resonances

Bass information on the great majority of stereo records is recorded equally in each channel and in phase, partly because of the nature of bass information itself and partly to avoid certain problems related to cutting and replay. Thus resonances in pickup systems which are related to audible low frequencies should affect only the horizontal plane operation of the arm (at least in theory). Additionally, the problems of surface irregularities are confined to the vertical plane.

The existence of a high mass must obviously have a stabilising effect when these low frequencies are being tracked. Resonances are suppressed entirely at best or at least exhibit reduced Q factor. The fundamental system resonance, which is a complex function of system mass, cartridge compliance and tracking force, tends to be reduced in frequency in the horizontal plane. However, this particular resonance is most troublesome in the vertical plane where it can be excited by record surface ripples. In the Dynavector arm, the use of a very low mass vertical system

Continued on P. 26

helps reduce inertia and consequently the effects of this resonance. These benefits apply at lower sub-audible frequencies as well, the arm operating far more successfully than the majority of conventional arms by riding easily over warps and ripples without causing stylus motion relative to the arm. Should the fundamental system resonance affect horizontal operating modes, the arm has another card up its sleeve — a tuned damper, consisting of a rider weight fitted to a strip of spring steel, is located under the main arm. This can be tuned by moving the weight and is designed to resonate in anti-phase with the main resonance, thus cancelling it.

Further damping of vibration is provided by the accurate strip at the counterbalance end of the main arm. This passes through a magnetic field supplied by a pair of permanent magnets, and any vibration of the strip sets up eddy currents which interact with the fixed field. This expedient also helps reduce the effects of acoustic and mechanical feedback in the player system and in any event, the tremendous mass of the entire device helps reduce structural vibration in the turntable itself.

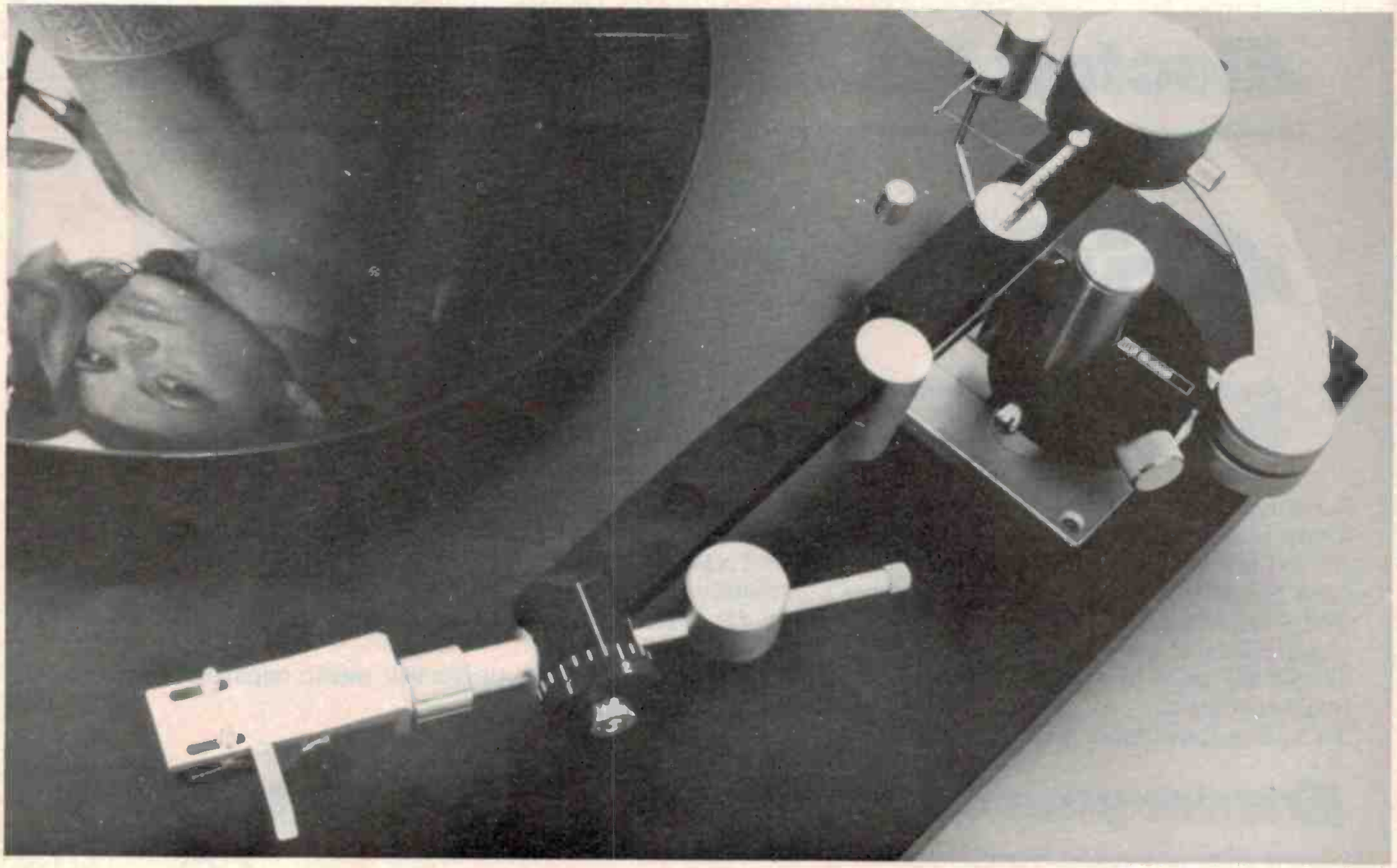
One of the possible drawbacks of the split pivot system is the substantial change in vertical tracking angle of the stylus when tracking warped and rippled records. Tominari acknowledges this but points out that any distortion due to this is likely to be negligible compared with the distortion produced by a conventional arm, by virtue of its high vertical plane inertia, under the same conditions. Tominari also regards the problem of bias force as negligible with this arm; the force is so small compared with the stabilising mass of the horizontal system that it should have virtually no effect. The bias compensator was added to meet market demands but our tests showed that it probably is superfluous — no audible improvement resulted from its use. In fact, the existence of a bias force could perhaps be seen as beneficial — helping counteract any tendency there might be for the stylus to be held in contact with the outer groove wall because of the need for so substantial a mass to follow the inward groove spiral to the record centre. But since the force required to move even this large a mass inward is very small indeed, particularly in view of the very low friction of the system, no real problems should arise, and the benefits of the high mass should certainly be far greater than the drawbacks.

Performance

We tried the arm with a range of cartridges, including Onlife's Dynavector 20B, Decca Mk. 6E and Garrott P77 (improved). The 20B has never sounded better, the bass shyness and upper frequency emphasis exhibited with this cartridge in other arms being less pronounced. Stereo performance was greatly improved with better separation, and better perspective, the latter resulting from improved dynamics. So with the Garrott cartridge, which, whilst not exhibiting the excellent definition of very fine detail of the 20B, nevertheless sounded better than we've ever heard it, with a particularly clean and open bass performance.

Our Decca sounded, unfortunately, like a poor sample in this arm — we're not entirely convinced, though, that the arm is incapable of doing justice to the Mk. 6E. We suspect the main problem is the mounting arrangement for the Decca, which is very sloppy and definitely needs attention. Perhaps Decca might see fit to introduce a new body — perhaps like the old C4E — which might help alleviate these problems.

The arm was pleasant to use, despite having no lifting device (one is available as an option). All adjustments were very easy to make and the tracking force calibrations (tracking force is applied by a spiral spring about the vertical pivot) were found to be accurate. Our sample was mounted on a Rega Planar 3 turntable, but that's another story which we hope to tell soon!



Radiometer BKF 10

Supplier: Foss Electric,
251 Condamine Street,
Balgowlah
Tel. 949.3044

EVERY ENGINEER AND TECHNICIAN at some stage of his career finds himself in the onerous position of having to produce a graph with two or more measured parameters. Most technicians only do this infrequently but for a small number this can be a day-by-day routine which either becomes a "chore" or a "charm" depending on the resources placed at their disposal.

Over the last twenty years a number of enterprising manufacturers have turned that chore into a charm with the development of sophisticated electronic equipment that produce automated graphs from all kinds of electrical, geophysical, physiological and biological data.

The area that interests our readers is acoustical and electro-acoustical data. Whilst many of you may not have realised it, most of the data that we present in our reviews is produced in Bruel & Kjaer equipment. For many years, Bruel & Kjaer of Copenhagen and General Radio of Massachusetts (now renamed Genrad) have dominated the electro-acoustical instrumentation field. More recently, another firm, Radiometer of Copenhagen, has decided to enter this field with a new system which is sufficiently different to warrant evaluation.

Radiometer are a well established firm whose reputation has been firmly founded by their biological equipment and specifically in the area of blood analysis. Over the years they have produced signal generators for AF, RF and voltmeters, all of which have found a receptive market.

Bruel & Kjaer and General Radio equipment is designed principally as building blocks, with which an engineer or technician can perform a wide range of measurements, depending on his ingenuity and which blocks he has at his disposal.

Radiometer carried out a market survey and followed a slightly different approach. They decided to build a series of "stand-alone" instruments which provide the electro-acoustic parameters most often required in one box, with optional chart print-out and other special facilities which are infrequently required being provided by relatively inexpensive stacking systems.

The basic unit, the BKF10 is a 19" unit, capable of being rack mounted, which measures level response (or gain), distortion (or signal to noise ratio), and frequency on three built-in meters, the outputs of these meters can be fed to direct graphs of frequency response or total harmonic distortion. In addition it is a low distortion 20 to 20 kHz signal generator with a 1 mV to 1 volt output capability.

What's so special about that you say — well we suspect that for the first time somebody has built the facilities into one (or two) boxes avoiding many of the complications resulting from at least twenty different controls by providing less than half that number. More important, the key note of the whole system is simplicity, directed to production testing of almost any electro-acoustic system, including tape recorders which this system measures better than anything else that we've seen.

Inside

The BKF10 is a neat instrument featuring three analogue meters and a minimal number of controls. Inside it contains an audio analyser covering therange 20 Hz to 20 kHz, and capable of measuring low level distortion.

An automatic Level Control Amplifier (ALU) which can control either the output or the input signal of the distortion analyser accurately measures the total distortion of the return signal even if not generated by the BKF10, and last but not least a frequency measuring circuit which can be used to control either the REC6152 servograph or any XY recorder whose Y parameter can be controlled over the range 0 to 3 volts (see figure 1).

The circuitry of the BKF10 has been cleverly conceived with a series of innovative features which will interest the professional and novice alike. The first feature that impressed us was the almost complete absence of controls for the input circuit — provided the level is less than 3 volts, no level or attenuation is necessary. If the level is between 3 and 30 volts a single attenuator switch is provided to reduce the signal to within the 60 dB dynamic range input of the amplifier. Even this is taken care of by the provision of an input out of range indicator light.

Whatever level of signal is fed into the BKF10 input socket, the input frequency and the harmonic distortion are displayed. If the signal being analysed is generated by the BKF10, then the ratio of input to output voltage (i.e. gain or loss) is also displayed directly on the 70 dB linearly scaled central analogue meter.

The other controls on the BKF10 unit are an input filter which provides a flat frequency position and 3 dB high pass or low pass filters at 250 Hertz, a signal to noise button which holds the automatic level control circuit gain fixed, whilst muting the oscillator output. This facilitates instantaneous signal to noise measurements in the "twinkling of an eye".

Control of the output frequency is provided through a switch which either selects a front panel potentiometer or external dc control. (i.e. from servograph if connected). A push button at the top of the panel activates an automatic single sweep when desired.

Back to Front

Unlike all other units with which we are familiar, this unit works back to front and sweeps down from 20 kHz to 20 Hz. The reasons for this are not clear but it was a little disconcerting when first encountered.

Continued on P.29

Modern expertise and computer technology have created a fine piece of equipment.

The NEW B&W DM 7

DM7 is the first of a new loudspeaker family reflecting our computer-aided research programme. It is a compact 3 unit system employing entirely new drive units in an enclosure engineered to exceptionally high standards. Many advances have been incorporated to reveal new horizons in loudspeaker performance, making possible a standard of musical reproduction unequalled in an enclosure of this size. The DM7 gives almost perfect amplitude linearity throughout the entire audio spectrum, and produces phase-coherent sound within a broad listening area. The drive units are purpose-designed and manufactured entirely in our own factory, employing new technology in order to achieve incredibly low distortion levels — typically less than 1% THD from 30Hz to 200Hz and less than 0.5% above that frequency. Another new feature in the DM7 is a variable energy control giving four frequency weightings — different to those obtainable from the control unit — to accommodate widely varying room acoustics.

Hear the B & W DM7 — you may well agree that this is the finest small speaker in the world today. Guaranteed for 5 years.

The DM7 complements a remarkable range of monitor loudspeakers from B & W.

The B & W DM6 is Britain's first linear phase loudspeaker. A dynamic system that will reproduce sound with transient accuracy usually achieved only by the very best electrostatic designs.

The DM4 is a 3-unit monitor loudspeaker system that produces high quality results from an incredibly small cabinet (20.8 litres) making it perfect for home or small studio use where space is at a minimum.

Only 28" x 9" x 9½". Despite its compact size, OM5 speakers can be rated as a system of very high quality. The design philosophy of John Bowers — "To design loudspeakers that reproduce in your home sound as you would hear in the concert hall"

NSW: CONVOY SOUND WOOLLOOMOOLOO SHOWROOM 357 2444; INSTROL HI-FI PTY.LTD. 29 7290; PARK ST. HI-FI STEREO CENTRE 26 2798; MILVERSON PTY.LTD. (CHATSWOOD) 412 2122 (PARRAMATTA) 635 3588; RIVERINA HI-FI 938 2663/4; UNITED RADIO DISTRIBUTORS PTY.LTD. 232 3718; ARROW ELECTRONICS 29 8580; RUSSIN HI-FI 799 2421; PITMAN'S RADIO & TV (WAGGA) 25 2155; ALBURY AUDIO CENTRE 25 1712; LEISURE SOUND (CHATSWOOD) 411 4944; WROTH CENTRE HI-FI (BATHURST) 31 2088; BYRON BAY TV & SOUND CENTRE 85 6762; SINGLETON HIGH FIDELITY CONSULTANTS 72 2270; HI-FI JUNCTION 389 4000; ACT: DURATONE 82 1388; VIC: SHEPPARTON HI-FI 21 9006; ENCEL ELECTRONICS PTY.LTD. 42 3761; SOUND SPECTRUM (GEELONG) 9 6616; SOUTHERN SOUND (CITY) 67 7869 (MOORABBIN) 97 7245; TIVOLI HI-FI 81 2872; THE SOUND CRAFTSMAN 509 2444; BUY RITE ELECTRIX 42 6200; NATSOUND 678158; INSTROL HI-FI 675831; INSTROL HI-FI (FRANKSTON) 783 7535; QLD. JOHN GIPPS SOUND 36 0080; PREMIER SOUND (NTH. ROCKHAMPTON) 27 4004; TARGA ELECTRONICS (CAIRNS) 53 2715; RUSS ADAM (TOWNSVILLE) 71 5618; TAS. BEL CANTO (HOBART) 34 2008; UNITED ELECTRONICS (LAUNCESTON) 31 8528; AUDIO SERVICES (BURNIE) 31 2390; WEST. AUST. TECHNICAL SERVICES PTY.LTD. 31 5455; THE GINZA 61 7444; STH. AUST. BLACKWOOD SOUND CENTRE 278 1281; INSTROL HI-FI 22 37622; SOUND SPECTRUM 223 2181.

Sole Australian agent:

Convoy INTERNATIONAL 4 Dowling Street, Sydney 2001. Phone: 358 2088.

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The back of the unit has a BNC socket which carries the distortion component of the signal being measured which can then be viewed on an oscilloscope. In addition a 25 pin socket allows connection to the external recorder, in our case, the REC 61 Servograph. The Servograph uses this cable to feed back the DC control voltage which it generates on a precision wire wound potentiometer. The distortion signal can be fed to an additiional selective measuring unit to provide harmonic data if desired.

The SMU401 provides facilities for the analysis of fundamental, second, third, fourth and fifth harmonics of the signal being measured, and the second, third and fourth harmonics of the mains frequency. What this means is that a distorted signal with superimposed mains components can be further analysed with the SMU401 to determine what is causing the problem and thereby allow a solution to be more readily effected.

Fortunately the SMU401 is a relatively cheap addition to the system, being only $A1200. This represents only 18% additional expenditure for an extremely powerful facility. No professional worth his salt would fail to appreciate this facility. Most importantly it allows the automatic plotting of selected harmonics on the output distortion graph. By using separate colours, a series of plots can be superimposed providing the user with a neat visual picture of total distortion characteristics. This capability can be further expanded by plotting at different drive levels.

The Servograph, which "neatly stacks on top of the BKF10 or BKF10 + SMU401", is a simple device which seems a little expensive. however, it does its job very well and is accurate and very convenient when compared to a conventional level recorder. Taken all in all it is most probably easier to use and when it comes to producing multiple graphs on the same chart is exceedingly reliable on resetability.

The REA 241 distortion interface provides for the selection of level or distortion plotting on the specially calibrated chart paper. Unlike conventional level recorder charts, this system has two separate areas of the graph for this purpose (see figure 1). The only other controls are Pen Up (Ready), Pen Down, a 12 position chart speed selector and the tracking potentiometer. The 12 position speed selector provides an accurate speed from 1 second/cm to 120 minutes/cm. Additional controls include a coarse and fine pen position and a paper stop, forward and reverse switch.

Loading a graph is extremely simple: because of the flat bed principle utilised nothing could be easier.

Confounding the Sceptics

We are always sceptical of any new system which carries out its functions differently from all others. Fortunately, the Radiometer system caused us to change our minds about its techniques and more importantly, its accuracy. The system provides direct answers using the time honoured black box approach. To evaluate its performance necessitated setting up a series of tests with rationally produced or contrived signals to check out the system accuracy.

The first series of checks were of the distortion read out by means of comparisons with the Hewlett Packard and Bruel & Kjaer laboratory system that we normally use. These units which are fully calibrated, showed that the correlation between the three systems was excellent and that the maximum deviation did not exceed 2 dB, at distortion levels of the order of –74 dB. By reading the 1 kHz signal generated by the BKF10 on the 3 volt position (which clips the output and is intended to be used as a set up signal), the THD figure was 8.3%. The computed total harmonic distortion (THD) figure from the 2nd, 3rd 4th and 5th harmonics obtained with the use of the SMU401 was 8.25%. An analysis of the same signal by means of our conventional laboratory system resulted in a THD of 7.8%. Our analysis was effected by the method of RMS detection of the distortion component and as it would appear that none of the Radiometer equipment utilises true RMS detection, this is probably the primary reason behind the variation in total or computed distortion figures.

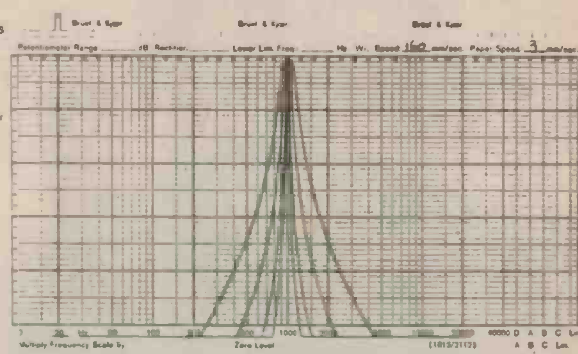
The measured output distortion from the BKF10 unit is quite good for output levels between 10 mV and 1 Volt. Below this range there are hum and noise problems and above it severe assymetry problems in the generated signal (i.e. 10% distortion).

This problem can be overcome on the 3 Volt range if one purchases the BAT10 floating output amplifier which came into our hands late in our evaluation. This unit is particularly useful when evaluating circuits with high gain and or high power output as it can overcome the common earth loop problem when a signal is both generated and measured by the same basic circuit. More important it allows the testing of equipment at distortion levels of less than 0.01% across most of the audible spectrum.

Louis A. Challis & Associates Pty Ltd

FREQUENCY SELECTIVITY OF BRUEL & KJAER TYPE 2121 NARROW BAND ANALYSER FAMILY OF CURVES SET FOR 1/3RD OCTAVE 10%, 3% AND 1% BANDWIDTH AT 1kHz.

Figure 2.



We measured the accuracy of the frequency meter, for which the manufacturer states a tolerance of ±5%. The greatest error that we could find was at one point (1 kHz) on the dial where it was 4.8% high.

The distortion generated by the oscillator varies as a function of level. Whilst the manufacturer states that it is less than 0.01% in one place in his literature, and less than 0.03% in another, we found it to be a function of frequency and level (See table). For most applications the internal distortion will prove to be satisfactory. For the most critical applications we fear the user will face the same problems that we do and be forced to pre-filter the signal to achieve the required low level of signal distortion.

One of the joys of using this machine is when measuring the frequency response and distortion response of Tape Recorders. If the paper is offset by the time lag corresponding to the distance between the record/replay heads and the speed for 3 head machines, or in the case of a single head record and replay machine then without offsetting the paper (but on replay) excellent results can be graphed with great ease.

As the BKF10 automatically determines the fundamental frequency of any signal applied to its input, it can track and accurately analyse (for distortion) any previously recorded signal.

Continued on P. 31

THE LOUDSPEAKER THAT LOOKS AT MUSIC THE WAY YOU DO: JBL's NEW L110.

You're at a concert. The sound surrounds you. There's a guitar. A piano. Some horns.

You hear all of it.

But more than that, you hear each part of it. Each sound. Every sound. All the sound.

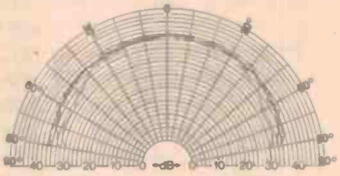
Most loudspeakers can't do that. They only meet you half way. Only left and right, all or nothing. JBL's new L110 goes all the way. It looks at music the way you do.

Left. Right. Front. Back.

The L110 has almost perfect stereo imaging—a result of precise, uniform dispersion at every frequency.

Inside the L110, there's a brand new, super-sophisticated crossover network designed specifically to match the new components.

There's a new 10" woofer which utilizes a massive 3" voice coil and 7½ lb. magnetic assembly—normally found in 12" woofers.



Frequency Dispersion of the L110
~~~ at 400Hz ~~~ at 2kHz ~~~ at 10kHz

JBL's new L110 loudspeaker is part of the same research and development breakthrough that created our no-tradeoff, top-of-the-line L212 system.

If this graph looks familiar, it should. The L212 produced an almost identical one.

The result is smooth, accurate bass, plus an amazing level of efficiency and power handling capability throughout the entire system. (One more nice: You get more headroom for your amplifier. Less clipping.)

Now look at the L110. The most acoustically transparent grille JBL has ever created is visually transparent, too. You can see right through to the satin black components inside.

If you'd like a lot more technical information on the L110, write us and we'll send you an engineering staff report. Nothing fancy. Except the specifications.

But you really should come listen to the L110. And ask for it by its first name: JBL. You'll be getting the same craftsmanship, the same components, the same sound heard in the very top recording studios in the world.

Over four hundred of the leading recording studios in the world—from Los Angeles to London to Muscle Shoals to Munich to Tokyo to Tennessee—use our sound to make theirs. Shown here is Capitol Records in Hollywood, California.

HA118/78

Distributed by—
HARMAN AUSTRALIA PTY. LTD., P.O. Box 6, BROOKVALE, N.S.W. 2100.

JBL
GET IT ALL.


~~~

One interesting problem occurs with tape drop outs where the distortion analysis responds to the drop-out as a loss of fundamental and artificially boosts the percentage distortion on the chart.

The BKF10 system is equally at home when testing loud speakers, both for linearity, as well as for distortion which it does very nicely. With the SMU401 it really plots out the harmonic components.

Conclusion

As a system the BKF10 is very attractive, its only limitation is the REC 61 servograph. This is the only component which limits the speed of analysis because of its need to track slowly if it is to track accurately. The need to provide the BAT10 floating amplifier to achieve 3 Volts output capability is a further limitation. Most oscillators can provide 10 Volts which the typical laboratory would call for in such testing.

Notwithstanding this we are impressed that this system has a lot going for it and will meet most of the requirements that production facilities, maintenance and testing laboratories call for.

Continued P. 32; Typical frequency response measurement and specifications of BFK 10.

AUDAX

Audax speakers are to be imported into Australia by Bill Webb Stereo of Melbourne. Made in France, Audax drivers have been used for many years by European speaker manufacturers and have recently become popular with a number of well known English manufacturers.

Spendor and Rogers both use Audax drivers and Dudley Harwood, the former B.B.C. design engineer, uses the Audax dome tweeter in his new Harbeth speaker system.

Audax manufacture a comprehensive array of audio components including speaker kits and microphones. Initially the importers intend marketing drivers only and will concentrate on the HF range of which there are over 70 units available ranging from a 355 mm 100 watt base driver to 25 mm soft dome tweeters.

Naturally it is the commercial manufacturer who is expected to show most interest in the range but Bill Webb will be interested in helping and advising all interested parties and will welcome enquiries from enthusiasts generally.

Future plans call for the release of at least a few of the very comprehensive range of speaker kits and these should prove to be of great interest to the home builder. Prices for the kits should be most competitive as they are for the individual drive units.

Further information may be obtained from *Audax Speakers, Bill Webb Stereo, 32 Wilson Street, Oakleigh. Vic. Phone: (03) 579-5196.*

SOUND BRIEFS

Otoscan 1

This active-line, staggered resonance speaker system has been designed by Colin Wait who was responsible for developing the AMW range. The name? Otos is Greek for ear. Scan is English for scan.

Armstrong speaker

A new compact reflex speaker system, using dome midrange and high frequency drive units, has been introduced by Armstrong Audio. Designated model 602, the new system should retail at about $700 per pair according to Concept Audio, 13, Rickard Road, Narrabeen 2101, the local distributors.

Hadcock Arm

The much-vaunted Hadcock pickup arm should soon be available in Australia. This is the first of a range of top-quality components to be represented by a new distributor, Audio 2000, of Sydney. More details of Hadcock and Audio 2000 will be published as they come to hand.

Modified Grace

A modification service for Grace G707 arms is available from Riverina Hi-Fi, Brookvale. The mod. consists of decoupling the counterweight and, if a heavy moving-coil cartridge is to be used, addition of a supplementary counterweight.

Parabolic Decca

Allen Wright of Audiolab and Garrot Brothers in Melbourne have come up with an improved Decca Mk-6 cartridge. Fitted with a Weinz parabolic stylus and hand tuned, the modified Deccas should be in good supply before long. Details of price and availability will be published as soon as they are to hand.

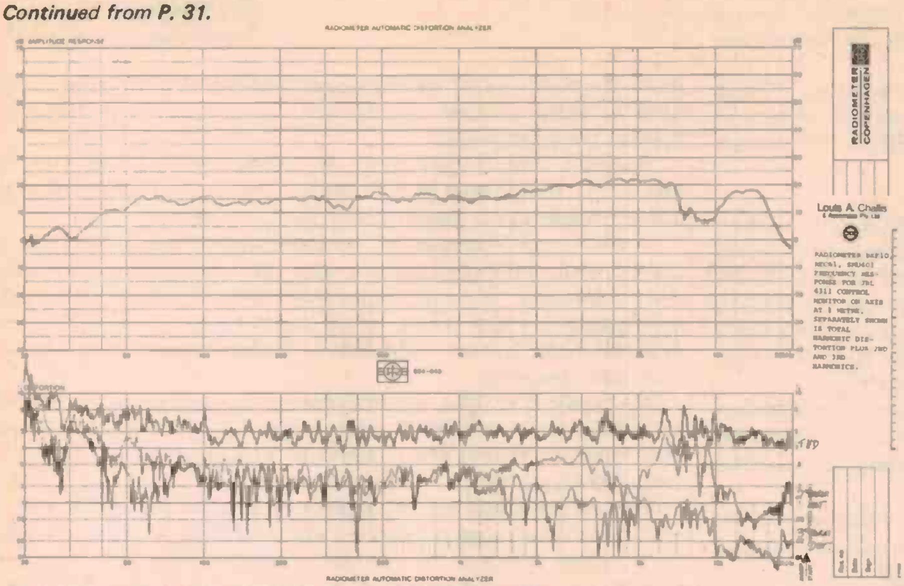
Win with Boron

Win Laboratories' latest version of the SDT-10 strain-gauge semiconductor cartridge is fitted with a boron cantilever for minimising resonances in the audible spectrum. Details from Megasound, 220 West Street, Crows Nest, NSW.

Pneumatic Arm Lift

Audio Technica's latest pickup arm, the AT-1009, is fitted with a pneumatic lifter. This is operated by a pump which can be placed at the front of the turntable – good news for owners of soggy suspension decks like Linn Sondek, Thorens etc.

Continued from P. 31.



Typical plot produced by BFK 10 from a JBL 4311 speaker.

TABLE 1

TOTAL HARMONIC DISTORTION GENERATED AND MEASURED ON BKF10

Output	100Hz	1kHz	6.3kHz	10kHz	20kHz
3V	8.5%	8%	8.5%	9%	8%
1V	0.026%	0.012%	<0.01%	<0.01%	<0.01%
300mV	0.026%	0.012%	0.01%	<0.01%	0.01%
100mV	0.026%	0.012%	0.013%	0.014%	0.019%
30mV	0.033%	0.024%	0.024%	0.03%	0.04%
10mV	0.07%	0.07%	0.07%	0.09%	0.13%
3mV	0.18%	0.2%	0.24%	0.28%	0.4%
1mV	0.3%	0.37%	0.45%	0.6%	0.47%
3 Volts Via	0.026%	0.01%	<0.01%	<0.01%	<0.01%

TABLE 2

ACCURACY OF TOTAL HARMONIC DISTORTION MEASUREMENT

(i) Input Frequency : 500Hz
Graph Indication : THD = 0.015%
BKF10 Meter : THD = less than 0.02% (minimum indication)

(ii) Input Signal : 3 RMS at 1 kHz (BKF10)

Frequency (Hz)	Graphed Distortion Components (%)	Distortion Components Measured by External Spectrum Analyser (%)
2K	6.0	5.6
3K	4.5	4.3
4K	3.0	2.9
5K	1.17	1.5
6K	—	0.5
THD	8.3% (Meter) 8.2% (Sum of Graphed Harmonics)	7.8

Introducing Accutrac. The only turntable in the world that lets you tell an LP which selections you want to hear, the order you want to hear them in, even how many times you want to hear each one.

Sounds like something out of the 21st century, doesn't it? Well, as a result of Accutrac's electro-optics, computer programming and direct drive capabilities, you can have it today.

Just imagine you want to hear cuts 5, 3 and 7 in that order. Maybe you even want to hear cut 3 twice, because it's an old favorite. Simply press buttons 5, 3, 3 again, then 7. Accutrac's unique infra-red beam, located in the tonearm head, scans the record surface. Over the recorded portion the beam scatters but over the smooth surface between selections the infra-red light is reflected back to the tonearm, directing it to follow your instructions.

What's more, it can do this by cordless remote control, even from across the room.

The arm your fingers never have to touch.

Since Accutrac's tonearm is electronically directed to the record, you never risk dropping the tonearm accidently and scratching a record, or damaging a stylus.

And, since it cues electronically, too, you can interrupt your listening and then pick it up again in the same groove, within a fraction of a revolution. Even the best damped cue lever can't provide such accuracy. Or safety.

What you hear is as incredible as what you see.

Because the Accutrac servo-motor which drives the tonearm is decoupled the instant the stylus goes into play, both horizontal and vertical friction are virtually eliminated. That means you get the most accurate tracking possible and the most faithful reproduction.

You also get wow and flutter at a completely inaudible 0.03% WRMS. Rumble at −70 dB (DIN B). A tracking force of a mere 3/4 gram. And tonearm resonance at the ideal 8-10 Hz.

The Accutrac 4000 system. When you see and hear what it can do, you'll never be satisfied owning anything else.

Its father was a turntable. Its mother was a computer.

The Accutrac 4000

BSR (A'asia) Pty. Ltd. Anne St., St. Mary's. Box 272 St. Mary's NSW 2760. Phone 6230375/6. Telex 23159. Telegrams "BSR" St. Mary's 2760

Audio Dynamics Corporation
A BSR Company

COMPTON BSR 142

AUDIO OSCILLATOR

Audio oscillator utilises new design in frequency meters, giving good accuracy and fast reading rates.

THE AUDIO OSCILLATOR is an almost essential piece of test equipment in any test lab be it professional or only the home workshop. Only the multimeter would rate more highly. We first published a simple sine-square oscillator way back in 1971 and this design is still very popular and selling well. We decided however to bring the design up to date adding a few improvements, and present it again.

Design Features

This oscillator started out as a redesign, mainly mechanical, of the earlier design. It then started to evolve as a voltage controlled sweep oscillator but when it became too complex we reverted to a simple Wein bridge oscillator.

One major problem with all home made oscillators is that of scaling the frequency dial. This is not just a problem of positioning the knob but since normally available potentiometers have a tolerance of +/- 20%, the scale length will also vary. In commercial units the use of an expensive wire wound potentiometer solves most of the problems giving reasonably accurate scaling.

We then decided to build in a frequency meter, basing it on the ETI 533 display module. However the high power consumption (we wanted to allow battery operation) and the poor resolution, especially at low frequency, prompted the design of a completely new frequency meter.

This uses what is literally an analogue computer to convert a period measurement into frequency with some digital electronics controlling it and displaying the results. We based this on the Intersil ICL7106 module which, due to its liquid

Continued on page 38

Front view of the audio oscillator. Note that this is an early prototype and the 3V range has been deleted.

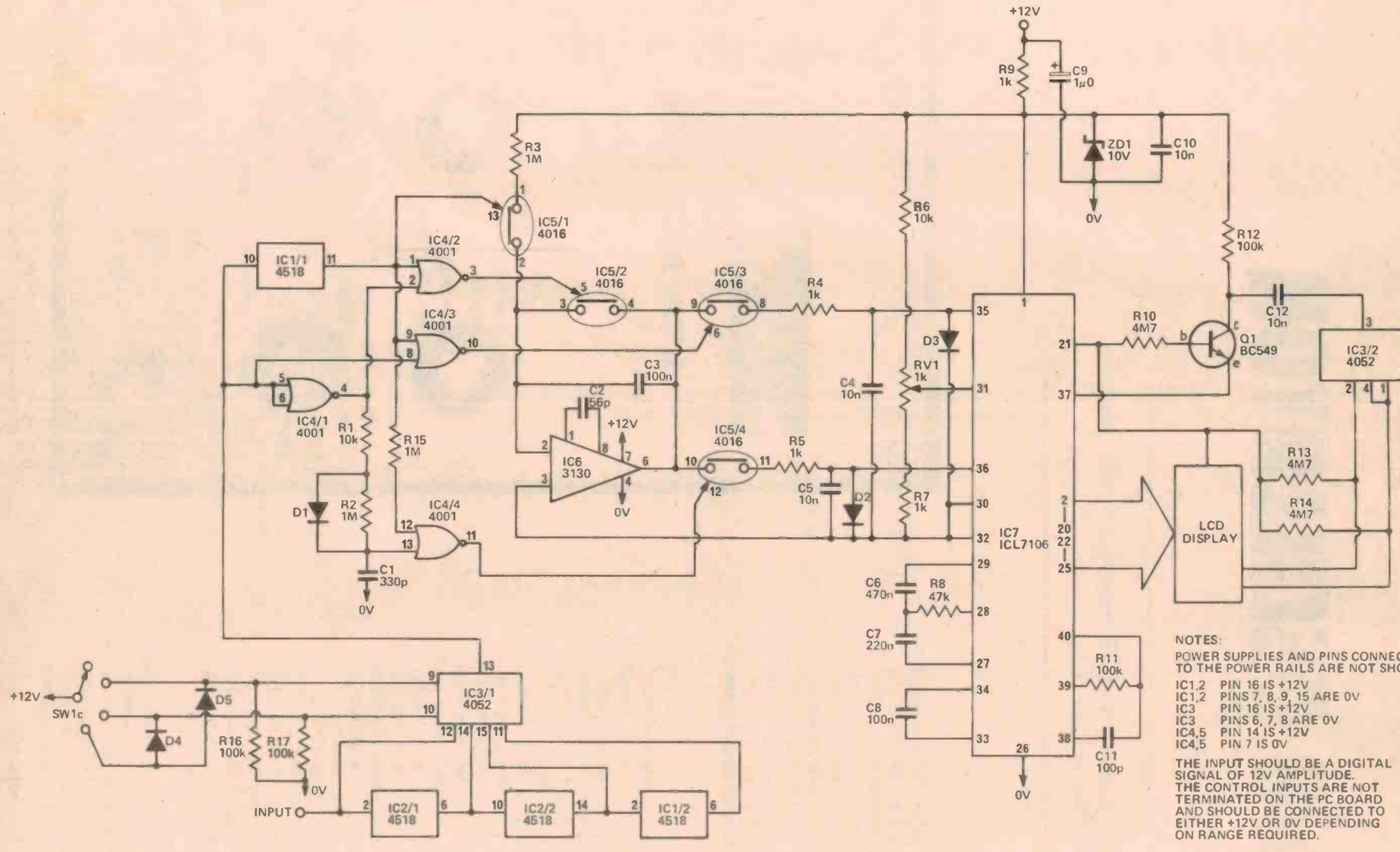


Fig. 1. The circuit diagram of the frequency meter section.

NOTES:
POWER SUPPLIES AND PINS CONNECTED TO THE POWER RAILS ARE NOT SHOWN.

IC1,2	PIN 16 IS +12V
IC1,2	PINS 7, 8, 9, 15 ARE 0V
IC3	PIN 16 IS +12V
IC3	PINS 6, 7, 8 ARE 0V
IC4,5	PIN 14 IS +12V
IC4,5	PIN 7 IS 0V

THE INPUT SHOULD BE A DIGITAL SIGNAL OF 12V AMPLITUDE.
THE CONTROL INPUTS ARE NOT TERMINATED ON THE PC BOARD AND SHOULD BE CONNECTED TO EITHER +12V OR 0V DEPENDING ON RANGE REQUIRED.

Scotchcals of the front panel are available for $3.50 post paid from Nebula Electronics Pty. Ltd., 15 Boundary St. Rushcutters Bay 2011.

HOW IT WORKS - ETI 137

Oscillator

The oscillator is the conventional Wein bridge type with a differenial amplifier made up by Q1-Q5. Gain stabilization is done by the thermistor TH1. This type of circuit oscillates at the frequency where the impedance of the capacitors equals the resistors in the Wein bridge arms. With this feedback network the attenuation does not vary greatly like that of a twin tee but the phase shift does. The result is a sine wave oscillator with low distortion.

For frequency variation a two gang potentiometer is used to give a 20/1 continuous variation with switched capacitors giving four ranges each a decade apart.

The sine wave output is turned into a square wave by IC1 with the amplitude stabilized by D3-D6.

Frequency Meter

This section works by generating a voltage proportional to the period of one cycle and using this as the reference voltage for the Intersil voltmeter IC with a fixed voltage on the normal input. This gives the inverse function of normal operation and the display therefore is frequency.

To generate the reference voltage we use an integrator (IC6) which is controlled by IC5. Operation is as follows. Initially C3 is discharged and for one cycle of the input signal IC5/1 turns on. As the module provides a stable voltage between pin 1 and pin 32 of about 2.8V the output of IC6 will fall linearly with time and as IC5/1 is on for exactly one cycle the voltage change will be proportional to that period.

After IC5/1 turns off the output of IC6 will stay fixed. IC5/3 is then turned on and C4 will charge to that voltage. After half a cycle IC5/3 will turn off leaving C4 at that voltage and IC5/2 will turn on. This discharges C3 to zero volts. After a short delay to allow C3 to discharge IC5/4 is turned on transferring that voltage level onto C5. After a total of two cycles the process recommences. The voltage difference between the two capacitors is therefore the voltage *change*, (proportional to frequency) thus eliminating any offset errors in IC6. The pulses which control IC5 are derived from IC1/1 and IC4.

A reference voltage less than half the input voltage will result in the ICL7106 counting past 2000 (over ranging). The two inputs must also lie within the supply rails (less 1.5V). This limits the range of the instrument from 5 Hz to 200 Hz. For the higher frequency ranges, three decade dividers are provided and the necessary output selected by IC3. The correct decimal point is also selected by the other half of this IC.

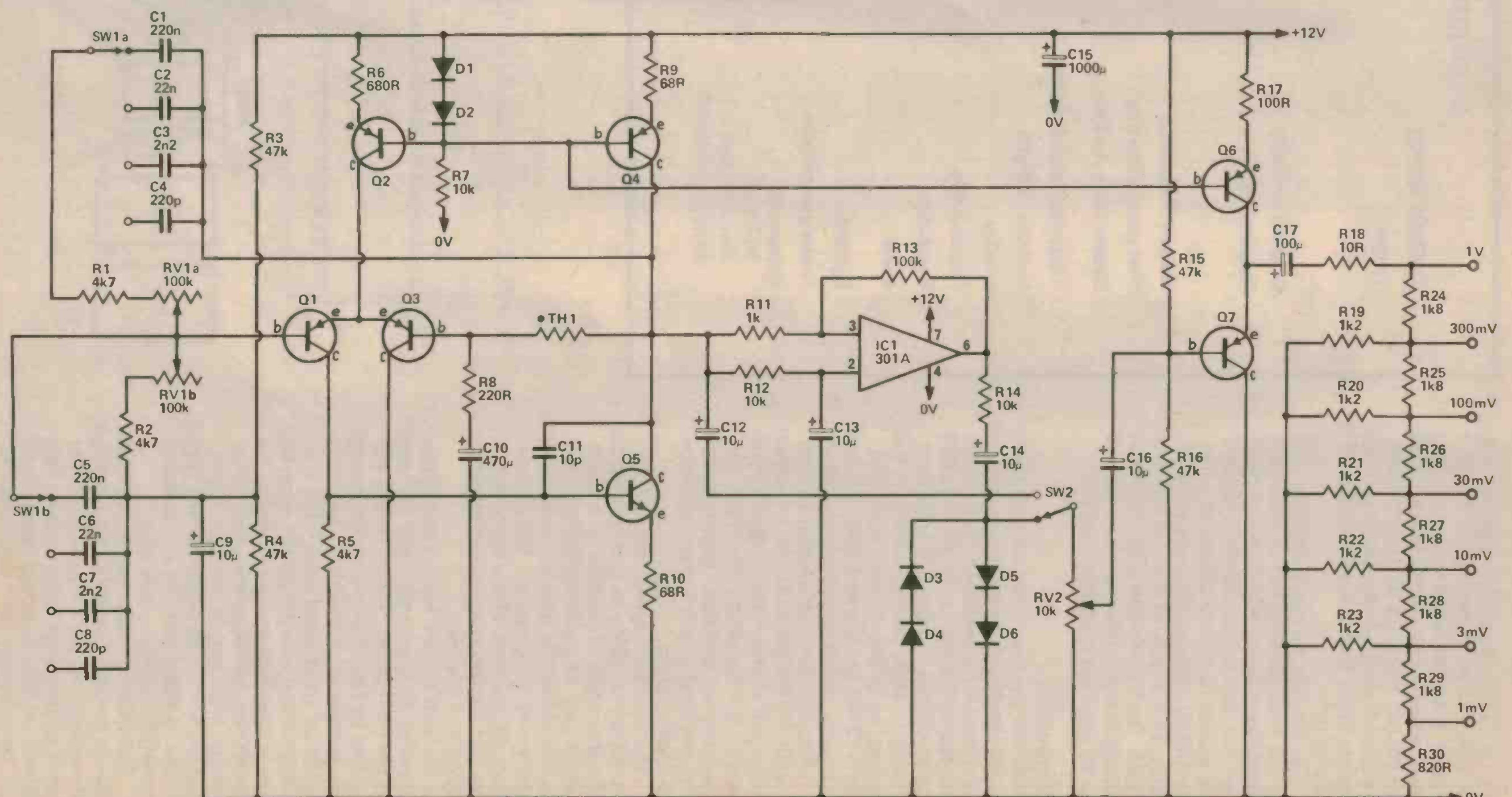


Fig. 2. The circuit diagram of the oscillator section.

crystal display, features low power consumption. Due to the method of conversion from period to frequency the range is limited from about 50 to 1999 counts and therefore automatic range selection is used. As the oscillator itself has less range than this, this limitation is no problem.

To simplify wiring we initially used CMOS analogue switches to select the range changing capacitors in the oscillator but this unfortunately increased the second harmonic distortion when the supply voltage dropped below 12 volts. This is due to the non-linearity of the "on" resistance when the input voltage changes. We therefore reverted to the good old mechanical switch!

Construction

Assemble the frequency counter board first, following the overlay provided. As this board is mounted very close to the front panel (only the height of the LCD) the capacitors should have leads long enough to allow them to be laid on their side on top of the resistors, etc. Also the CA3130 and the transistor will have to be mounted close to the board. While it is not essential that a socket be used (we didn't) for the LCD, one is recommended and although the Molex pins provided in the evaluation kit are not the best, they are available. Be very careful with the display as it is glass and therefore fairly fragile.

The oscillator board can now be assembled following its overlay diagram. The thermistor should be tied down using a loop of tinned copper wire and pc pins should be used on all external wire terminating points. Cut all leads short on the back of the pc boards as the two are mounted back-back with only 6 mm spacing.

We built the units into a large zippy box with all the components mounted on the front panel. The pc boards are secured by four 6BA c/s screws through the aluminium but hidden by the Scotchcal front panel used. The frequency meter board is spaced using 6BA nuts to give just enough clearance for the display and is held in place using 6.4 mm long tapped spacers. Check that the spacers do not touch any tracks on the pc board and if so add pieces of insulation material under them.

The switches and potentiometers can now be mounted on the front panel and the wiring from the frequency counter board to the range switch done. Add wires from the two power connections and the input for later connection to the oscillator board.

Continued on page 40.

SPECIFICATION – ETI 137

Oscillator section	
Ranges	10.0 – 100.0 Hz 100 – 1000 Hz 1.00 – 10.00 kHz 10.0 – 100.0 kHz
Outputs available	sine or square
Output level	1 V maximium continuously variable plus 10dB steps down to 1 mV
Output impedance	nominally 600 ohms
Sine wave distortion	<0.1%
Square wave risetime	200ns
Frequency meter section	
Number of digits	3½
Display	LCD
Reading rate	5 per second
Resolution	0.1 Hz on lowest range
Mode	Period measurment computed to read frequency
General	
Power consumpion	26 mA @ 12 V dc
Battery life	
Ni Cads	20 hours
Pencells (red)	30 hours
Pencells (alkaline)	50 hours

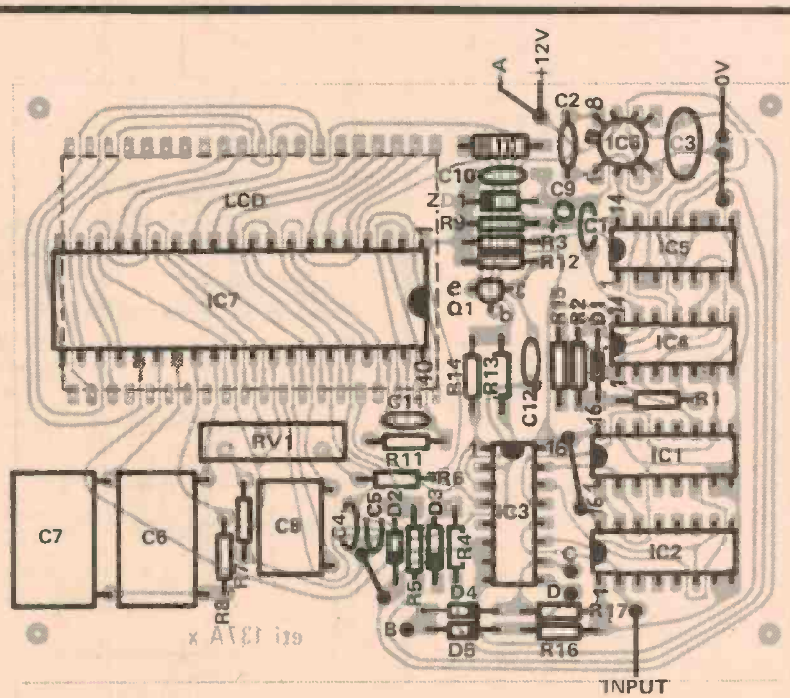


Fig. 3. Component overlay of the frequency meter board. Insert the LCD such that the +1 digit is on the left.

PARTS LIST — ETI 137

General
- Plastic box UB
- 1 One pole 12 position rotary switch
- 1 Three pole 4 position rotary switch
- 2 STDP toggle switches
- 4 knobs to suit
- 12V battery (8xdry cell or 10xNicads)
- External power socket
- Scotchcal front panel
- Wire, screws etc.

Frequency Counter Board — ETI 137A

Resistors all ¼W 5%

R1 . . . . 10k
R2,3 . . . . . . 1M
R4,5 . . . . . . 1k
R6 . . . . 10k
R7 . . . . 1k
* R8 . . . . . . 47k
R9 . . . . 1k
R10. . . . . . . 4M7
* R11. . . . . . 100k
R12. . . . . . . 100k
R13,14 . . . . . 4M7
R15. . . . . . . 1M
R16,17 . . . . . 100k

Potentiometer

* RV1 . . . . . 1k ten turn trim

Capacitors

C1. . . . . 330p ceramic
C2. . . . . 56p ceramic
C3. . . . . 100n polyester
C4,5 . . . . . . 10n polyester
* C6. . . . . . . 470n polyester
* C7. . . . . . . 220n polyester
* C8. . . . . . . 100n polyester
C9. . . . . 1µ0 35V tantalum
C10. . . . . . . 10n polyester
* C11. . . . . . 100p ceramic
C12. . . . . . . 10n polyester

Semiconductors

IC1,2 . . . . . 4518 (CMOS)
IC3 . . . . 4052 (CMOS)
IC4 . . . . 4001 (CMOS)
IC5 . . . . 4016 (CMOS)
IC6 . . . . CA3130
* IC7 . . . . . . ICL7106
Q1 . . . . BC549
D1—D5. . . . . 1N914
ZD1. . . . . . . 10V 300mW Zener

Miscellaneous

PCB ETI 137A
* LCD display

* These parts are provided in the Intersil ICL7106 Evaluation Kit.

Oscillator Board — ETI 137B

Resistors all ½W 5%

R1,2 . . . . . . 4k7
R3,4 . . . . . . 47k
R5 . . . . 4k7
R6 . . . . 680R
R7 . . . . 10k
R8 . . . . 220R
R9,10. . . . . . 68R
R11. . . . . . . 1k
R12. . . . . . . 10k
R13. . . . . . . 100k
R14. . . . . . . 10k
R15,16. . . . . 47k
R17. . . . . . . 100R
R18. . . . . . . 10R
R19—R23 . . 1k2
R24—R29 . . 1k8
R30. . . . . . . 820R

Thermistor

TH1. . . . . . . type R53

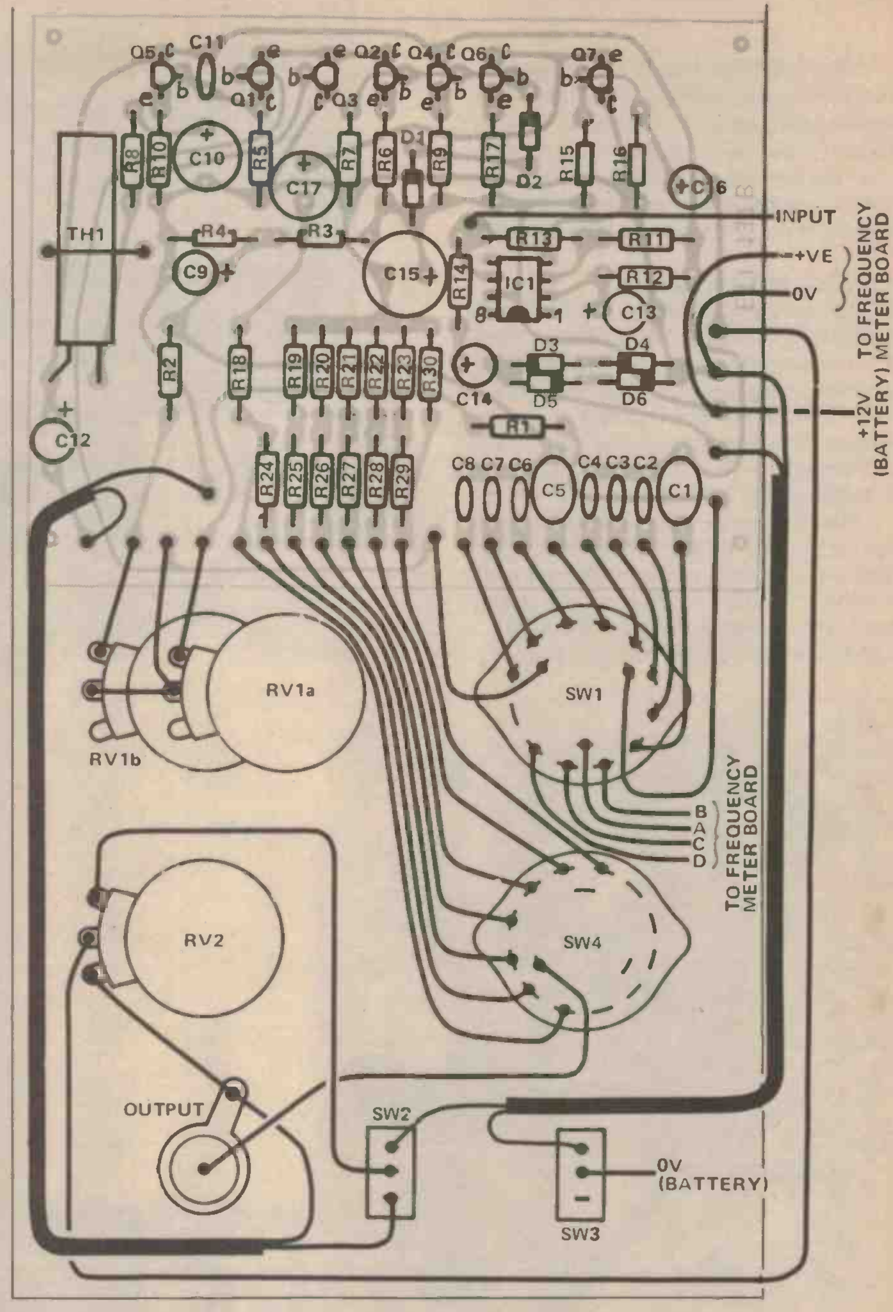


Fig. 4. The component overlay of the oscillator board and the wiring of the front panel.

Potentiometers

* RV1 . . . . . 100k dual rotary
RV2 . . . . . . 10k lin rotary

Capacitors

C1. . . . . 220n polyester
C2. . . . . 22n polyester
C3. . . . . 2n2 polyester
C4. . . . . 220p ceramic
C5. . . . . 220n polyester
C6. . . . . 22n polyester
C7. . . . . 2n2 polyester
C8. . . . . 220p ceramic
C9. . . . . 10µ 25V electro
C10. . . . . . . 470µ 25V Electro
C11 . . . . . . 10p ceramic
C12—C14 . . 10µ 25V electro
C15. . . . . . . 1000µ 16V electro
C16. . . . . . . 10µ 25V electro
C17. . . . . . . 100µ 25V electro

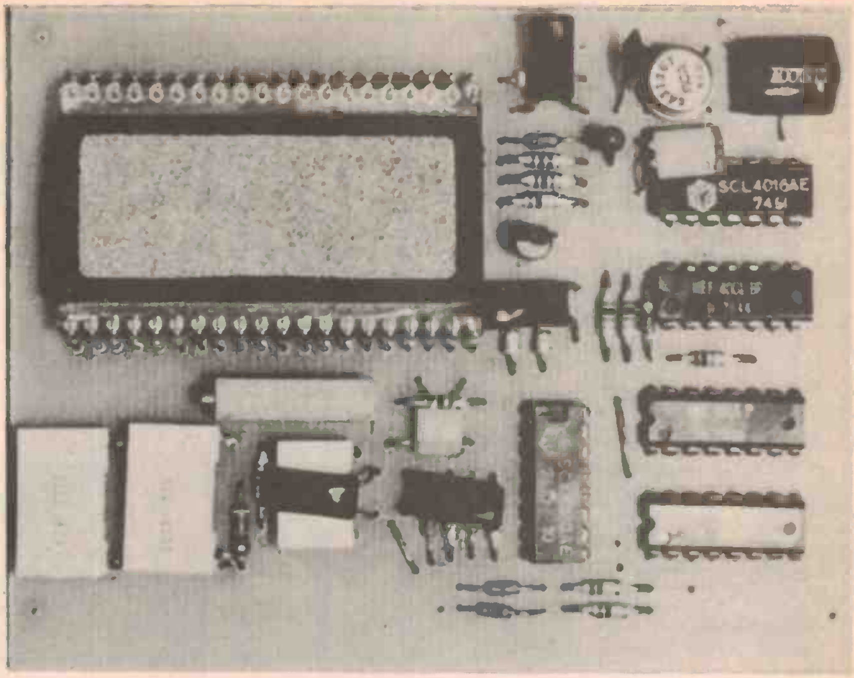
Semiconductors

IC1 . . . . 301A
Q1—Q4. . . . BC559
Q5 . . . . BC549
Q6,7 . . . . . . BC559
D1—D6. . . . 1N914

Miscellaneous

PCB ETI 137B

* RV1 — the preferred curve giving best resolution is antilog. If reverse rotation is acceptable log is as good. Otherwise use a linear curve.

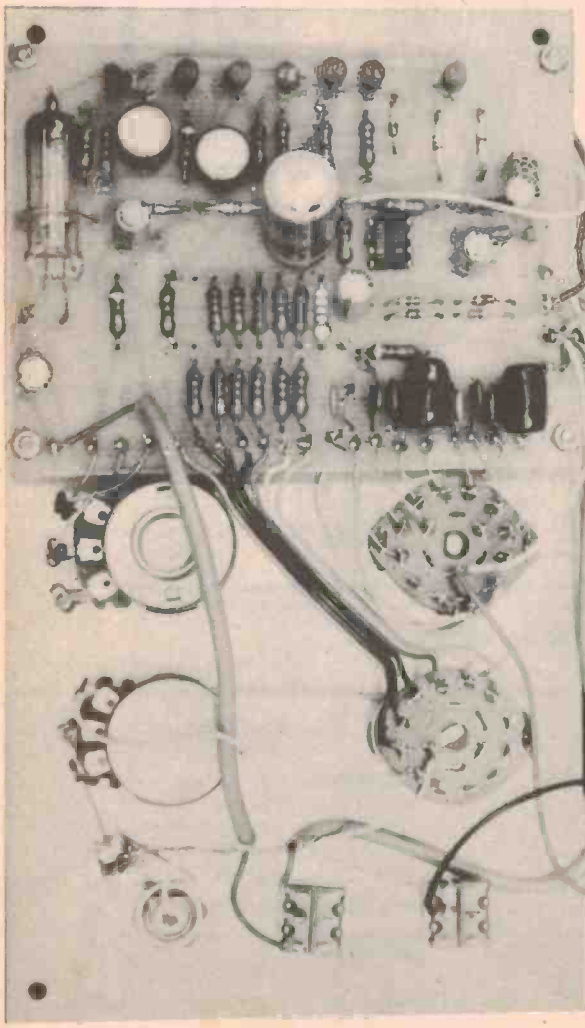


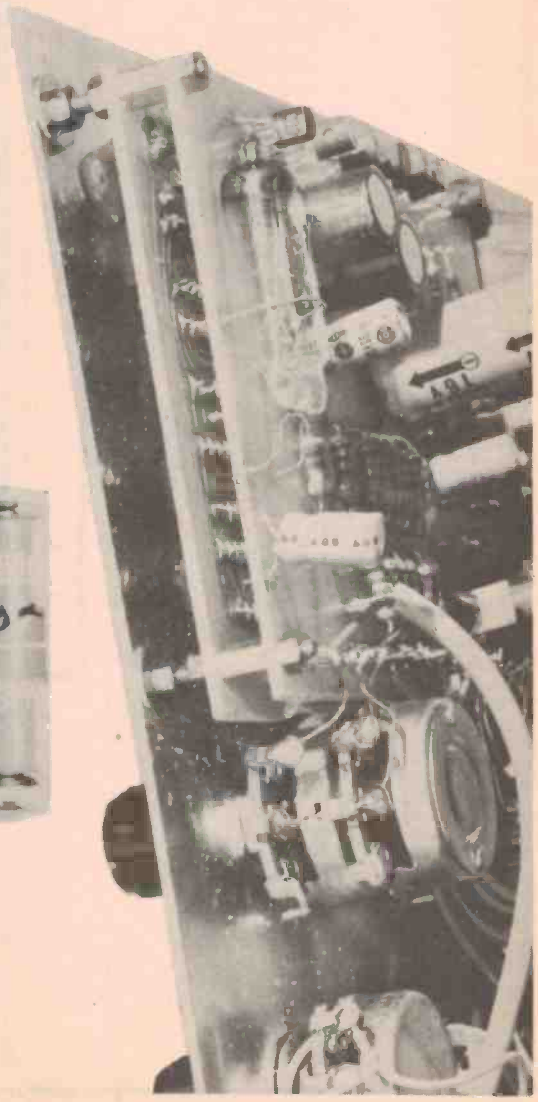
The oscillator board can now be mounted onto the back of the frequency meter board ensuring that no leads short between the two boards. Also check that the spacers do not touch any tracks on the oscillator board. The wiring of the front panel can now be completed.

Checking and Adjustment

Switch on and check that the frequency meter and oscillator are working. Monitor the output of the oscillator with an accurate frequency counter and adjust the oscillator to the top end of one range. The frequency meter can now be calibrated by means of the 10 turn potentiometer on that board.

Check that the display range changes correctly and that the decimal point also moves. Each range while nominally having a 10-100 variation will be adjustable from about 7 to 150. Check the attenuator has 10 dB between steps.





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74LS27	.40
74LS30	.40
74LS32	.50
74LS38	.50
74LS47	2.50
74LS73	.55
74LS74	.60
74LS78	.65
74LS90	1.60
74LS92	1.60
74LS93	1.40
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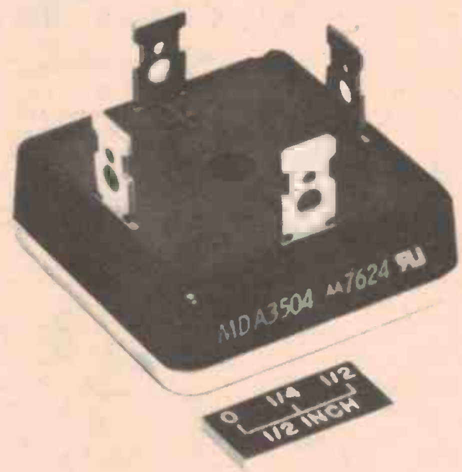

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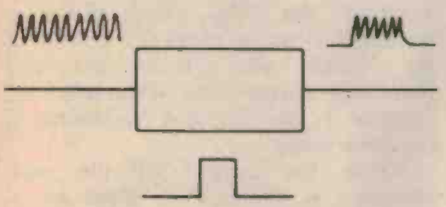
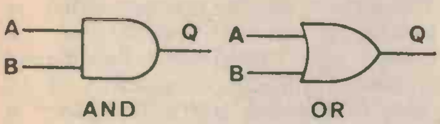
DIGITAL ELECTRONICS BY EXPERIMENT pt3

A GATE CIRCUIT, in general, is a circuit which will allow a signal to pass for a time defined by another signal, often a rectangular pulse (Figure 1a). In linear circuitry we need linear gates which do not affect the shape of the signal which is gated, but in digital circuitry, all the signals are steady voltage levels, 1 or 0, or fast transitions between these levels, so that speed of operation is important and *no* linear action is needed. Ideally, a perfect switch is also a perfect digital gate.

Logic gates are of two basic types, the AND the OR type. The simplest examples of each have two inputs and one output, though up to 13 inputs are found in some types. Taking the two input AND gate, the output is a logic 1 when, and only when, both inputs are also at logic 1 (A *and* B are at 1); the output is zero for any other combination of inputs. The two input OR gate gives a logic 1 output when *either* input is logic 1, or when both are at logic 1 (A *or* B both).



(a)



(b)

Fig. 1. Gates. (a) General gating action (b) Logic gate symbols.

ANO–GATE		
A	B	Q
1	1	1
1	0	0
0	1	0
0	0	0

(a)

OR–GATE		
A	B	Q
1	1	1
1	0	1
0	1	1
0	0	0

(b)

Fig. 2. Truth tables. (a) AND-gate. (b) OR-gate.

These actions can be summarised in a truth table which shows at a glance what combinations of inputs and outputs are possible. Fig. 2 shows the truth tables for the AND and OR gates. Truth tables, though useful, become rather bulky when the gate has a large number of inputs, so that a better way of memorising the action is to remember that only when all inputs are 1 is the output of the AND gate 1, and only when all inputs are zero is the output of the OR gate zero.

NAND and NOR gates have outputs which are the inverse of the AND or OR gates respectively, as the truth tables of Fig. 3 show; internally these gates are AND/OR gates with inverters at the outputs. Another gate encountered at times is the exclusive-OR (XOR) which has the truth table and symbol shown in Figs. 3c, d. Note that the action is that of the OR gate, except that the output is 0 when both inputs are 1.

NAND–GATE		
A	B	Q
0	0	1
0	1	1
1	0	1
1	1	0

(a)

NOR–GATE		
A	B	Q
0	0	1
0	1	0
1	0	0
1	1	0

(b)

X–OR GATE		
A	B	Q
0	0	0
0	1	1
1	0	1
1	1	0

(c)

(d)

Fig. 3. Truth tables. (a) NAND-gate. (b) NOR-gate. (c) X-OR-gate. (d) Symbol for the X-OR-gate.

Working over a 7400

The second IC we shall deal with in this series is a 7400 quad NAND gate. This consists of four separate two-input NAND gates, and like all the other ICs used in this series is a TTL circuit. An unconnected input will therefore float to logic 1, and will need a current of 1.6 mA to be sunk to hold it down to logic 0.

Start work on this gate by connecting the power supply leads. Pin 7 is taken to the negative line by a wire connection, and pin 14 is similarly taken to the +5 V line. The connections to the gates are shown in Fig. 4; we shall start by using gate 1.

Connect a 470R resistor between pin 3 and a spare pad, as shown in Fig. 5. Now connect another LED between the spare pad and the zero line to act as an indicator to light when the output is at logic 1.

We could obtain inputs by soldering in wires, but this is rather tedious. Wire up the switches as shown in Fig. 5, wiring the terminals directly to the "0" line and the spare pads. Since these are press-to-make switches, their effect will be to give a logic 0 when pressed, the input to which they are connected will then float to logic 1 when the switch is released. Miniature slide switches were tried, but found to short 1 to 0.

With the switches in place, check the truth table for a NAND gate, using the LED to indicate the state of the output. The truth table should agree with that of Fig. 2a.

Now investigate the effect of adding an inverter, by joining a wire from pin 3 of the 7400 to pin 1 of the 7414, using the LED which is connected to pin 2 of the 7414 as the output indicator (Fig. 6). This connection, using the switches to provide inputs to the 7400, should give the truth table for an AND gate.

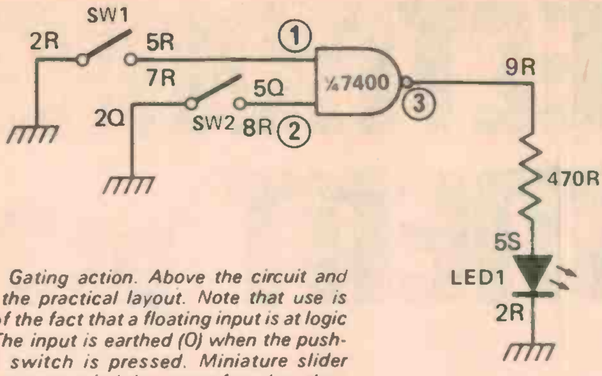
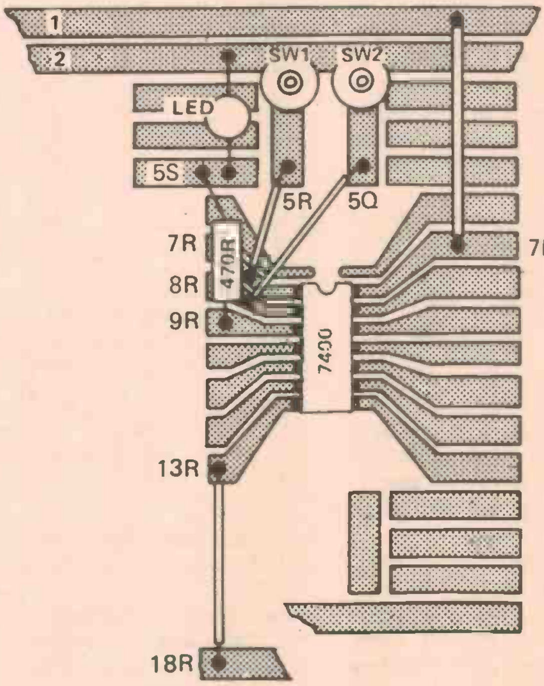


Fig. 5. Gating action. Above the circuit and below the practical layout. Note that use is made of the fact that a floating input is at logic "1". The input is earthed (0) when the push-button switch is pressed. Miniature slider switches were tried, but were found to short momentarily between the 1 and 0 positions.



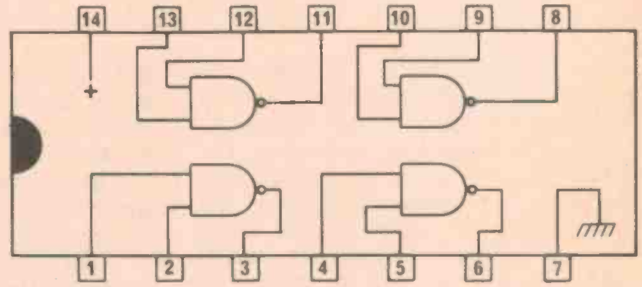


Fig. 4. Pin-out diagram for the 7400.

We find, however, that if we invert each input before applying to the 7400 inputs (Fig. 7) that we do not obtain an AND gate this way. What truth table do we find?

To try it out, connect the switch outputs to the inverter inputs instead of to the 7400, one to pin 1 and the other to pin 3 of the 7414. Join pin 2 of the 7414 to pin 1 of the 7400 and pin 4 of the 7414 to pin 2 of the 7400, using single strand insulated wire. Use the LED which is connected to pin 3 of the 7400 as an indicator.

Having done this, could you design a NOR gate, and construct one? Try out your circuit and draw up a truth table.

The exclusive-OR circuit needs rather more thought. One possible circuit is shown in Fig. 8. Construct this, using the 7400 and 7414 units, and check that the truth table agrees with that of Fig. 3c.

Combinational Logic

Circuits which contain only logic gates are called combinational logic circuits, because the output can always be predicted from the combination of inputs which is present. As we shall see later in this series, there are circuits in which the previous inputs matter as much as the present ones. Combinational logic circuits obey the rules of Boolean algebra, which will not be dealt with here, but have been previously discussed in ETI.

Because the output can always be predicted from the inputs which are present, logic gates can be used for control circuits. We can, to take a simple example, control the heating of a house by having logic gates control the circulating pump (or fan), by way of a thyristor or triac.

The inputs to the gates will be the signals from room thermostats, perhaps an outside thermostat, a boiler thermostat, a hot-water tank thermostat, and a timeswitch or two. There will be another output from the gates to control the operation of the boiler.

For such a system, logic gates easily carry out AND and OR actions which would need much more wiring and space to carry out with relays, but the full advantage of using logic gates is obtained when all the thermostats and other signal generating equipment and timing are also electronic.

Bawdy Work

An application of gating is shown in Fig. 9, using the 7414 and 7400 to make a gated oscillator circuit. Two sections of the 7414 are used as oscillators, one at an audio frequency of about 1 kHz and the other at a much slower rate, and the outputs of the oscillators are taken each to one gate input of the 7400. When the slow oscillator input is high, the output of the NAND gate will be the high frequency square wave, since with one input at 1, the output is the inverse of the other input.

When the output of the slow oscillator is at logic 0, there is no oscillator output from the 7400, because the output is set to logic 1. The output can be detected either by feeding it to an amplifier, or by using high resistance headphones connected through a capacitor, or by using a capacitor and a 1k resistor in series with a small earpiece from a transistor radio.

Could you now design and construct a circuit whose output was a two-tone oscillation (HI-LO-HI-LO-). Remember that the output of the NAND gate in Fig. 9 was a logic 1 when not oscillating. Do NOT be tempted to combine the outputs of two gates by joining output pins; this will BURN OUT YOUR IC, because very large currents will flow if one output is at 1 and the other at 0. One possible scheme uses three of the 7414 inverters as oscillators and one as an inverter, with three NAND gates also used.

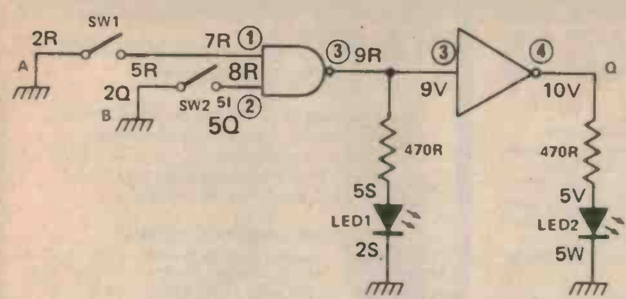


Fig. 6. Using a NAND-gate and an inverter to make an AND-gate.

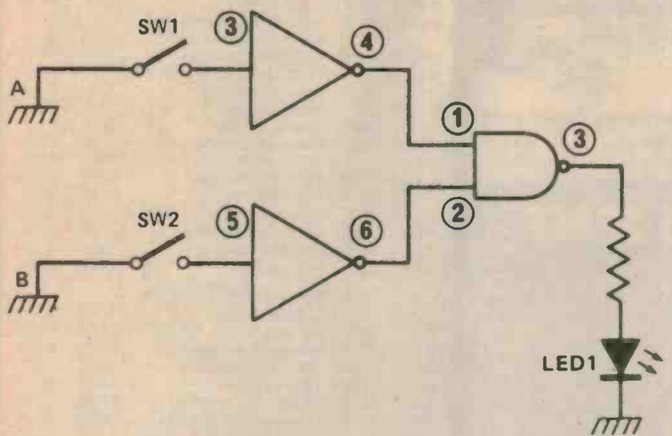
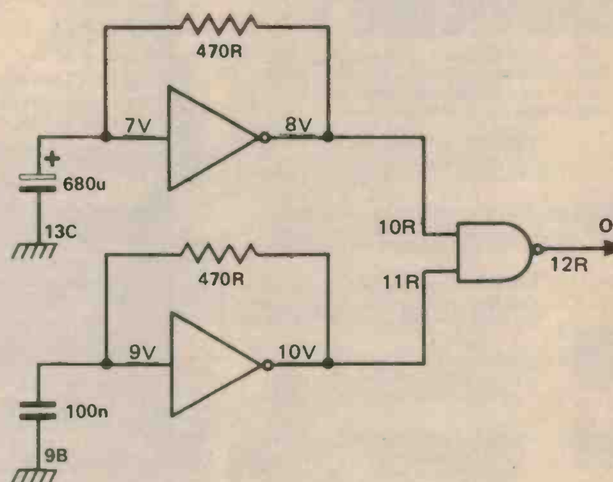


Fig. 7. What is the truth table for this circuit?



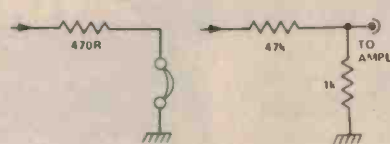


Fig. 9. A gated oscillator. (a) Circuit. (b) using an earphone to detect the note. (c) Connecting the output to an amplifier.

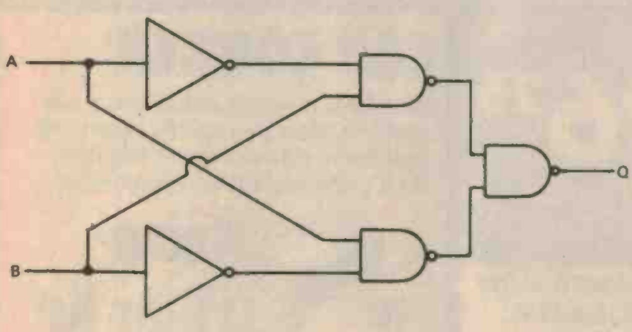
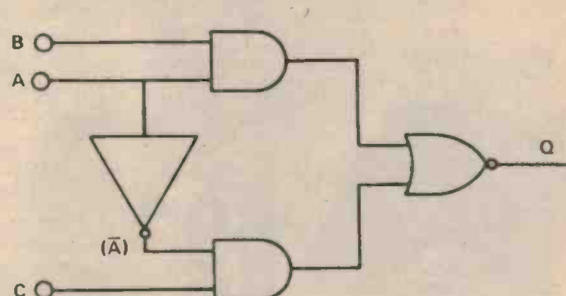


Fig 8. An exclusive-OR gate built from NOR-gates and inverters.



Racy Hazards

One problem of combinational logic circuits is the short but measurable time delay (some 30-80 ns) which occurs in a gate, which can cause momentary spikes to appear in the outputs. A circuit which can give such a problem is shown in Fig. 10. Imagine that B and C are both 1 and that A is changing from 1 to 0. With B and C at 1, the output of the circuit is A or A, and since A is obtained from an inverter it will arrive at the OR gate a little later than A. Momentarily, then, A will be at 0, and A will still be at 0, so that the output will dip to 0, and then rise to 1 when A arrives. The pulse will be very short, but not too short for a counter to detect and register. Race hazards will not affect any of the circuits in this series, and the avoidance of race hazards is a topic which is beyond the scope of our work at present.

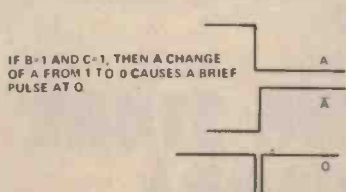


Fig. 10. Race hazards. If we imagine that lines B and C are both at one, then the change from A = 1 to A = 0 should cause no change in the output. Because of the delay in the inverter, however, A goes low just before $\overline{A}$ goes high so that there is a narrow negative pulse developed at the output. This could cause problems if a counter were being driven from the output.

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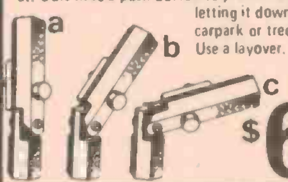

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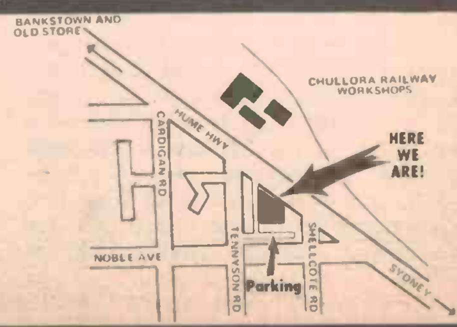

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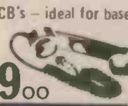

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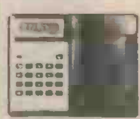

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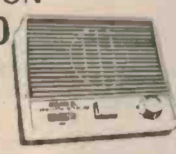

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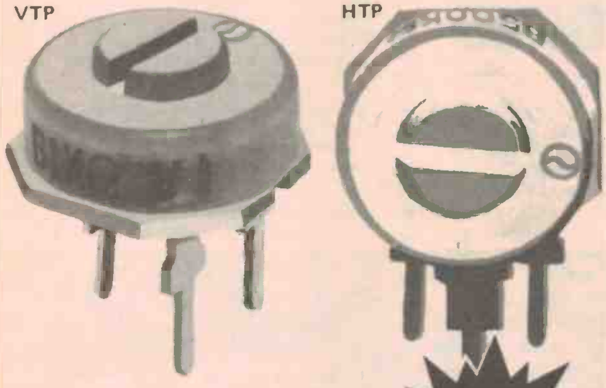

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  - c. Period counter
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DESCRIPTION

The ICM 7208 is a fully integrated seven decade counter-decoder-driver and is manufactured using the Intersil low voltage metal gate C-MOS process. As such it has applications as either a unit, frequency or period counter. For unit counter applications the only additional components are a 7 digit common cathode display, 3 resistors and a capacitor to generate the miltiplex frequency reference, and the control switches.

Specifically the ICM 7208 provides the following on chip functions: a 7 decade counter, multiplexer, 7 segment decoder, digit & segment drivers, plus additional logic for display blanking reset, input inhibit, and display on/off.

The ICM 7208 is intended to operate over a supply voltage of 2 to 6 volts as a medium speed counter or over a more restricted voltage range for high frequency applications.

As frequency counter it is recommended that the ICM 7208 be used in conjunction with the ICM 7207 Oscillator Controller which provides a stable HF oscillator, and output signal gating.

TESTING PROCEDURES

The ICM 7208 is provided with three input terminals: 7,23,27 which may be used to accelerate testing. The least two significant decade counters may be tested by applying an input to the 'COUNTER INPUT' terminal 12. 'TEST POINT' terminal 23 provides an input which bypasses the 2 least significant decade counter. Similarly terminals 7 and 27 permit rapid counter advancing at two points further along the string of decade counters.

COUNTER INPUT DEFINITION

The internal counters of the ICM 7208 index on the negative edge of the input signal at terminal #12.

Format of Signal to be Counted

The noise immunity of the Signal Input Terminal is approximately 1/3 the supply voltage. Consequently, the input signal should be at least 50% of the supply in peak to peak amplitude and preferably equal to the supply. **NOTE: The amplitude of the input signal should not exceed the supply; otherwise, damage**

Fig. 1. Pinout.

Fig. 2. Absolute maximum ratings.

Power Dissipation (Note 1)	1 watt
Supply voltage $|V_{DD} - V_{SS}|$ (Note 2)	6 V
Output digit drive current (Note 3)	150 mA
Output segment drive current	30 mA
Input voltage range (any input terminal)	Not to exceed the supply voltage
Operating temperature range	$-20^\circ C$ to $+70^\circ C$
Storage temperature range	$-55^\circ C$ to $+125^\circ C$

* Absolute maximum rating define parameter limits that if exceeded may permanently damage the device.

Fig. 3. Typical operating characteristics.

($V_{DD} - V_{SS} = 5V$, $T_A = 25^\circ C$, TEST CIRCUIT, display off, unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Quiescent Curent	I_{DD1}	All controls plus terminal 20 connected to V_{DD}. No multiplex oscillator		30	100	μA
Quiescent Current	I_{DD2}	All control inputs plus terminal 20 connected to V_{DD} except store which is connected to V_{SS}.		70	150	μA
Operating Supply Current	I_{DDS}	All inputs connected to V_{DD}, RC multiplexer osc operating f_{in} < 25KHz		210	500	μA
Operating Supply Current		f_{in} = 2MHz			700	μA
Supply Voltage Range	V_{DD}	f_{in} 2MHz	3.5		5.5	V
Digit Driver On Resistance	R_D			4	12	ohm
Digit Driver Leakage Current	I_D				500	μA
Segment Driver On Resistance	R_S			40		ohm
Segment Driver Leakage Current	I_S				500	μA
Pullup Resistance of Reset or Store Inputs	Rp		100	400		Kohms
Counter Input Resistance	R_{IN}	Terminal 12 either at V_{DD} or V_{SS} potentials			100	Kohms
Counter Input Hysteresis Voltage	V_{HIN}			25	50	mV

NOTE 1 This value of power dissipation refers to that of the package and will not be obtained under normal operating conditions.
NOTE 2 The supply voltage must be applied before or at the same time as any input voltage. This poses no problems with a single power supply system. If a multiple power supply system is used, it is mandatory that the supply for the ICM 7208 is not switched on after the other supplies otherwise the device may be permanently damaged.
NOTE 3 The output digit drive current must be limited to 150 mA or less under steady state conditions. (Short term transients up to 250 mA will not damage the device.) Therefore, depending upon the LED display and the supply voltage to be used it may be necessary to include additional segment series resistors to limit the digit currents.

may be done to the circuit.

The optimum input signal is a 50% duty cycle square wave equal in amplitude to the supply. However, as long as the rate of change of voltage is not less than approximately $10^{-4} V/\mu$ sec at 50% of the power supply voltage, the input waveshape can be inusoidal, triangular, etc.

Display Considerations

Any common cathode multiplexable LED display may be used. However, if the peak digit currents exceeds 150 mA for any prolonged time, it is recommended that resistors be included in series with the segment outputs (terminals 2, 3, 15, 17, 18, 26, 28) to limit current to 150 mA.

The ICM 7208 is specified with 500 μA of possible digit leakage current. With certain new LED displays that are extremely efficient at low currents, it may be necessary to include resistors between the cathode outputs and the positive supply V_{DD} to bleed off this leakage current.

Display Multiplex Rate

The multiplex frequency reference is divided by eight to generate an 8 bit sequencer. Thus the display multiplex rate is one eighth of the multiplex frequency reference.

The ICM 7208 has approximately 0.5 μs overlap between output drive signals. Therefore, if the multiplex rate is very fast, digit ghosting will occur. The ghosting determines the upper limit for the multiplex frequency reference. At very low multiplex rates flicker becomes visible.

It is recommended that the display miltiplex rate be within the range of 50 Hz to 200 Hz which corresponds to 400 Hz to 1600 Hz for the reference frequency.

CONTROL INPUT DEFINITIONS

INPUT	TMNL	VLTG	FUNCTION
1. Display	9	V_{DD}	Display on
		V_{SS}	Display off
2. Store	11	V_{DD}	Counter Inform. Stored
		V_{SS}	Counter Inform. Transferring
3. Inhibit	13	V_{DD}	Input to Counter Blocked
		V_{SS}	Normal Opertn.
4. Reset	14	V_{DD}	Normal Opertn.
		V_{SS}	Counters Reset

Fig. 4. Typical performance characteristics.

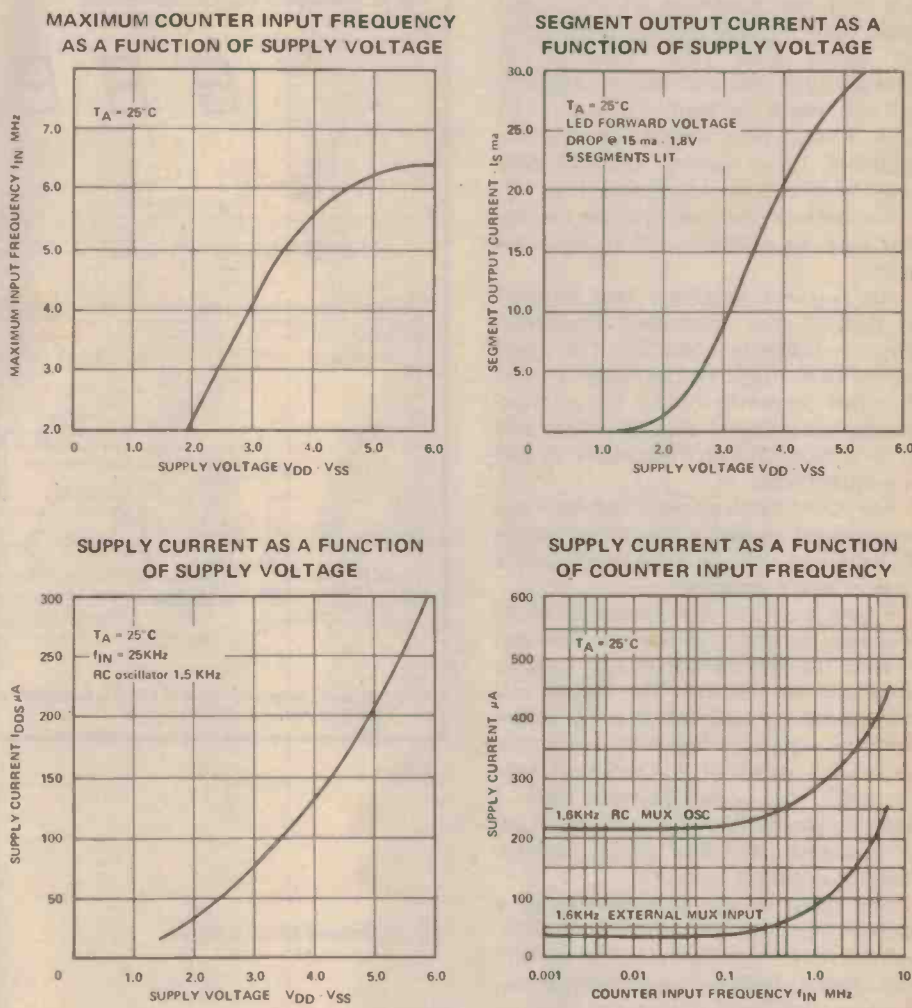
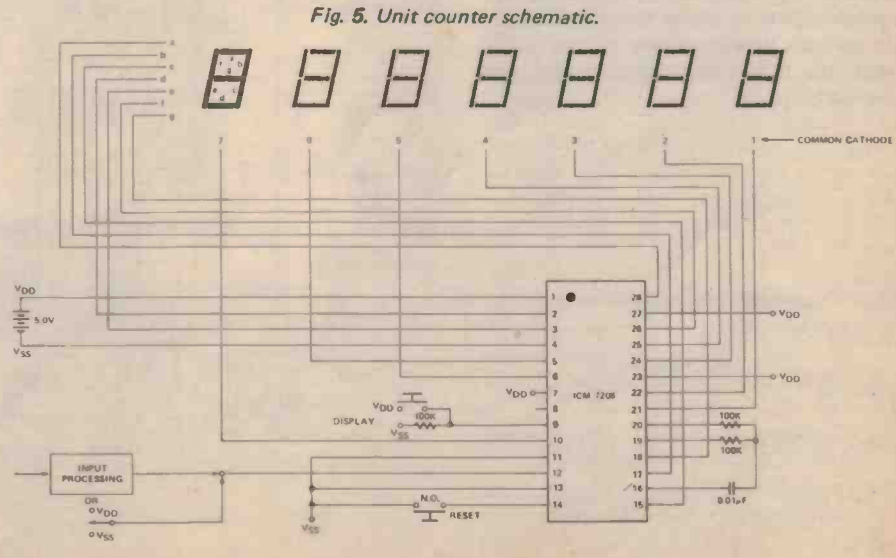


Fig. 5. Unit counter schematic.



ETI data sheet

Unit Counter

The unit counter updates the display for each negative transition of the input signal. The information on the display will count after reset from 00 to 9,999,999 and then will reset to 0000000 and will begin to count up again. To blank leading zeros actuate reset at the beginning of a count. Leading zero blanking affects two digits at a time.

For battery operated systems the display may be switched off to conserve power.

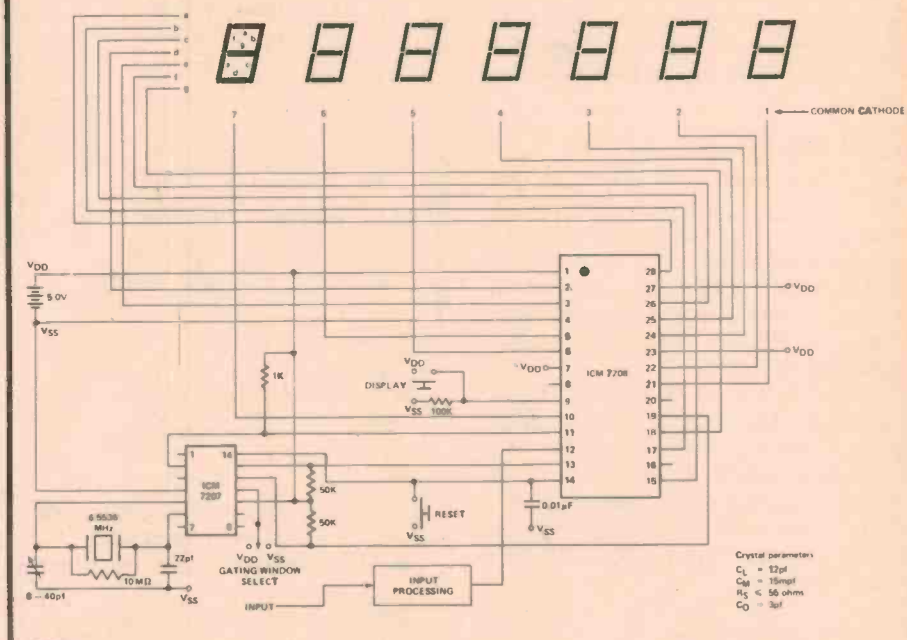
An external generator may be used to provide the multiplex frequency reference (input terminal 20). The signal applied to terminal 19 (terminals 16 and 20 open circuit) should be approximately equal to the supply voltage and for minimum power dissipation should be a square wave.

For stand alone systems two inverters are provided so that a simple but stable RC oscillator may be built using only 2 resistors and a capacitor.

Figure 5 shows the schematic of an extremely simple unit counter that can be used for remote traffic counting, to name one application. The power cell stack should consist of 3 or 4 nickel cadmium rechargeable cells (nominal 3.6 or 4.8 volts). If 4 x 1.5 volt cells are used it is recommended that a diode be placed in series with the stack to guarantee that the supply voltage does not exceed 6 volts.

The input switch is shown to be a single pole double throw switch (SPDT). A single pole single throw switch (SPST) could also be used with a pullup resistor. However, anti-bounce circuitry must be must be included in series with the counter input. In order to avoid all contact bounce problems due to the SPDT switch the ICM 7208 contains an input latch on chip.

Fig. 6. Frequency counter schematic.



Note:
For a 1 sec count window which allows all 7 digits to be used with a resolution of 1 Hz, the ICM7207 can be replaced with the ICM7207A. Circuit details are given on the 7207A data sheet.

Fig. 7. Internal block diagram.

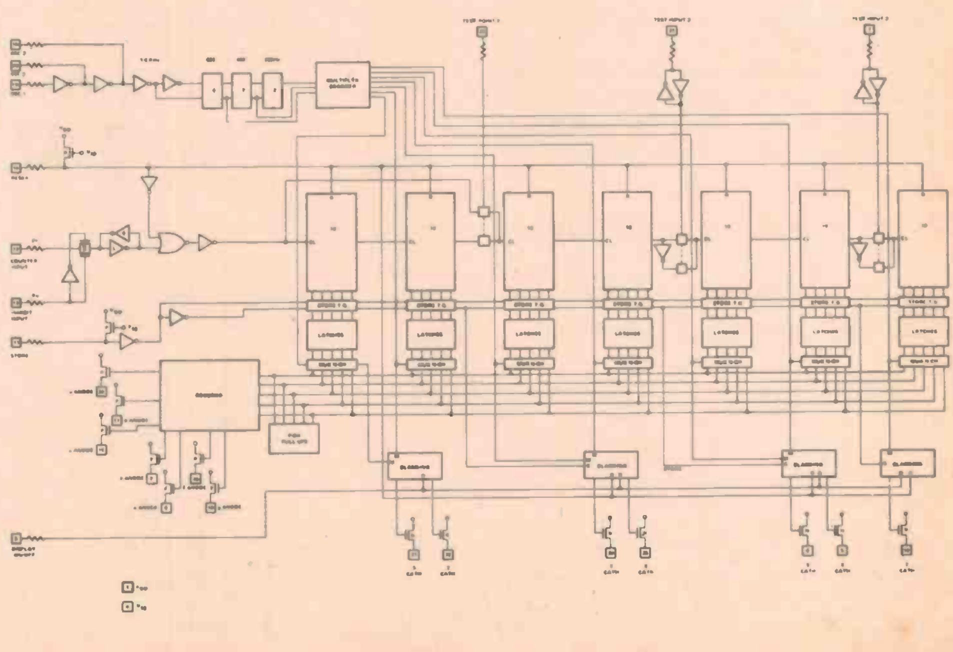
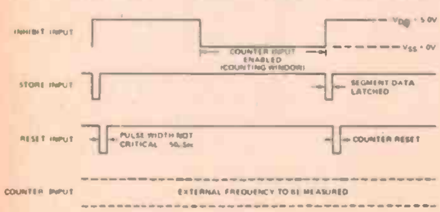


Fig. 8. Frequency counter input waveforms.



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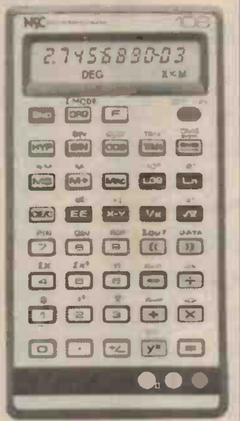

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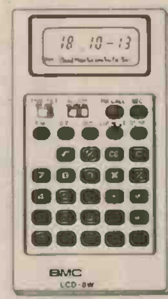

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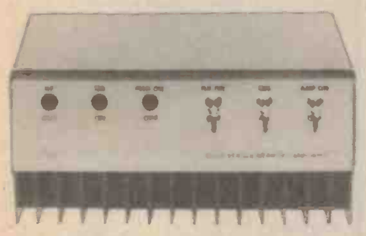

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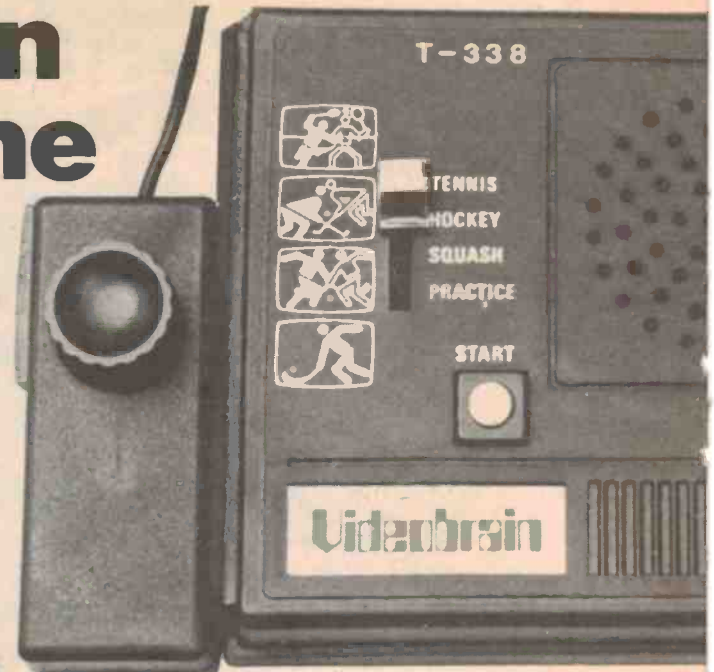

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Although it is so small, this game features selectable bat angle, speed, bat size and auto or manual serve. The two hand controls can be attached to the case or hand-held. The Videobrain game runs on 6 x 1.5 volt pen cells, although an AC adapter is available for $3.95 plus 50 cents postage, if required. The game, which is warranted by Caldor for 90 days, is black and white — for $19.95 + $2.50 p & p, we reckon that's really good value. We also reckon you'll agree.

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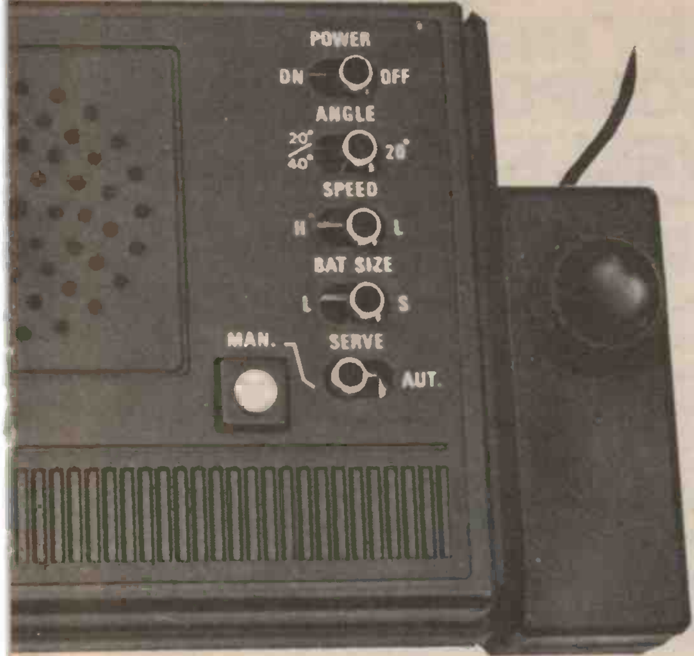

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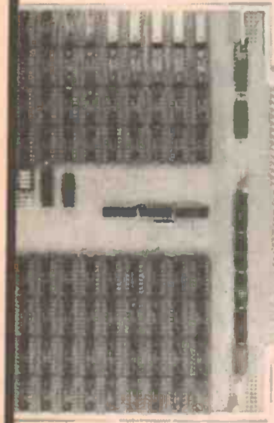

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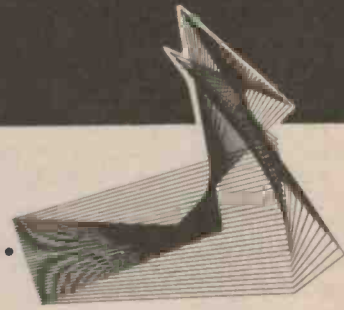

NEWS

F8 S100 CPU

Comptronics, Inc. of 19824 Ventura Blvd., Woodland Hills, CA 91364, has announced an S100 CPU based on the Fairchild F8 3850 MPU and 3853 static memory interface. The board carries sockets for 2 K of EPROM, two processor I/O slots and connections for six I/O ports. The F8 CPU also provides 64 bytes of scratchpad RAM.

Also from Comptronics is an F8-based microcomputer with keyboard and six digit display which has an audio interface and speaker designed to work with a special KD-Bug music routine.

Timex Calculators?

Timex, suffering problems in the watch market, is now test marketing three calculator models in the US. These are: a basic four-banger at $19.95; a machine with memory at $24.95; and a calculator with built-in alarm clock at $39.95 (all US prices). Timex has reportedly sold one of its watch factories to its chief rival, Texas Instruments.

Wagga Wagga Activity

Any calculator or computer enthusiasts in the Wagga Wagga area are invited to contact David Aleksic, PO Box 186, Wagga Wagga, NSW 2650, who is trying to organise a club in the district. David is on the phone at (069) 21.4613.

NZ Micro Clubs

Chris Sullivan, of the New Zealand Microcomputer Club, writes to inform us of several clubs in NZ:

The NZ Microcomputer Club, PO Box 6210, Auckland, New Zealand.
Paul Campbell, 50 Francis Avenue, Christchurch, New Zealand.
Wellington Microcomputer Club, PO Box 1581, Wellington, New Zealand.

Chris enclosed a copy of 'Comshare', now known as 'Micro', a new microcomputer magazine published in New Zealand. The 28 page magazine is well put together and full of interesting info. Subscriptions are $10/year from 9 Galsworthy Place, Bucklands Beach, Auckland, New Zealand.

MM74C911/12

National Semiconductor's new MOS 'intelligent' display controllers interface a microprocessor with an LED or gas discharge display. They replace 5-10 transistors and medium scale ICs.

Peripheral Drivers

Signetics have released two new addressable peripheral drivers which each incorporate a 1-of-8 decoder and 8 latchable outputs. The 590 is a 16-pin device with open collector outputs which sink current to ground. The 591 has 18 pins with open emitter outputs which source current to the external load from a common collector line. Further details from Philips distributors.

Octal Reference Card

In our August '77 issue we reviewed George Morrow's front panel, which is the heart of the Equinox range of personal computer gear. In the article we explained the way 8080 machine code naturally works out in byte-oriented octal. Now, most microprocessor programmers work in hex, and Intel give hex machine code on their 8080 reference card, but there are a lot of 8080 users around who prefer to work in octal. To match his front panel, George Morrow has produced an 8080 Octal reference card which gives octal equivalents for the 8080 instruction set, an ASCII-octal table, the 8080 pinout and the S100 bus layout.

For those of you out there who are dedicated octal users, Automation Statham Pty. Ltd., who represent Morrow in Australia, have made available fifty of these cards to be given away to our readers. So, if you send us a stamped self-addressed envelope at least 180mm by 100 mm in size, and if yours is one of the first 50 received, we will send you one of these cards by return, courtesy of Automation Statham. If you get back an empty envelope, tough luck, you weren't one of the first fifty. Just send your SSAE to 'Reference Card', ETI Magazine, 15 Boundary Street, Rushcutters Bay, NSW 2011.

COMPUTER CLUB DIRECTORY

Sydney: Microcomputer Enthusiasts Group, P.O. Box 3, St. Leonards, 2065. Meets at WIA Hall, 14 Atchison St., St. Leonards on the 1st and 3rd Mondays of the month.

Melbourne: Microcomputer Club of Melbourne, meets at the Model Railways Hall, opposite Glen Iris Railway Station on the third Saturday of the month at 2 p.m.

Canberra: MICSIG, P.O. Box 118, Mawson, ACT 2607 or contact Peter Harris on 72 2237. Meets at Building 9 of CCAE, 2nd Tuesday of month at 7.30 p.m.

Newcastle: contact Peter Moylan, Dept. of Electrical Engineering, University of Newcastle, NSW 2308. (049) 68—5256 (work), (049) 52—3267 (home).

Brisbane: contact Norman Wilson, VK4NP, P.O. Box 81, Albion, Queensland, 4010. Tel. 262 1351.

New England: New England Computer Club, c/- Union, University of New England, Armidale, NSW 2351. (New club; not restricted to students)

Auckland: Auckland Computer Club, P.O. Box 27206, Auckland, N.Z.

Computer clubs are an excellent way of meeting people with the same interests and discovering the kind of problems they've encountered in getting systems 'on the air'. In addition, some clubs run hardware and software courses, and may own some equipment for the use of members. Try one — you'll like it!

If your club is not listed here, please drop us a line, and we'll list you. The same applies if you are interested in starting a club in your area. Also, if established clubs know their programme of forthcoming events, we can publicise them.

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Tandy's TRS-80

Self-contained computer unit is aimed at the first-time user.

AIMED FAIRLY AND SQUARELY at the novitiate computer user, Tandy's TRS-80 microcomputer has burst forth onto the Australian scene. Designed in the States by Tandy's Radio Shack parent, the TRS-80 is a completely assembled and self-contained microcomputer, based on the Zilog Z-80 microcomputer with 4K bytes of ROM and 4K bytes of dynamic RAM.

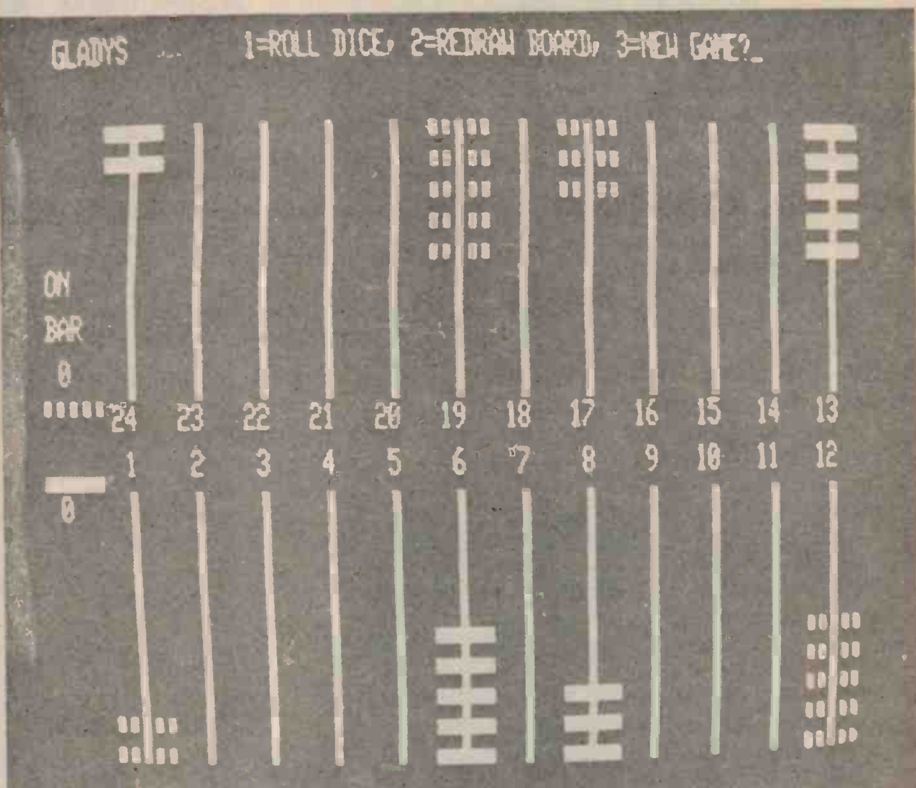
The design approach behind the TRS-80 has been to provide a complete, stand-alone system for the non-technical user, and which could be programmed in a simple language (BASIC) with no need to learn about hardware or assembly language. Other design constraints include provision of cassette storage, built in keyboard and video monitor, and, of course, low cost. Several other home computing products have (or will shortly) appeared, based on this philosophy, including the Commodore PET and the F-8-based Videobrain.

The TRS-80 is supplied as a complete package of four separate units. The most important box is the TRS-80 computer itself, which incorporates the keyboard in a moulded plastic case only slightly larger than most keyboard cases. Inside there are two boards, (one is the keyboard) connected by a fragile-looking ribbon cable. The main board carries power supply circuitry (AC power comes from a separately-boxed transformer), the Z-80 CPU, 8 x 4K dynamic RAMs (in sockets), two socketed ROMs containing Level 1 BASIC, VDU circuitry with its own five 2102's, and a cassette interface. Also mounted at the rear of the board are various connectors to other units, including a bus expansion connector, and power and reset switches.

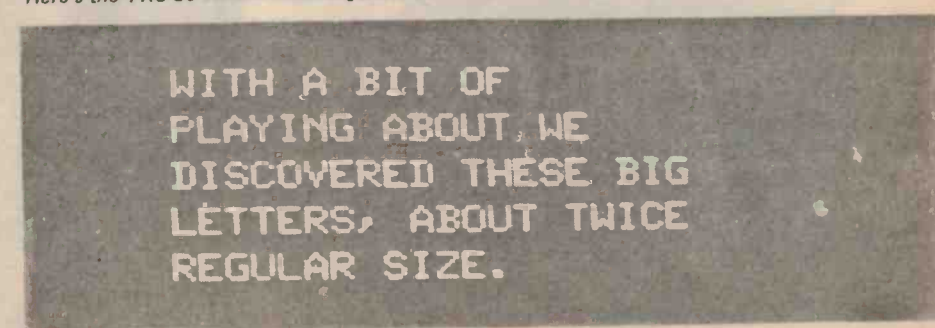
As mentioned above, the second box is the mains transformer for the computer – the unit supplied is manufactured in Australia and meets Australian standards. The video monitor is a separate unit – it appears to be a stripped-down (or rather, not-fully-assembled) mains/portable TV – and the cassette recorder is a standard Realistic model.

All this is yours for $799. When it first arrives you unpack it all and stand the units on a table – now you are ready to begin. You plug the power supply into the back of the computer, the TV monitor into the back of the computer and the cassette recorder cable into the cassette recorder and into the back of the computer. Now the three mains cables connect into the wall outlet, the blanking plug connects into the mic. input, de thigh bones connected to de knee bone, now hear de word of de . . . . Sorry, got carried away with all these connections!

Apply power, and lo and behold! It says READY on the screen. The first thing most users will do at this stage is look up how the CLOAD command works so they can load the supplied cassette into the computer and play a game of Blackjack. This soon becomes less exciting, however, so a frantic scrabble amongst the discarded packing reveals the owner's manual. This book is written in a friendly, humorous style which will drive some readers up the wall – especially those with previous BASIC experience, who will find the 'plot development' excruciatingly slow.



Here's the TRS-80 version of Backgammon.



Wonder where these big letters came from?

Tandy's TRS-80

Complete neophytes, especially kids, will probably love it; for maximum enjoyment it should probably be read at a local franchised hamburger chain whilst sipping a milk shake.

The manual does however have the redeeming feature of covering the operation of the computer and its BASIC dialect thoroughly, with particular attention paid to graphics operation.

The keyboard itself is farly typical of those used with hobby-type micros and is of reasonable quality and operation. The construction of the unit is rather frustrating for hardware-oriented enthusiasts, however. There is no room for expansion or modification inside the case — in fact one is hesitant to even open the case, due to that fragile-looking ribbon cable with no connector. There are no I/O ports on the board, which rules out simple add-ons, such as switching devices on and off, hooking up a speaker and other popular experiments.

There is a connector at the back which brings out the address, data and control lines, as well as the keyboard lines, thus facilitating system expansion by an add-on box, or an S100 adapter (soon to be available). The keyboard interface is not implemented with a PIA-type chip as might be expected, but with ordinary buffers and latches, a cheaper, but less versatile, system.

There are some other bits of hardware in the pipeline, including a floppy desk, printer, and a memory expansion box.

The monitor displays 16 lines of 64 characters, or 128 by 48 dot graphics, on a 30 cm screen. The display is upper case only, but a bit of messing around revealed that double-sized characters can be displayed.

Expansion

The first expansion of a TRS-80 that is possible is the replacement of the 4K RAM chips with 16K chips (no kidding, it's that easy) and replacement of the 4K ROM, with the Level II BASIC kit contained in 12K ROM $159.95 — see "LEVEL II"). We have advanced details on a variety of other add-ons as well.

The key to further expansion is the "Expansion interface" unit, which comes in its own TRS-80 style plastic box designed to sit under the monitor. This unit enables you to add more additional RAM (16 or 32K), dual cassettes, four mini floppy disks and a line printer. It includes a clock, and space for an extra PCB. And guess what, it has a separate power supply, but it has a slot in the back in which to place the power supply, and also the original TRS-80 power supply. The interface requires BASIC Level II.

The Mini Disk unit stores up to 96K bytes, comes with operating system, and gives you an access time for any single byte of less than half a second.

Two printers are to be available. The "Line Printer" is a modified Centronics dot matrix impact printer capable of up to 110 characters per second and 80 or 132 characters per line. Level II and the interface box are required. On the other hand a "Screen Printer" can be obtained for $899.95, which according to Tandy's literature will at the touch of a button reproduce your screen (including graphics) on 5½" electrostatic paper at a rate of 2,200 characters per second!

Software

As a home computer system, the TRS-80 is probably the least hardware oriented. There are two points which support this thinking: you can't get at the internal hardware without voiding the warranty and there is no hardware interface capability other than to the display and the cassette recorder.

So how would you go about evaluating a relatively complex product like this? Proabably in the same way as you'd evaluate another type of product which enjoys a high profile at Tandy Stores: a home stereo system.

In choosing a computer system, the potential customer will be influenced by what he sees (i.e.: packaging) and by what he can be led to believe about it (by advertising, by friends, by using the system, and even by reading electronics magazines). That customer's attention will be focused on the keyboard and display not on the internals. It won't matter to him that a Z-80 incorporates efficient machine language instructions for data searching and moving or that it's a microprocessor that can run at a 4 MHz clock rate. He will be more interested in what it can do as opposed to how it does it (he's buying capability, fun and perhaps even status, not speed).

What You Get On The Soft Side

The TRS-80 comes with "Radio Shack Level I BASIC" in 4K ROM; Level I claims to support "standard BASIC statements". But whose standard? It seems to be Radio Shack's since some important capabilities are missing (for example: exponentiation and array dimensioning). All calculations are performed in floating point with 5 or 6

The four units which make up the complete TRS-80 microcomputer.

decimal place accuracy. Twenty-six numeric variables are available (A to Z) along with one numeric array variable. Two 16-character string variables can also be used. Actually, these are more properly called "string things", since they cannot be compared, manipulated, indexed or used in any but the most mundane ways. You can input and output using them, but that's all folks.

Cassettes can be used to handle programs (CSAVE and CLOAD commands) or data (PRINT # and INPUT # statements). Since whatever you have in memory will be wiped out if you cut off the power (intentionally or otherwise), having a cassette recorder to store your information permanently is invaluable. And it makes entering of other people's programs (such as the Backgammon and Blackjack games supplied by Radio Shack) especially convenient.

Speaking of which, the Backgammon game makes extensive use of the TRS-80's rather limited graphics capability: there are virtually no special graphics characters — you've got to construct whatever image you have in mind by turning on some points on the display (48 points vertically by 128 points horizontal). This can be tedious. Mind you, in the low cost home computer system field this is not unusual. To compensate you can write subprograms which draw vertical and horizontal lines, draw patterns, fill them in, etc.

Programming

Immediately after powering up your display and keyboard, you can:

1 do simple calculator type computations (immediate execution)
2 bring in a program from tape
3 type NEW and enter a program

Program statements are preceded by line numbers to distinguish them from immediate execution statements, and keep them in order. A LIST command is available to display the program. Unfortunately the cursor control keys cannot be used to edit this display, so if you want to change a line in a program, you must retype the entire line.

Output which would otherwise stream by while your program is executing can be frozen by depressing any key. Unfortunately, if you interrupt the program itself, you cannot modify the variables it is using and then return to the point of interruption. So your only alternative is to rerun the program and in many cases, that's a nuisance.

As for error messages, they are confined to: WHAT? HOW? or SORRY (along with an indication of where the problem is). These terse messages are not unexpected when you consider that the interpreter was written to fit into 4K of ROM. In a tradeoff of readability against the amount of program code you can fit into the standard 4K of RAM, Level I has a "shorthand dialect". For example: G.= GO TO, N.= NEXT, and P.= PRINT. However, REA. seems to be a shortform of dubious value for READ (probably done for consistency).

The overriding philosophy controlling the design of this interpreter seems to have been "make it fit". It's hard to believe that a 4K interpreter is anything but "stripped down" after you've used this one. Radio Shack has dropped a few hints about releasing a Level II BASIC. Until then it is unfair to compare this software package with, say, the 14K monitor/interpreter that comes in Commodore's PET. They're just not in the same leagues.

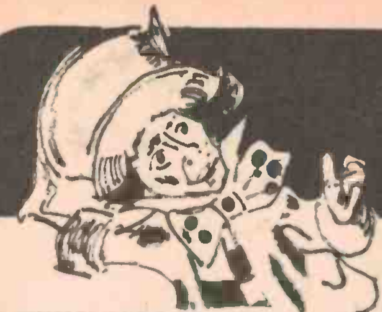
At the same time, it is somewhat unrealistic (no pun intended) for Radio Shack to claim, as they have in their sales literature, that "applications of the TRS-80 are limited only by the imagination and ability to write programs". Try something quite unimaginative like sorting a list of names. Good luck! You'll need it.

Level II

Sketchy details are available on Level II BASIC, an interpreter written by Microsoft. From the list of statements and functions to be available, it appears that this version of BASIC is at least as powerful as PET's including many editing features. In fact we would go so far as to say that Level II is the most significant upgrade for the TRS-80. We wonder how logical it is to sell a home computer with such a limited BASIC and then offer the upgrade as an option. Will this turn people off computing, or will most of them jump for BASIC II anyway?

For the average (?) reader of this magazine, who has fairly sophisticated applications in mind for his personal computer, and who is likely to dabble in hardware, the TRS-80 is not the best way to go. For the complete novice, for schools, for people with limited requirements, it offers reasonable value for money. The possibility of expansion of the basic system to 16K Level II BASIC and 16K of RAM simply by replacement of a few IC's is a tempting one, and will appeal to many of our readers. Perhaps the clincher will be the forthcoming S100 expander board which will allow connection of all kinds of peripherals. With these additions, the TRS-80 looks like being a very powerful and compact computer indeed. Until then . . . .

The actual computer, shown here, also incorporates a 53-key keyboard and VDU.



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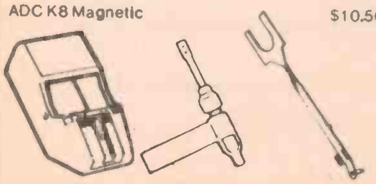

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BZX83C-4V7	4.7	.30	IS3010A	10	.65
BZX83C-5V1	5.1	.30	IS3012A	12	.65
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BZX83C-6V8	6.8	.30	IS3020A	20	.65
BZX83C-7V5	7.5	.30	IS3024A	24	.65
BZX83C-8V2	8.2	.30	IS3027A	27	.65
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BZX83C-12	12	.30	IS3036A	36	.65
BZX83C-13	13	.30	IS3039A	39	.65
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BZX83C-16	16	.30	IS3051A	51	.65
BZX83C-18	18	.30	IS3056A	56	.65
BZX83C-20	20	.30	IS3062A	62	.65
BZX83C-22	22	.30	IS3068A	68	.65
BZX83C-24	24	.30	IS3075A	75	.65
BZX83C-27	27	.30	IS3100A	100	.65
BZX83C-30	30	.30	IS3150A	150	.65
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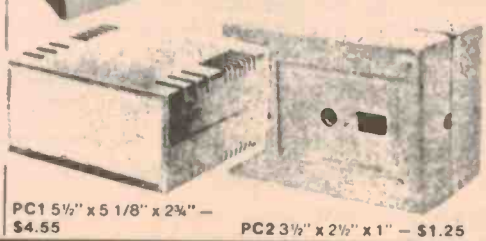

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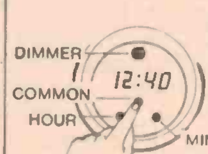

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CROSSHATCH GENERATOR

New oscillator scheme allows simplified set-up procedure.

THE COLOUR television picture is created in the receiver picture tube by three separate electron guns - one each for red, green and blue. As these guns cannot be in the same physical position they need to be converged into one spot on the screen.

The process of converging at the centre of the screen is called static convergence and is performed by magnets on the yoke assembly.

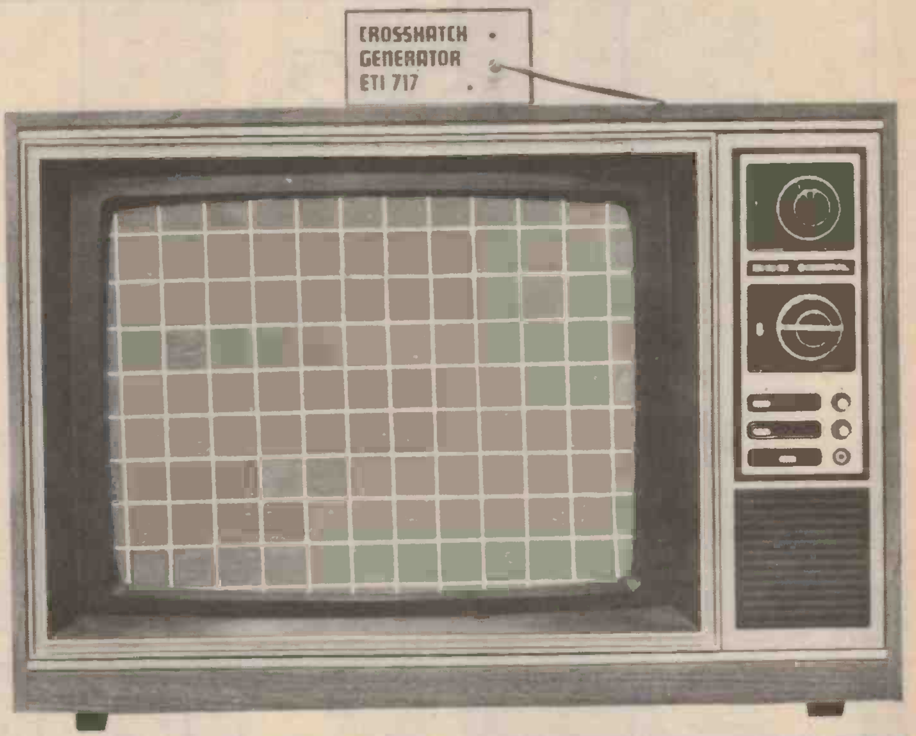
However, the screen of the picture tube is not everywhere coincident with the deflection plane and this causes errors when the beam is deflected away from centre. These deflection errors are corrected electronically by 12 or more controls and the process is known as dynamic convergence.

An important part of the process is the use of a crosshatch generator to provide horizontal and vertical lines on the screen. Using the generator, the convergence errors are immediately apparent and the controls on the set are usually labelled with the effect each has on a crosshatch pattern.

In addition to setting up convergence the generator pattern may also be used to set up horizontal and vertical linearity and to orientate the deflection yoke coils on both black and white and colour sets.

Most of the inexpensive pattern generators, which are currently available, produce a video waveform, which must be injected into the correct place in the TV, and require a synchronizing signal from the TV set. Such generators are thus fiddly things to use.

Text continued on page 72.

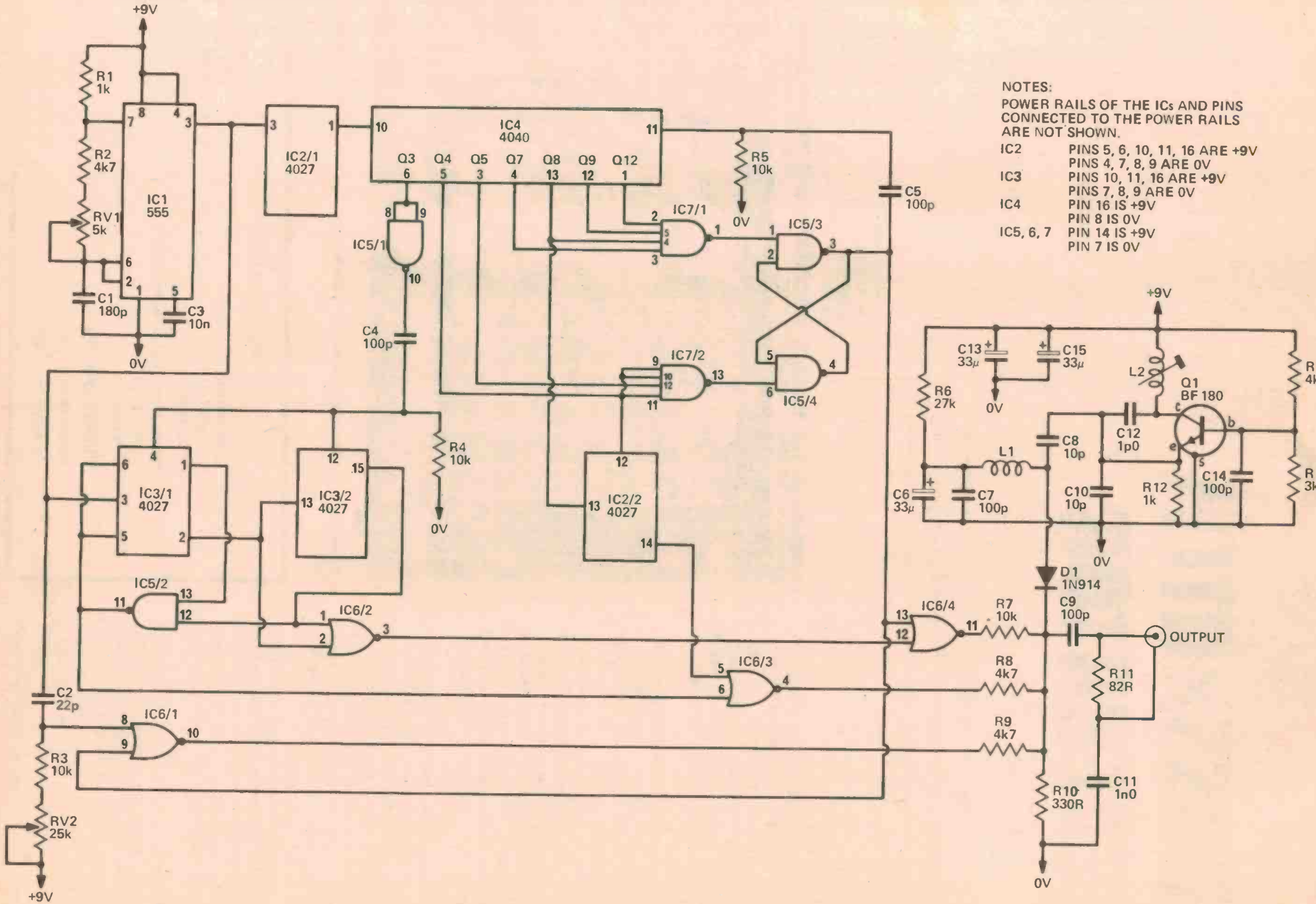


The new ETI 717 crosshatch generator replaces the earlier ETI 704 and is considerably easier to set up.

SPECIFICATION – ETI 717

Line spacing	
Horizontal	every 16 lines
Vertical	every 4 μs
Number of Lines normally visable	
Horizontal	9
Vertical	12
Output impedance	75ohm
Power consumption	16mA @ 9V
Battery life (Type 216)	10–12 hours

CROSSHATCH GENERATOR



NOTES:
POWER RAILS OF THE ICs AND PINS CONNECTED TO THE POWER RAILS ARE NOT SHOWN.

IC2	PINS 5, 6, 10, 11, 16 ARE +9V
	PINS 4, 7, 8, 9 ARE 0V
IC3	PINS 10, 11, 16 ARE +9V
	PINS 7, 8, 9 ARE 0V
IC4	PIN 16 IS +9V
	PIN 8 IS 0V
IC5, 6, 7	PIN 14 IS +9V
	PIN 7 IS 0V

Fig. 1. The circuit diagram of the crosshatch generator.

HOW IT WORKS – ETI 717

A TV picture is made up of a series of horizontal lines equally spaced down the screen with the information transmitted in a serial form along with the necessary synchronization pulses. In Australia there are 625 lines in each complete picture but these are transmitted as two "frames" each of 312½ lines with the second frame interlaced between the first giving a total of 625 lines. This is to reduce flicker of the picture which would otherwise occur.

To simplify our circuit and prevent a double horizontal line we have used 624 lines which eliminates the interlacing. The TV set automatically accepts this change.

To synchronize the TV set we need a 192μs wide pulse every frame (20ms) and a 4μs wide pulse every line (64μs). All pulses, including the information, are derived from a single 249.6 kHz oscillator IC1. This is divided by 2 in IC2/1 and then by 2496 by IC4 giving an output of 50 Hz. This IC is a 12 stage ripple counter which, while normally dividing by 4096, can be forced to divide by 2496 by decoding (IC7) the outputs from the 7th, 8th, 9th and 12th stages and reseting IC4 back to zero. The output of IC7 toggles the RS flip flop IC5/3, IC5/4 which resets IC4 via C5. This flip flop is reset by the decoded output from the 4th and 5th stages of IC4. This occurs 192μs later; thus the output from IC5/3 is the frame sync. pulse.

To generate the line sync pulse the output from the 3rd stage of IC4 (15,600 Hz) is used to reset both halves of the dual JK flip flop IC3. This IC is then toggled by the 249.6 kHz clock until, after three pulses, both "Q" outputs are "1" when IC5/2 detects this and disables IC3/1. IC6/2 decodes the second of these clock periods and this becomes the line sync pulse. These pulses are combined in IC6/4 to give a combined sync pulse.

The 249.6 kHz is differentiated by C2/R3 and after being squared up by IC6/1 is used to generate 16 white spots on each line which results in vertical lines. These pulses are deleted during the frame sync period to prevent interference to synchronization. Due to variations in the CMOS a trim potentiometer is provided to give equal width to the vertical and horizontal lines.

The horizontal line is generated by IC2/2 (JK flip flop) and this IC is toggled by the 8th output (487.5 Hz) of IC4 and is reset by the output of the 4th stage (64μs later). This gives a single white line every 16 lines. To prevent this line interfering with the line sync pulse the output of IC2/2 is combined with that of IC5/2 which is high for a period 4μs before the line sync pulse to 4μs after the pulse. This gives a short black region on both ends of the line (normally off the screen). The outputs of IC6/1, IC6/2 and IC6/3 are combined by R7-R10 to give a composite video signal. Note that the video information gives positive pulses while the syncronization pulses are negative.

The VHF oscillator, Q1, is mixed with this signal and the resulting modulated signal can be tuned in by the TV set. Adjustment of the frequency by the tuning slug allows operation on any desired channel from 7 to 10.

PARTS LIST ETI – 717

Resistors all ¼W, 5%

R1	1k
R2	4k7
R3–R5	10k
R6	27k
R7	10k
R8, 9	4k7
R10	330R
R11	82R
R12	1k
R13	4k7
R14	3k3

Potentiometers

RV1	5k trim
RV2	25k trim

Capacitors

C1	180p ceramic
C2	22p ceramic
C3	10n polyester
C4, 5	100p ceramic
C6	33μ 16V tantalum
C7	100p ceramic
C8	10p ceramic
C9	100p ceramic
C10	10p ceramic
C11	1n0 polyester
C12	1p0 ceramic
C13	33μ 16V tantalum
C14	100p ceramic
C15	33μ 16V tantalum

Inductors

L1	see table 1
L2	see table 1

Semiconductors

IC1	NE555
IC2, 3	4027B (CMOS)
IC4	4040B (CMOS)
IC5	4011B (CMOS)
IC6	4001B (CMOS)
IC7	4012B (CMOS)

Note: all CMOS should be 'B' series

Q1	BF180
D1	1N914

Miscellaneous

PC board ETI 717
Zippy box
Output socket
Single pole toggle switch
9V battery

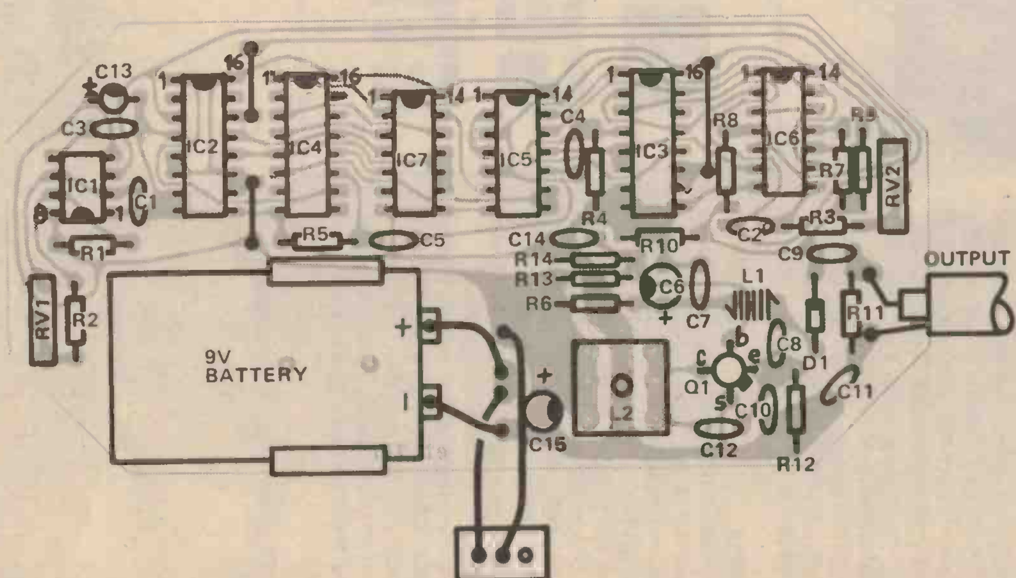


Fig. 2. Component layout.

The ETI 717 generator produces a combined horizontal and vertical sync waveform and this, together with the crosshatch video, is modulated onto a carrier frequency operating in VHF channel 8 (189.25/194.75 MHz). Thus to use the generator one simply attaches it to the antenna terminals and selects channel 8.

Table 1
Coil Winding Date

L1 6 turns 0.5 mm enamelled wire close wound, 5 mm dia, air core.

L2 4 turns 0.5 mm enamelled wire close wound onto a miniature Neosid former with VHF slug, 6 pin base and aluminium can.
Terminate leads on opposite sides of the base. Use teflon locking strip on core.

Construction

Assemble the pc board according to the overlay starting with the links, resistors and diodes. The 555 IC, the transistor, capacitors and coils next with the CMOS IC's last. Solder the power supply pins of the CMOS (7 and 14 or 8 and 16) first. This allows the internal protection diodes to protect the inputs of these ICs.

We mounted the unit into a zippy box as it is cheap and available. This does however allow the oscillator to drift due to the presence of hands, etc., as it does not provide good shielding. If the crosshatch generator is going to be used continuously a die cast box is recommended. A teflon or rubber locking strip is necessary on the adjustable coil L2 as slight movement of the slug will put it off frequency.

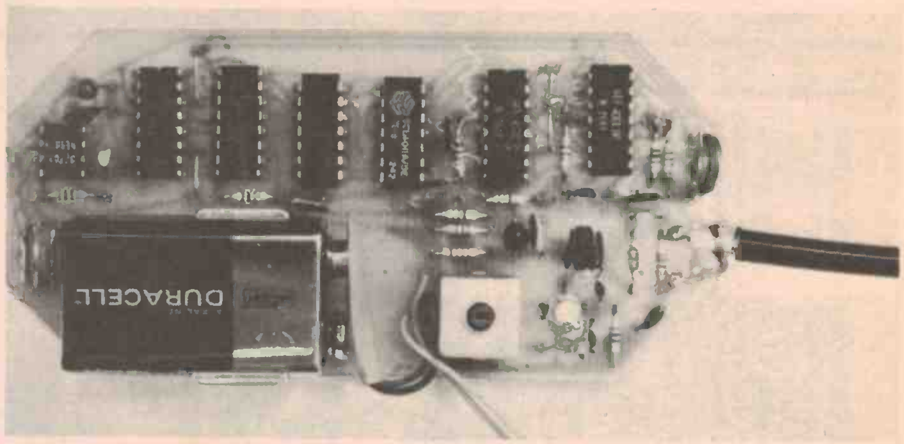
Alignment

This is easiest if a frequency counter or oscilloscope is available. Monitor the output on pin 1 of IC4 and adjust RV1 to give 50 Hz.

Connect the unit to the TV set and select channel 8 (or an unused channel from 7 to 10). Switch on and adjust L2 to give a stable picture. RV2 should be adjusted to give vertical lines of about the same width as the horizontal.

If an oscilloscope or counter is not available adjust L2 first to tune channel 8 as best you can and then RV1 to syncronize the picture. Now fine adjust both of these controls to give the best result.

The PCB artwork for the project is on page 94.



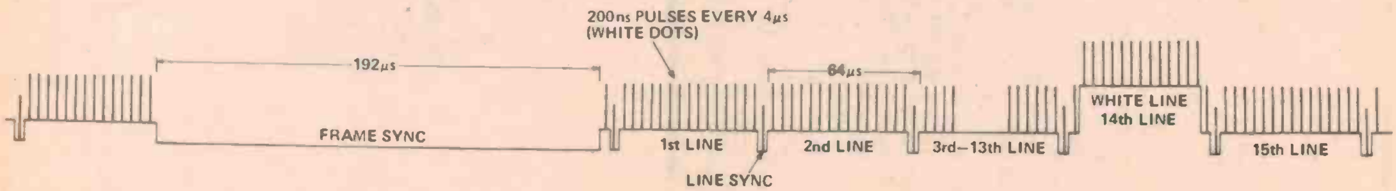


Fig. 3. Diagram showing part of the video waveform across R10. Due to the time scale involved (200ns wide pulses and 20ms between frame sync pulses) it is not possible to show the entire waveform. The first white line is the 14th and is then every 16th line.

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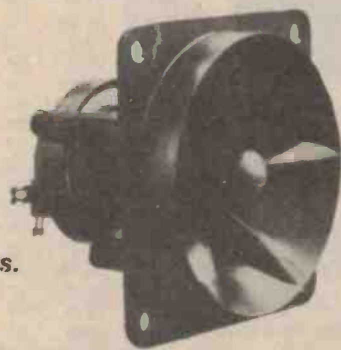

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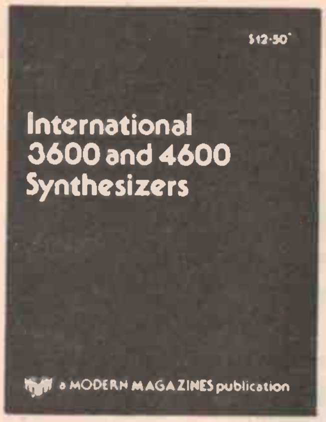

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74LS163	.31	74LS38	.60
74LS174	.55	74LS42	.70
74LS175	.60	74LS47	.70
74LS192	.60	74LS48	.70
74LS221	.40	74LS74	.85
74LS257	.40	74LS75	.55
74LS266	.30	74LS86	.35
74LS283	.60	74LS90	.63
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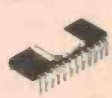
4012	.20	4035	.95
4013	.35	4040	1.00
4014	.80	4049	.50
4015	.80	4050	.50
4016	.40	4071	.22
4017	.80	4507	.28
4018	.85	4510	.50
4019	.35		



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Project 139

SWR/POWER METER

New design provides wide sensitivity range and wide bandwidth.
By Roger Harrison VK2ZTB and Phil Wait VK2ZZQ

THIS REFLECTOMETER DESIGN, apart from being simple, elegant and easy to construct, covers three decades – from 100 kHz to 100 MHz, and can be constructed for RF powers as low as 500 mW or up to 500 watts.

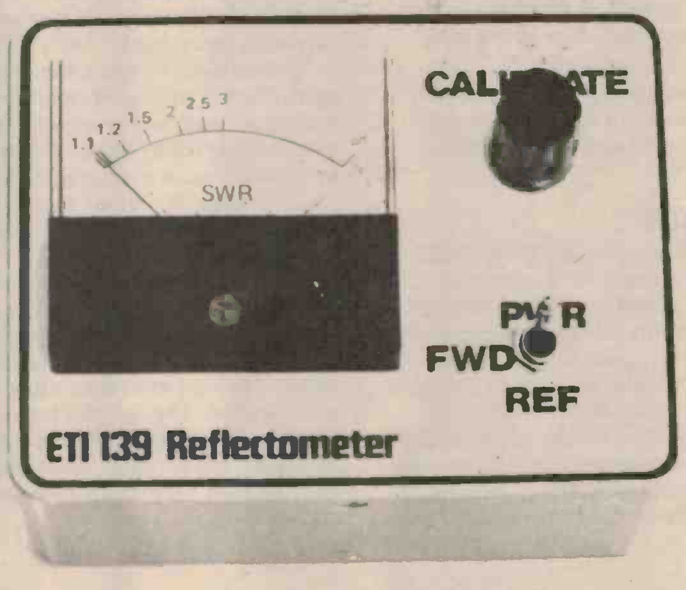
The problem with most designs for reflectometers, or "Swar" meters as they tend to be called colloquially these days, is that they generally only cover about one decade in frequency range – usually 3 to 30 MHz or, if further, have discontinuities and drastic sensitivity variations at the extreme ends of their frequency range.

Sensitivity is a problem with the commercially available instruments also. Those with the best sensitivity – 5W full scale usually – are made for the CB market, and while they will work over most of the HF spectrum (some extending beyond that), sensitivity is insufficient if you are working with low power solid state RF circuitry or doing a deal of antenna experimentation.

Performing antenna measurements at powers of 5W or more is discourteous to say the least, especially where sustained or many consecutive measurements need to be made.

The reflectometer/RF power meter described meets the requirements of most people involved in RF measurements requiring such an instrument and where a disparate variety of facilities are required.

This project will be extremely useful to radio amateurs, CBers, servicemen involved in communications, in laboratories etc.



CONSTRUCTION

Construction is very straightforward. The printed circuit design given is recommended, otherwise variations in layout may affect performance.

All the components are mounted on the *copper side* of the pc board, which is subsequently assembled onto the coax sockets and mounting bolts.

Commence by winding the toroid current transformer secondary turns. Refer to the circuit diagram. Cut a 45 mm length of RG58, stripping back the braid and insulation as illustrated in the component overlay and photographs.

This is not all that critical, but maintain as much braid as you can to reduce problems with errors creeping in at the top end of the frequency range due to discontinuities here.

Slip the toroid over the short length of coax and mount this assembly on the pc board. Position the toroid centrally and fix it in place with a small amount of pliable plastic cement compound such as "Silastic".

Mount all the other components next. Pay particular attention to the orientation of the diodes D1,D2,D3.

The trimmer capacitor, C2 is shown

as a mica compression type. Any suitable trimmer — such as the Philips film trimmers — can be used, however, the mica compression trimmer provides a certain amount of 'vernier' adjustment.

The pc board and major components are assembled into a suitable metal box. We used a Horwood type 34/2/D which measures 100 mm by 75 mm by 50 mm. This provides for a compact finished instrument without a crowded layout.

The completed pc board is mounted in the following way:

Once the coax sockets are mounted, and the two mounting bolts are in position, a coax plug (with cable) should be plugged into each of the sockets in order to locate the centre-conductor pins of each socket.

The pc board is then placed into position and the input/output pads soldered to the coax socket pins. make sure that a good fillet of solder secures the pin to the pc board pad.

Two nuts on the mounting bolts, one under the pc board, one on top of the pc board, then secure the board mechanically as well as providing a ground connection. Refer to the pictures and component overlay.

Connections to the meter, pot, and switch — located on the front panel, can then be made with short lengths of hookup wire.

CALIBRATION

A suitable RF source, a dummy load and an RF voltmeter or a known-accurate RF power meter are required for test and calibration of the instrument.

Suitable low power dummy loads, marketed for CBers, are readily available or any of the standard amateur texts (ARRL, RSGB handbooks etc) provide excellent construction details of dummy loads to dissipate a variety of powers. The same texts describe suitable RF voltmeter probes that may be used in conjunction with a multimeter.

SWR Scale

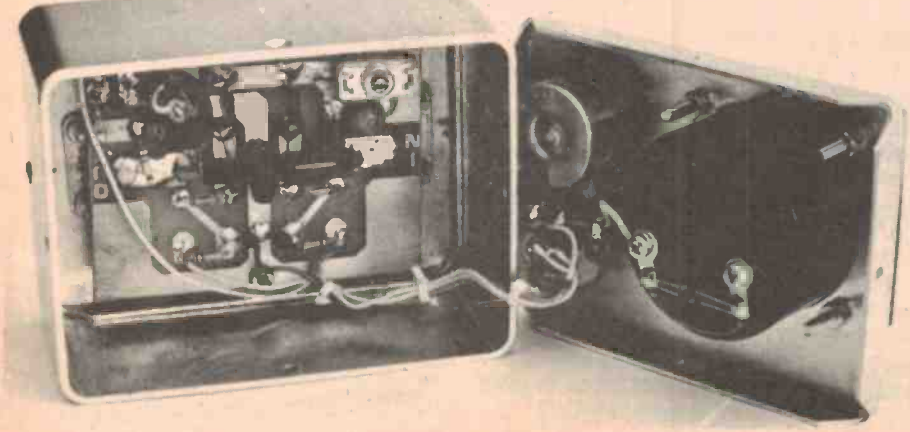
The instrument is connected between the RF source and the dummy load. Turn the sensitivity control fully anti-clockwise. Switch to read forward power.

Key the RF source and slowly rotate the sensitivity control clockwise. The meter reading should increase. If it doesn't, check wiring. If it goes in reverse, you've got D1 back to front!

If all is well, advance the sensitivity control until the meter reads full scale. Switch to read reverse power. Adjust the trimmer C2 to obtain a minimum meter reading. It should go to zero; increase the sensitivity when a very low reading is reached to ensure that C2 is adjusted correctly.

This completes the adjustment of the Reflectometer section. The scale calibration can be obtained from Table1.

The scale on the meter may be hand-lettered using Letraset or other 'rub-on' lettering. The original lettering may be painted over and the new SWR scale inserted beneath the original scale. Kit suppliers may make a whole new scale available.



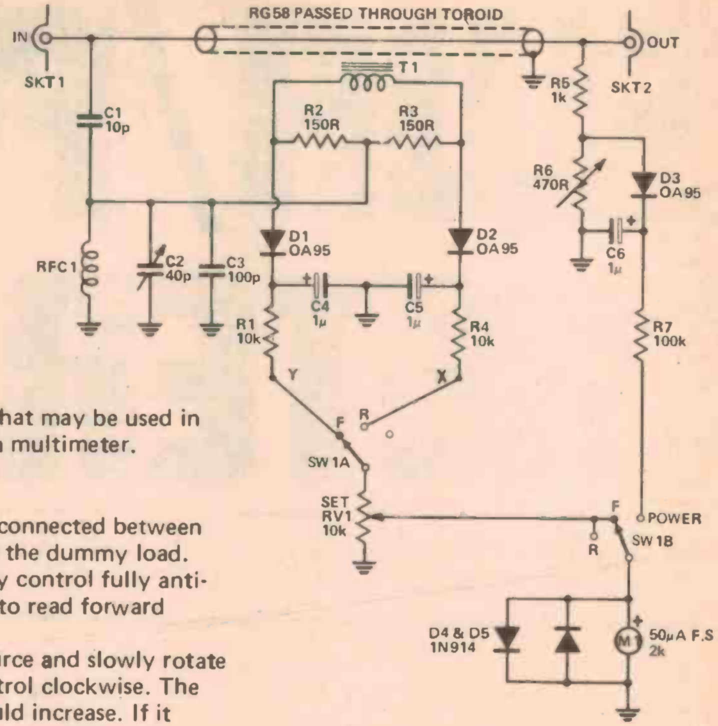


Fig.1. Circuit diagram of the SWR/Power meter. Note the unusual switch configuration. A special C & K toggle switch was used as it provides the simplest operation. Otherwise, a double-pole, triple-throw switch is necessary.

Power

The circuit (Figure 1) shows a divider network, consisting of R5 and R6, tapped across the RF on the coax line.

The lower divider resistance R6 is shown as a variable element. A miniature deposited carbon track trimpot was used in the prototype. The low value types seem to perform quite well over a wide frequency range and one was used here for convenience. It was set so that the full-scale reading of M1 corresponded to a particular peak power dissipated by the dummy load (as measured with an RF voltmeter or known-accurate RF power meter).

Fixed resistors may be substituted for a trimpot, necessitating only a check of the accuracy of the full scale peak power reading. Values for particular full-scale power readings are given in Table 2.

The power scale should be calibrated to suit the individual instrument. It will be non-linear, particularly at the bottom end.

Performance

The inherent impedance of the prototype instrument was measured using a TEK 5 W dummy load and a Hewlett-Packard vector impedance voltmeter. The results are illustrated in Figure 4.

TABLE 1

SWR	Scale reading
3:1	0.5 full scale
2.5:1	0.42 full scale
2:1	0.34 full scale
1.5:1	0.2 full scale
1.2:1	0.1 full scale
1.1:1	0.05 full scale

TABLE 2

Peak Power, full scale	R2 value
500 W	6R8
200 W	2 x 33R in parallel
100 W	33R
50 W	68R
20 W	2 x 330R in parallel
10 W	330R
5 W	680R
3 W	1k + 100R in series *

*linearity suffers

How it works – ETI 139

The reflectometer employs a "current transformer" having an electrostatically-shielded primary with a high-ratio secondary winding driving a low value load resistance.

A short length of coaxial cable, passed through a ferrite toroid, forms the primary with the braid connected so as to form an electrostatic shield.

The secondary of the current transformer consists of a winding around the circumference of the toroid, coupled to the magnetic component of the 'leakage' field of the short length of coax cable.

The secondary drives a centre-tapped resistive load (R2/R3) connected to a voltage sampling network (C1-C2/C3) tapped across the RF input such that sum and difference voltages will appear across the ends of the current transformer (T1) secondary winding.

Diodes D1 and D2 rectify the sum and difference voltages from the secondary of T1, RF and audio (modulation) bypassing being provided by C4 and C5. The RF choke, RFC1, provides a low-resistance DC return for the signal rectifiers, D1 and D2.

The power measurement facility is obtained by tapping off a portion of the RF voltage on the line via R5 and R6, and rectifying this with D3. Capacitor C6 provides RF and audio (modulation) bypassing.

As the load on the rectifier is so light – R7 being 100 k and the meter being 2 k, peak power is measured.

Diodes D4 and D5 provide protection for the meter.

PARTS LIST – ETI 139

Resistors all ¼W, 5%
- R1 . . . . . 10k
- R2,R3 . . . 150R
- R4 . . . . . 10k
- R5 . . . . . 1k
- R6 . . . . . 470R trimpot or fixed —see text
- R7 . . . . . 100k

Potentiometer
- RV1 . . . . 10k/C pot

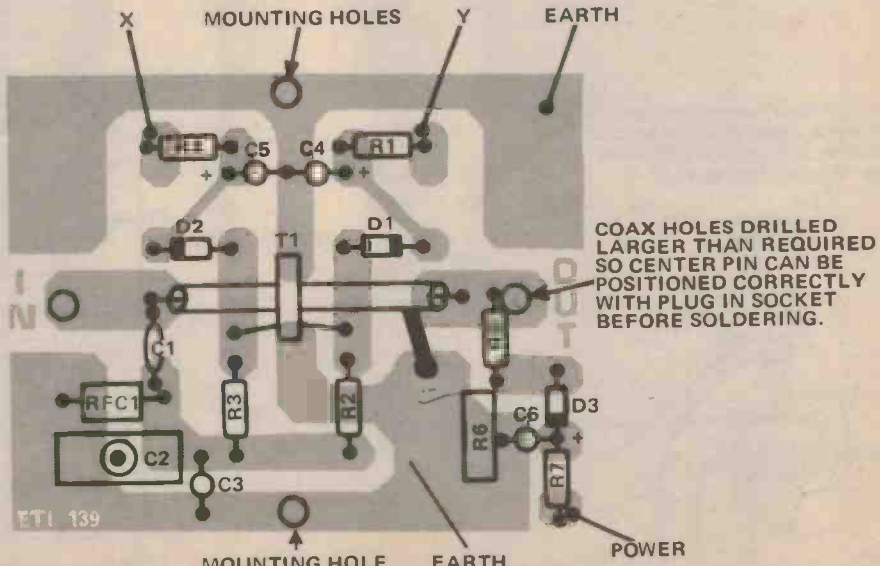
Capacitors
- C1. . . . . . 10p ceramic
- C2. . . . . . 40p trimmer
- C3. . . . . . 100p ceramic
- C4 - C6 . . . 1µ solid dipped tantalum

Semiconductors
- D1 - D3. . . OA95
- D4,5 . . . . 1N914

Miscellaneous
- RFC1. . . . Any moulded RF choke, 1mH or more (value not critical).
- SW1. . . . . C & K switch type 7211 (see text)
- M1 . . . . . 50 µA meter, T.E.W. type, 2k resistance.
- T1. . . . . . 40 turns of 35 gauge B & S enamelled wire, around circumference of Neosid toroid type 28-511-31, 12.7 mm o.d., 6.35 mm i.d., 3.18 mm thick, F14 material (see text)
- Coax sockets . . . SO239 or other type to suit
- Case. . . . . Horwood type 34/2/D (100 mm x 75 mm x 50 mm).
- PC board . . ETI 139

Two 25 mm long bolts with three nuts and two lock washers each; nuts and bolts for coax sockets (if required); length of RG58 coax; 6 mm dia. sleeving; hookup wire, etc.

Fig. 2. Component overlay for the pc board. Note that, contrary to the usual practice, the components are mounted on the copper side of the board.



The impedance discontinuities introduced by the prototype are well inside the basic accuracy capability of the meter movement! The real part of the instrument's impedance is within 5% of the nominal 50 ohms — most of this is probably due to connectors and construction discontinuities.

The variation in the real part of the impedance is within +/- one ohm across the frequency range of the instrument, and can be essentially ignored.

The reactive (imaginary) component of the instrument's inherent impedance is negligible up to 20 MHz when it begins to become slightly capacitive.

The overall impedance decreases rapidly above 100 MHz.

Sensitivity and sensitivity bandwidth of the prototype is excellent. The half-power points of the sensitivity bandwidth of the reflectometer are at approximately 350 kHz and 25 MHz.

Full-scale deflection at 27 MHz requires 0.8 watts into 50 ohms. Mid-band sensitivity is under half a watt!

Modifications

For higher power applications, the basic sensitivity of the reflectometer can be reduced by one of several methods, or a combination.

If you are working with powers around 20 to 50 watts, R2 and R3 can be reduced to 47 ohms. For higher powers, the number of turns on the toroid can be reduced, and R2/R3 further reduced in value. As a guide, reduce the secondary of T1 to 20 turns and R2, 3 to 47 ohms. Everything else remains unchanged. This should suit power levels of 200 watts and higher.

Other types of coax sockets can be used, such as the BNC, type N or the inexpensive Belling-Lee sockets. No modifications to the pc board are necessary, however, mounting details of the sockets and board will need to be altered to suit.

The basic reflectometer construction is so simple and inexpensive that several can be built and installed to provide remote SWR/RF-output monitoring of antenna installations.

The RF portion can be mounted at a convenient place and the reflectometer output leads X and Y taken to remote metering facilities. Power output measurement circuitry is probably superfluous in these circumstances.

Protection circuitry for transceivers and power amplifiers may be simply realised using the basic reflectometer circuit and activating protection devices by comparing the output voltages of D1 and D2.

Swept VSWR measurement can be accomplished using the basic reflectometer circuit. The differential output from D1/D2 can be used to drive the vertical axis of a CRT display (via suitable amplification), the horizontal axis being driven by the sweep voltage of a voltage-controlled signal generator. Voila! - swept VSWR measurements.

Accurate SWR measurements for VSWR values below 2:1 can be made by driving an expanded-scale differential voltmeter circuit that measures the output difference between D1 and D2. This technique is well illustrated in reference 2.

This type of instrument is particularly useful when making VSWR performance plots of antennas over a narrow bandwidth (providing they closely match 50 ohms in the first place).

This reflectometer technique can also be used to measure power. However, the authors opted for the diode RF voltmeter method as it is somewhat more versatile, and is unaffected by the sensitivity bandwidth of the toroidal current transformer. See the two references for more details.

The sensitivity bandwidth may be shifted up in frequency by a decade or more, such that it rolls off around 1 MHz and 50 MHz, by employing a toroid for T1 of the same dimensions but made of F25 material.

References

Whilst not the 'definitive' texts on this type of reflectometer, these two references provide good practical sources of information.

1. "Frequency Independent Directional Wattmeters"; P.G. Martin, Radio Communication (RSGB journal), July 1972.
2. "Test Equipment for the Radio Amateur", H.C. Gibson G8CGA, published by the RSGB, 1974.

Note: The manufacturers of the toroid, Neosid Limited (Australia), are located at 23/25 Percival Street, Lilyfield NSW. However, components suppliers such as Davred and Dick Smith's may have them in stock *— but accept no substitutes!*

Fig. 3. The meter, sensitivity pot and switch connections. Leads X and Y go to D2 and D1 respectively, while the lead marked 'POWER' goes to R7. Refer to figure 2.

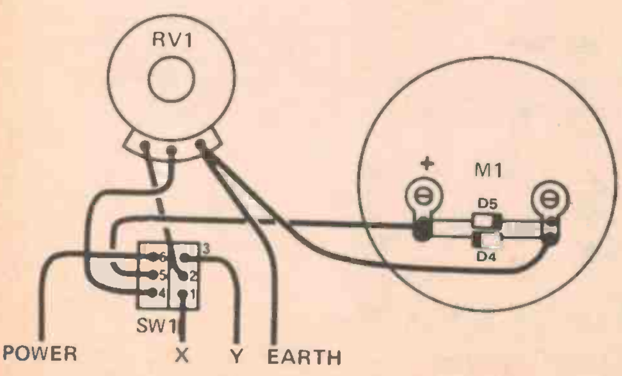
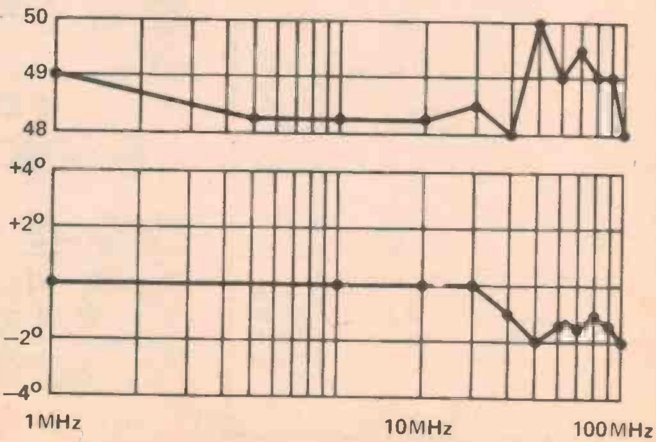


Fig.4. Top: real or resistive component of the prototype's inherent impedance. Lower. Reactive component.



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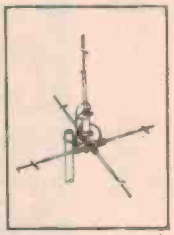

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propagation a closer look PART 2

Radio communications beyond the horizon in the high frequency (HF) spectrum between 3 MHz and 30 MHz are carried on as the result of the bending of the radio waves in the ionosphere, that region of our atmosphere extending from about 60 km to about 1000 km above the earth.

Formation of the ionoshpere

As mentioned before, the ionosphere is produced principally by ultraviolet radiation from the sun. The amount of ionisation produced is almost wholly dependent on the strength of the UV radiation and its wavelength. Different wavelengths of the radiation ionise different gases.

The process of ionisation absorbs energy from the UV wave, and as the radiation proceeds down through the atmosphere, it is almost completely absorbed in this way.

This process of creation of ions and free electrons in the ionosphere is offset by recombination which is continually taking place between the two to form neutral atoms once again.

In the lower atmosphere, the molecular density is so great that recombination occurs almost immediately after ionisation the rate of recombination is very rapid. However, in the upper atmosphere, where the number of molecules is very much smaller, the chances of a free electron meeting up with an ion is very much less. Hence, recombination occurs at a much slower rate.

These two opposing mechanisms result in regions in the upper atmosphere where a large amount of ionisation is present, the amount being determined by the balancing forces between the rate of ion production and the recombination rate.

The gases of the upper atmosphere which the solar UV radiation meets first are very rarified, hence little ionisation results and little of the radiation energy is lost. As the radiation penetrates further, the molecular density of the gases increases and hence the ionisation increases.

More and more energy is extracted from the ionising radiation as it penetrates further and at some stage the amount of ionisation which the radiation can produce begins to decrease. There is thus a certain height at which ionisation is maximised. The region around this height is known as an ionisation layer.

This is how the ionosphere comes to derive its name. It is the region of the upper atmosphere where appreciable ionisation can take place.

The lower limit of the ionosphere is about 50km and it extends to beyond 1000km.

Sydney Chapman, a British scientist, investigated the production of ionisation in the early 1930's and showed that the rate of production of ionisation would vary with height as shown in figure 6. The corresponding layers of electrons have been called Chapman layers.

The height of the 'peak' is determined by the concentration at particular heights of the atmospheric gas and by the ability of the gas to absorb the solar radiation. The less easily absorbed wavelengths of the radiation penetrate lower in the atmosphere before forming a layer of electrons. The *height* of the layer does *not* depend on the strength of the ionising radiation.

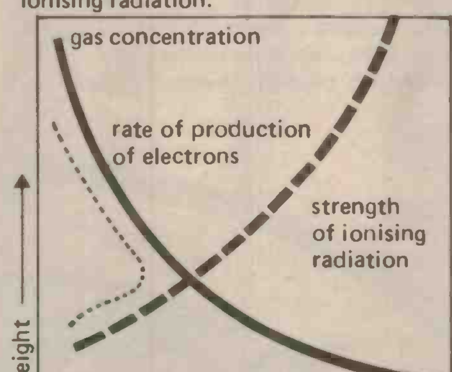

Fig. 6. How a layer of electrons is produced when ionising radiation comes from above the atmosphere. The gas concentration increases with decreasing height while the radiation strength decreases. Peak production of electrons occurs at the height where the curves cross.

The production rate of electrons at the peak of the layer depends on the strength of the ionising radiation and on its direction of arrival. When the radiation is vertically incident on the layer, ionisation is maximum, less when it arrives at an angle.

When curves representing the production rate of electrons of all possible

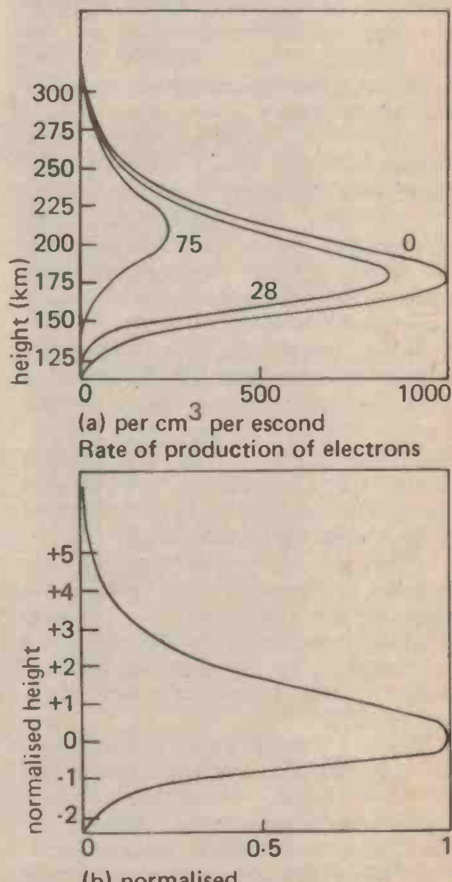

Fig. 7. (a) Theoretical 'Chapman' layers showing how electron production is affected by the angle of the sun's rays — best when sun is overhead (0° zenith angle).

(b) If all curves are 'normalised' about peak height, regardless of the sun's zenith angle, they all have the same shape.

shapes are 'normalised' with respect to the layer peak, they all look the same. See figure 7.

The three regions

There are three main regions of the ionosphere. They are designated by the symbols 'D', 'E' and 'F'. The F-layer actually divides into two layers, F_1 and F_2, which I will go into shortly.

The structure of the ionosphere varies widely over the earth's surface as the strength of the sun's radiation will obviously vary with geographical latitude.

The D-layer

This is a region of low ionisation density which does not show the well-defined 'peak' of maximum ionisation density associated with the other layers.

The D-layer only appears during daylight hours and extends rather diffusely from about 50km to about 90km. The density of electrons in the D region is generally insufficient to cause appreciable bending of radio waves but they do suffer considerable attenuation in passing through this region.

Solar X-ray radiation with wavelengths less than about 20 Angstroms contributes to some of the ionisation in the D-layer. This radiation can ionise all the gases present at these heights in the atmosphere, but this alone does not account for the level of free electrons found in this region.

Nitric oxide (NO) is formed at heights between 60 and 90km by a photochemical process that diffuses atomic nitrogen down from the E-layer above 100km. This nitric oxide is ionised by UV radiation from the sun having a wavelength of 1216 Angstroms — the Lyman-Alpha wavelength.

Hydrogen in the sun radiates very strongly at this wavelength which coincides almost exactly with a 'spectral window' in the atmosphere which allows this radiation to penetrate to very low levels in the atmosphere with little attenuation.

Because it penetrates down to where the nitric oxide is produced there is an abundant supply of electrons which contribute to the general ionisation of the D-layer at a height of around 75km. Solar X-ray and Lyman-Alpha radiation contribute in roughly equal proportions to the ionisation of the D region. However, the strength of the X-rays varies by a large factor both daily and through the solar cycle as well as with solar disturbances. There is no appreciable change in the strength of the Lyman-Alpha radiation.

Increased X-ray radiation associated with solar flares can increase the ionisation of the D layer thus causing increased absorption of radio waves travelling through the D region. These solar disturbances can be the cause of a complete 'radio blackout' at times.

Ionisation in the very lowest part of the D region is caused by cosmic radiation which consists of high velocity charged particles coming from distant parts of space. They impinge on the earth more or less constantly and can penetrate right to ground level with little loss in energy. The rate at which they produce free electrons and ions is related to the density or concentration of air molecules available to be ionised.

As cosmic rays are deviated by the earth's magnetic field ionisation of the lower D region is greater near the magnetic poles than it is near the equator.

Since the D-layer absorbs radio waves it affects the propagation of radio signals. During the day signals below about 5MHz are almost completely absorbed. Only signals radiated at a very high angle, and above a critical frequency where all signals are absorbed, manage to pass through the layer, being subsequently reflected by the E-layer.

Communication during daylight hours on the lowest frequencies of the HF spectrum from 3MHz to about 5MHz or so is thus limited to short distances, not much beyond ground-wave coverage.

Low angle radiation on these frequencies during the day travels a long way through the D-region and is thus absorbed.

The D-layer of course affects higher frequencies but its attenuation affect lessens as the frequency is increased.

The E-layer

This occurs during daylight hours, the maximum density or peak of the layer lying between about 100 and 150km. It remains weakly ionised at night.

During daylight hours it stays at practically a constant height. The height hardly varies from day to day. The electron density of the E-layer is lower in winter than in summer as the oblique angle of the solar radiation reduces the ionising effect.

E-layer ionisation is produced jointly by X-rays having wavelengths less than about 100 Angstroms — this ionising oxygen and nitrogen in the upper atmosphere at heights close to 100km — as well as UV radiation with wavelengths near 100 Angstroms which ionise oxygen.

The atmosphere in the E-region is still dense enough for recombination to take place fairly rapidly. As a consequence, the E-layer can only maintain its signal reflecting ability when it is continuously in sunlight.

Ionisation is generally the best around noon, disappearing rapidly some time after local sunset. (The sun sets on the ionosphere at a height of 100km about half an hour after local sunset.)

From a simple consideration of the geometry of the situation, communications via the E-layer has a maximum distance of about 2000km. See figure 8.

The F-layer

The F-layer is that region of the ionosphere above about 150km extending up to 800km and beyond.

During daylight hours, two distinct layers appear in the F-region of the ionosphere — the lower is known as the F_1 layer, the upper as the F_2 layer.

The F_1 layer generally occurs around a height of 200km and does not vary greatly in height. Its ionisation density is lower in winter than in summer.

As one would expect, the F_2 layer, being the uppermost has the greatest ionisation and shows considerable variations in density and height.

The height of the base of the F_2-layer during daylight hours is very dependant on solar heating of the upper atmosphere. It varies between about 150km and 300km during winter months.

There is only one layer during the

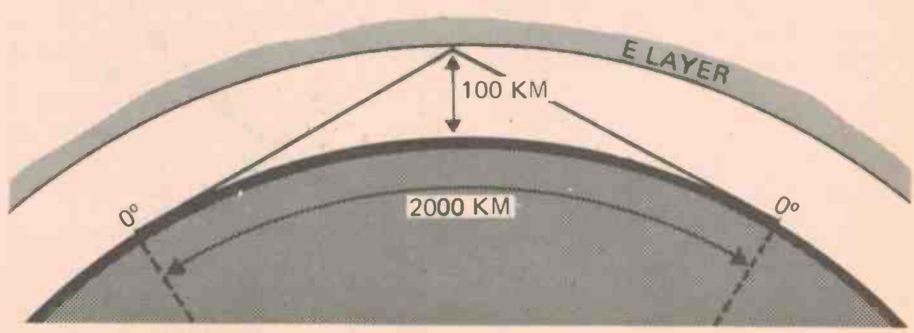

Fig. 8. Geometry of E-layer propagation. As the layer height is about 100 km, low angle radiation from a transmitter will reach distances of about 2000 km maximum.

night in the F-region which is likewise dependant on atmospheric temperature. The height and density of the night-time F-layer is also very variable owing to a number of factors.

Figure 9 illustrates typical variations of the F-layer throughout the day.

The principal ionising agent of the F-layer is the extreme ultra-violet region (EUV). Solar UV with wavelength between about 200 and 800 Angstroms does most of the work in this respect. Radiation at these wavelengths ionises molecular nitrogen and atomic oxygen at heights between about 150 and 180km.

The resulting electron distribution with height does not always show a peak at this level— when there is a peak it is usually that of the F1 layer.

The shape of the F_2 layer electron distribution, and thus the height of the peak, is largely determined by the variation with height of the loss process and by diffusion of the electrons to other regions. Ions and electrons diffuse above the peak of the layer, the production and loss of electrons (by recombination etc) below the peak determine both the position of the peak and the shape of the layer. The peak then occurs at a height where the effects of diffusion and loss of electrons reaches an equilibrium.

The F-layer will provide communications out to a range of 4000km on a single 'hop', multi-hop propogation being used for distances greater than this.

The F_1 layer will provide communications up to about 9 or 10 MHz during the day. The F_2 layer will support propagation beyond 30 MHz under favourable conditions, even higher in frequency and for longer durations at lower frequencies, during a sunspot maximum.

The maximum usable frequency of the F-layer varies seasonally, being greater during summer than during winter.

Summary so far

The *daytime* ionosphere consists of an absorbing region — the D-region — with three reflecting ionised layers above that — the E, F_1 and F_2 layers.

The night-time ionosphere consists almost entirely of the F-layer.

It should be noted that the allocation of the letters of these layers was made by Sir Edward Appleton. It was he who did most of the early investigative work on the ionosphere. The F-layer, which he discovered, is also known as the "Appleton Layer". The E-layer was originally named the "Kennelly-Heaviside Layer" (or just the Heaviside Layer) after the two gentlemen who discovered its existence.

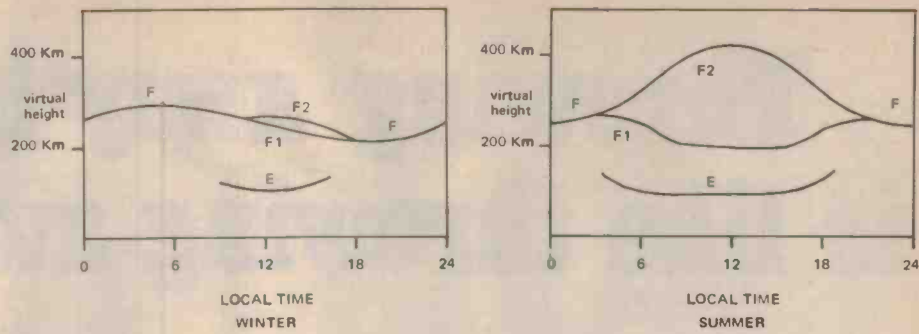

Fig. 9. Typical diurnal (daily) variations of the F-layer and E-layer heights for winter (left) and summer (right), as measured by an ionosonde — an instrument which measures the parameters of the various ionospheric layers.

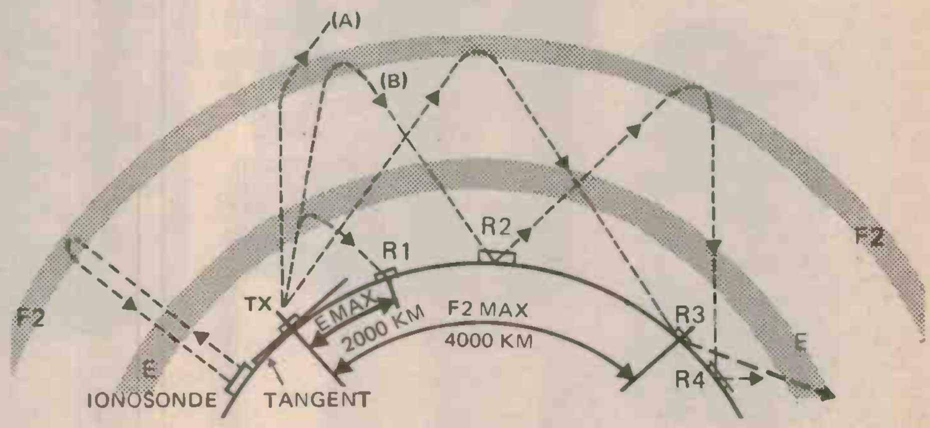

Fig. 10. The transmitter (TX) radiating RF at several different angles illustrates how signals are propagated by the various layers. A wave radiated at a high angle will be deviated by one or both of the layers, but unless the layer is dense enough, will pass through (A). A ray at a lower angle (B) will skip a relatively short distance and may do so several times (R2 - R4 etc.). A low angle ray from TX will skip a maximum of 4000 km from the F2 layer (TX to R3) and subsequently further. The ionosonde measures the heights and critical penetration frequencies of the layers vertically.

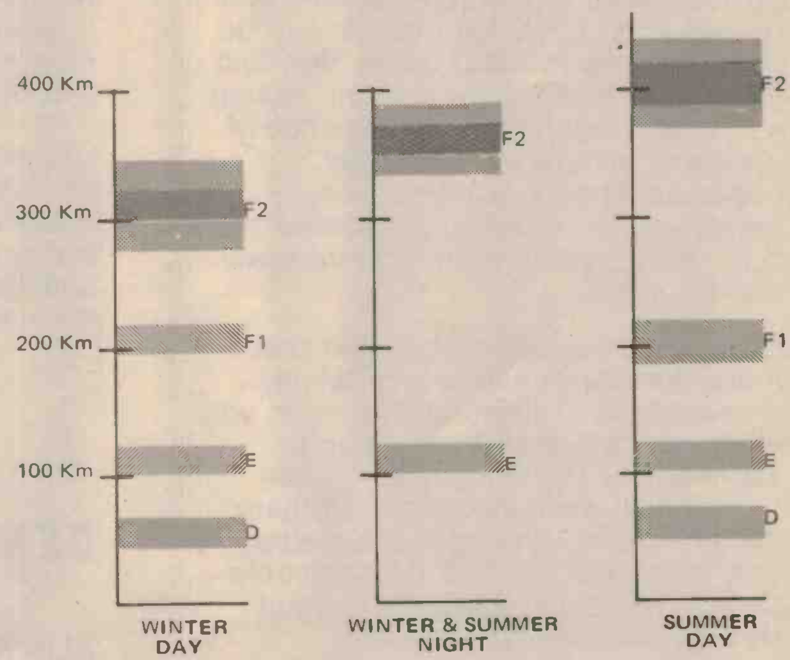

Fig. 11. Illustrating the diurnal and seasonal variations in the various layers.

Figs. 6 & 7 after J.A. Ratcliffe, 'SUN, EARTH AND RADIO', World University Library, 1970. In fact, if you want a good book on the subject, complete with charming historical anecdotes — this is it.

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ETI 706	Marker Generator	ES
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ETI 708	Active Antenna	E
ETI 709	RF Attenuator	E
ETI 710	2 metre Booster	C,E
ETI 711B	Single Relay Remote Control	AE
ETI 711C	Double Relay Remote Control	AE
ETI 711R	Receiver	AE
ETI 711AR	Remote Control Transmitter	AE
ETI 711DR	Remote Control Decoder	AE
ETI 712	CB Power Supply	E
ETI 740	FM Tuner	AE
ETI 780	Novice Transmitter	E

ELECTRONIC GAMES

ETI 804	Selecta-Game	O,A,DS

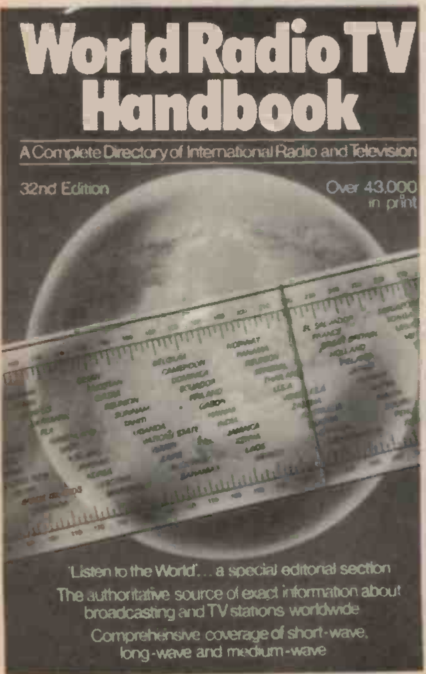
BOOK REVIEWS

World Radio TV Handbook, 32nd Edition, Billboard Publications Inc. $12.95. Review copy kindly supplied by the Technical Book Co, 295 Swanston Street, Melbourne.

Well, what can we say! This is the standard reference book, the 'bible', if you like, of broadcast band listeners all round the world. Most of the WRTV Handbook is taken up by a listing of the broadcasting stations of every country in the world including frequencies, transmitter power, call signs and station names. For each station, programme information, including times frequencies and beam areas is listed, as well as signature music where appropriate. In order to get all this information in, it is condensed enormously by the use of abbreviations, which means that it is difficult to use at first, but with practice it becomes easy to find one's way around the book.

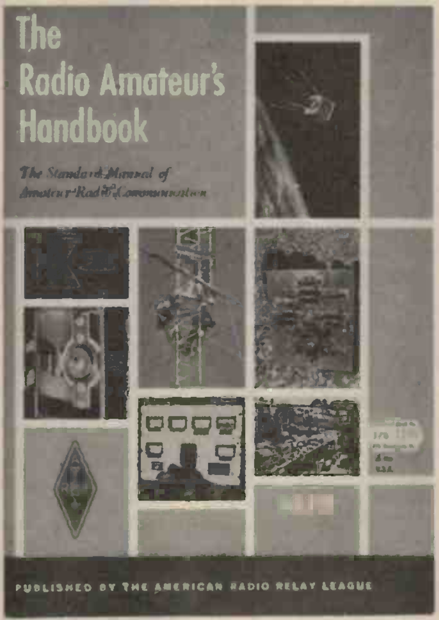
There is absolutely no way the serious DXer, or even just the interested occasional listener, can get by without this book. It makes sense of what can sometimes seem to be chaos on the broadcast bands, and increases the 'productivity' of hours spent at the receiver.

Apart from the reference material in the book, there are also several articles reviewing new receivers and discussing antennas, frequency counters, clandestine radio stations and log-period quad antennas, amongst other things.



For the short wave listener who wants to know where it's at, this is *the* book.

The Radio Amateur's Handbook, 1978 Edition, American Radio Relay League. $12.95. Review copy kindly supplied by the Technical Book Co, 295 Swanston Street, Melbourne.



Again, what can we say? Another standard reference, the amateur's 'bible' is on the bookshelf of most shacks already. If you've already got the 1977 edition, it's hardly worth looking at this one - there is a new section on portable AC generators and a new treatment of antenna theory, but for the most part it is the same as the last edition.

But if you only have an old and dog-eared copy of this worthy 700-page (almost) tome, or if - by some sin of omission - you haven't got one at all, then the Radio Amateur's Handbook is a must. It covers just about every facet of amateur radio in a most practical fashion, including principles, HF and VHF/UHF transmitters and receivers, mobile and emergency operation, antennas and feeders, single sideband, FM and repeaters, and so on.

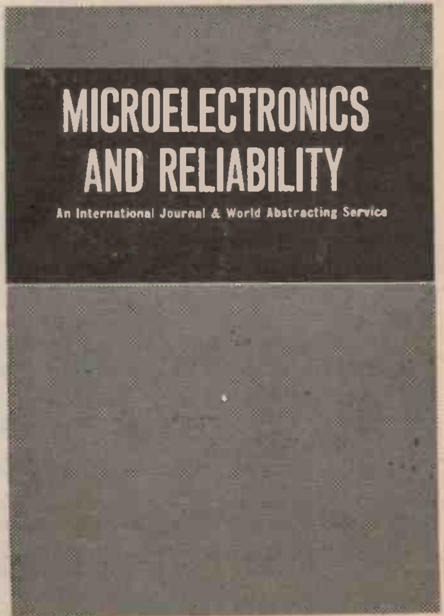
Emphasis throughout the book is on successful construction techniques backed up by solid design - the reader of this book is concerned more with building gear (and getting it to work) rather than design. Several sophisticated receiver and transmitter projects are described in detail, as well as test equipment and station accessories.

For everyone planning on sitting Novice or other amateur exams, this book will provide a standard text.

Microelectronics and Reliability Vol 16, No 4, special issue on Semiconductor Technology, 1977, Pergamon Press, $19.25. Review copy kindly supplied by the publishers.

This special issue of the professional journal Microelectronics and Reliability contains some of the papers read at the Seminex Seminar held at Imperial College, London in April last year. There are 24 papers on various topics: multiprocessor systems, testing and packaging of hybrids, solar panels, the obsolescence of the microprocessor (?), third generation micros, assemblers, semiconductor processing, A/D conversion, CCD's and bubble memories, LSI CMOS and an industry standard for B-series CMOS.

All the papers are presented by experts in their fields and are well up to date. Probably the papers of most interest to our readers are those concerned with microprocessors which form about one-third of the book, but anyone in industry who is involved with microelectronics would find something of use in its pages.



SCOOP PURCHASE !!!!

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This incredible module measures only 2" x 1" yet is a complete calculator including 8 digit LED display with full floating decimal system. Application notes are included and addition of a suitable keyboard will produce a full calculator with:

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The SCM100 module can readily be adapted to become a highly accurate stopwatch or even an economy output for a microprocessor. All that is required is to supply a 9V battery and address the relevant points in the 8 x 5 input matrix.

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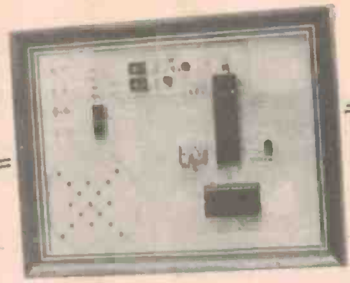
LM1889 . . . . **$3.75**

MICROPROCESSORS



COMPUTER DOORBELL

A real first, this SC/MP controlled doorbell has been designed and produced in Australia. See ETI March 1978 for full details. This kit comes complete with all components, full instructions for assembly and unique picture frame mount. Can be readily programmed to play any tune although kit is supplied with 8 preprogrammed tunes including:

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GREENSLEEVES	TWINKLE TWINKLE LITTLE STAR
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CAN CAN	COMPUTER MUSIC

This is an ideal kit for everyone even remotely interested in microprocessors. Picture frame displays finished PCB with all components so you can boast to all your friends and show off the actual computer chips!

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2650 COMPUTERS

Baby 2650 as described in E.A. this is an ideal starter kit. We include full instructions for assembly as well as programming manual and sample programs to run. Ideal to use with the new E.A. VDU. . . . **$75.00**

KT9500 fully buffered 2650 with 512 bytes RAM, PIPBUG, I/O ports, RS232 and TTY serial I/O. Can be readily expanded using our mother board (see E.A. March 1978) **$199.00**

Conversion Kit enables you to convert the Baby 2650 to a KT9500 . . . . **$142.00**

NEW E.A. VIDEO DISPLAY TERMINAL

Described in E.A. Feb/April 1978 this project is an ideal terminal for microprocessor applications. We are pleased to offer this exciting VDU as a package deal or, for those who prefer as a set of individual kits. Naturally we offer our full technical support and backup service (full details with each kit).

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KB04 Top Quality Keyboard Kit with PCB to simplify construction and connection to encoder module **$59.50**

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MICROPROCESSORS

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S100 VDU

Constructional details for our advanced VDU. Circuit and board design by David Griffiths and text by Les Bell.

THIS MONTH WE GIVE complete constructional details for the ETI 640 VDU, and give information about several points on the circuit which may require elaboration.

Last month we published the 'How It Works' section, which can now be laid out beside the circuit diagram. Prospective constructors would be well advised to sit down and read through this material checking it against the circuit diagram. A couple of errors in our IC numbering scheme appeared last month - under 'Positioning', the final counter is IC13, not IC14, under 'Graphics', the graphics multiplexer is IC14, not IC15; and under 'Black on White Characters' the 'D' flip flop referred to is IC18. These alterations should be incorporated immediately to avoid later confusion.

In order to minimise both the size and complexity of the circuit diagram, the two blocks of RAM have been represented as one box on the drawing. On the top edge of the box, it can be seen that each DO line goes, via a buffer, to pin 11 of a different 2102 RAM IC, and likewise, each of the DI lines comes from pin 12 of a different IC (right edge). The address lines go to all of the IC's in parallel. Note also that, in S100 parlance, the DO (Data Out) lines are outputs from the CPU (hence inputs to the VDU) and the DI (Data In) lines are CPU inputs, (hence outputs from the VDU). Further information on the S100 bus signals can be found in our September 1977 issue.

MERQ (pin 65) is not a regular S100 signal, but was included on the prototype as a means of avoiding some potential problems with the VDU responding to 'mirrored' I/O addresses put out on the upper eight bits of the 8080 address bus. In practice, this is not a problem, and pin 7 of IC34 is normally linked to ground.

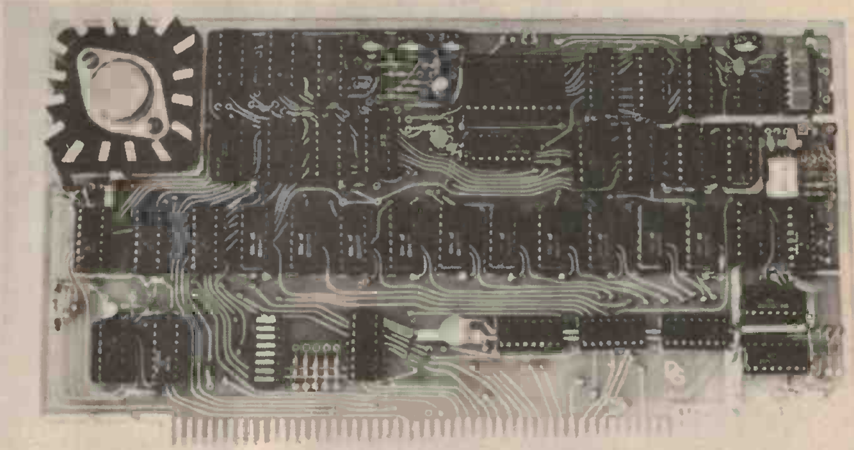


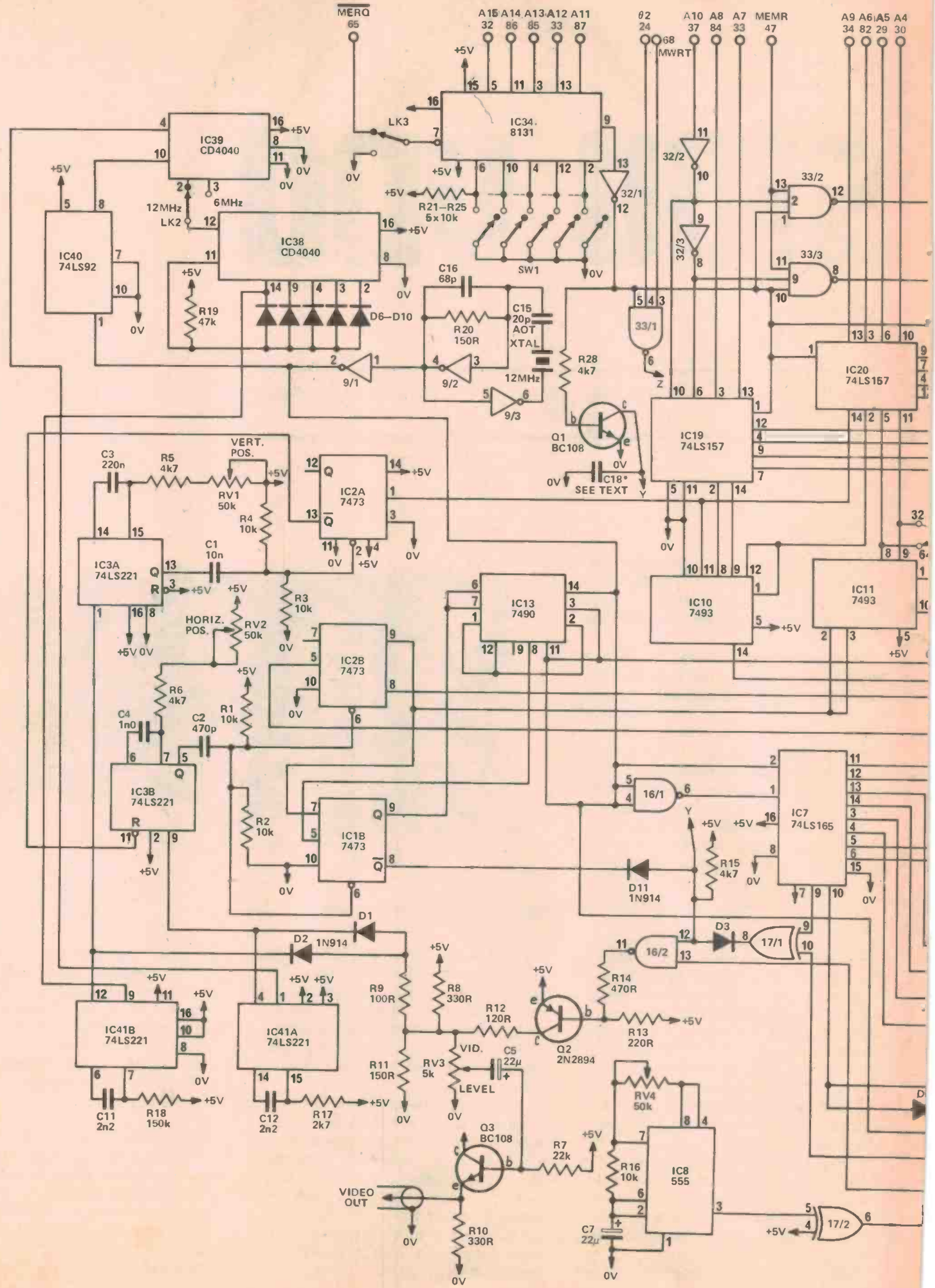
Fig. 1. The VDU board prototype.

Two other links on the board (above IC39 and above IC10) allow 32 character/line operation and operation with a 6 MHz clock. However, the 6 MHz clock modification is not fully implemented, being a 'hangover' from a previous prototype design - nonetheless, we have left it in for the benefit of those incorrigible individuals who must modify their projects.

The data sheet for the MCM6574 reveals that this device requires +5V, +12V and -3V supplies. Where, I hear you ask, does the -3V come from? The answer lies in IC9, a 7404, three gates of which are connected as an oscillator which pumps charge into the D12-D15, C9, 10 and C17 network to produce a negative supply.

Construction

The ETI 640 is not very difficult to assemble since there is no mechanical construction involved. However, it is a very complex board, and several points should be noted in order to ease construction. Firstly, the board was designed to be through-hole plated to



MERQ 65
A15 A14 A13 A12 A11
32 86 85 33 87
θ2 24
68 MWRT
A10 A8 A7 MEMR
37 84 33 47
A9 A6 A5 A4
34 82 29 30
IC34 8131
IC39 CD4040
IC38 CD4040
IC40 74LS92
LK2
LK3
12MHz
6MHz
R21–R25 5x10k
SW1
R19 47k
D6–D10
C16 68p
C15 20p AOT
XTAL 12MHz
R20 150R
9/1
9/2
9/3
32/1
32/2
32/3
33/1
33/2
33/3
R28 4k7
Q1 BC108
C18* SEE TEXT
IC19 74LS157
IC20 74LS157
C3 220n
R5 4k7
VERT. POS.
RV1 50k
R4 10k
IC2A 7473
IC3A 74LS221
C1 10n
R3 10k
HORIZ. POS.
RV2 50k
IC2B 7473
R6 4k7
C4 1n0
C2 470p
R1 10k
IC3B 74LS221
R2 10k
IC1B 7473
IC13 7490
IC10 7493
IC11 7493
16/1
IC7 74LS165
R15 4k7
D11 1N914
D1
D2 1N914
D3
16/2
17/1
R14 470R
R9 100R
R8 330R
R12 120R
Q2 2N2894
R13 220R
R11 150R
RV3 5k
VID. LEVEL
C5 22μ
IC41B 74LS221
IC41A 74LS221
C11 2n2
R18 150k
C12 2n2
R17 2k7
Q3 BC108
R7 22k
VIDEO OUT
R10 330R
RV4 50k
R16 10k
IC8 555
C7 22μ
17/2

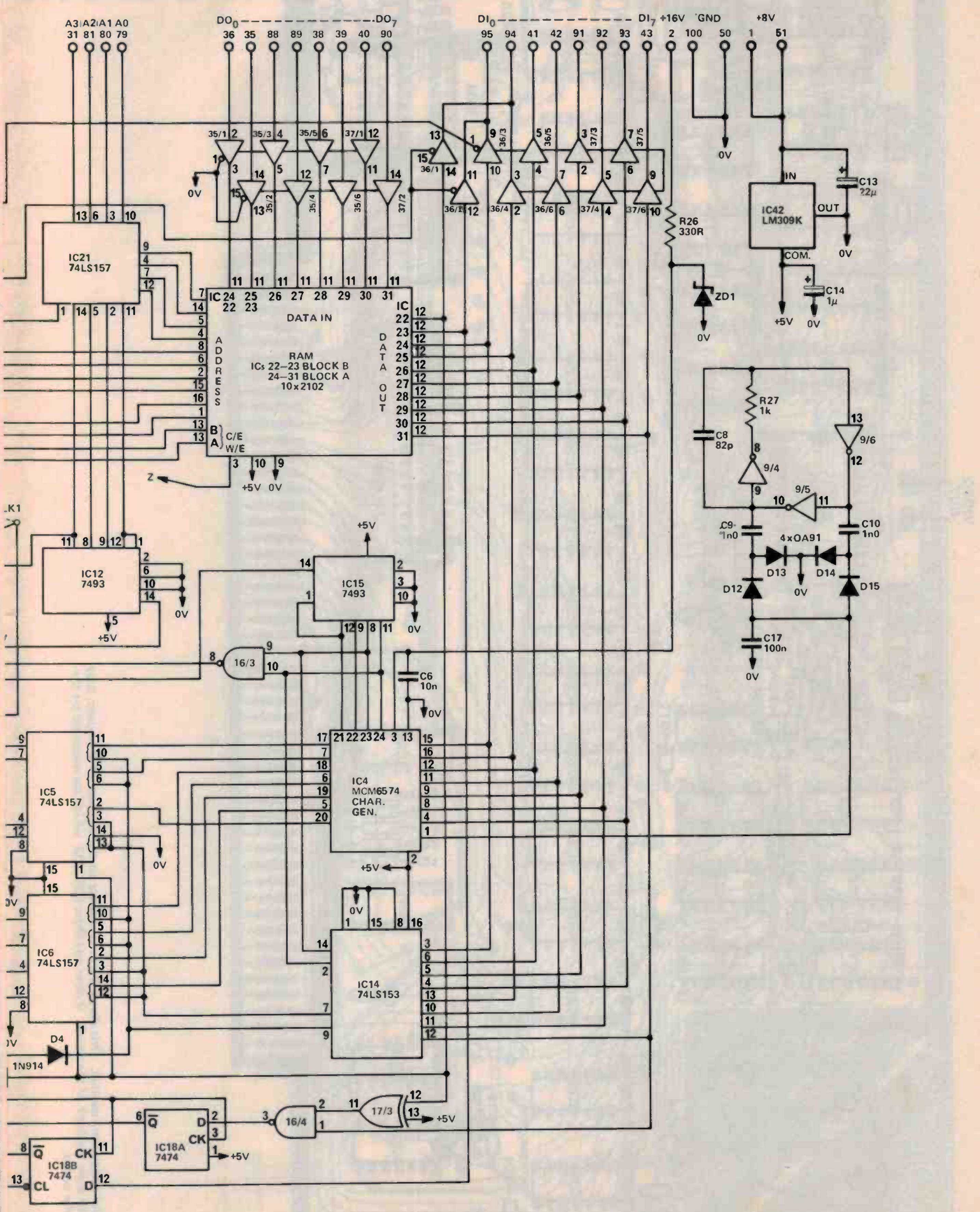


Fig.2. Circuit diagram of the VDU. This should be read in conjunction with the 'How It Works' section published last month.

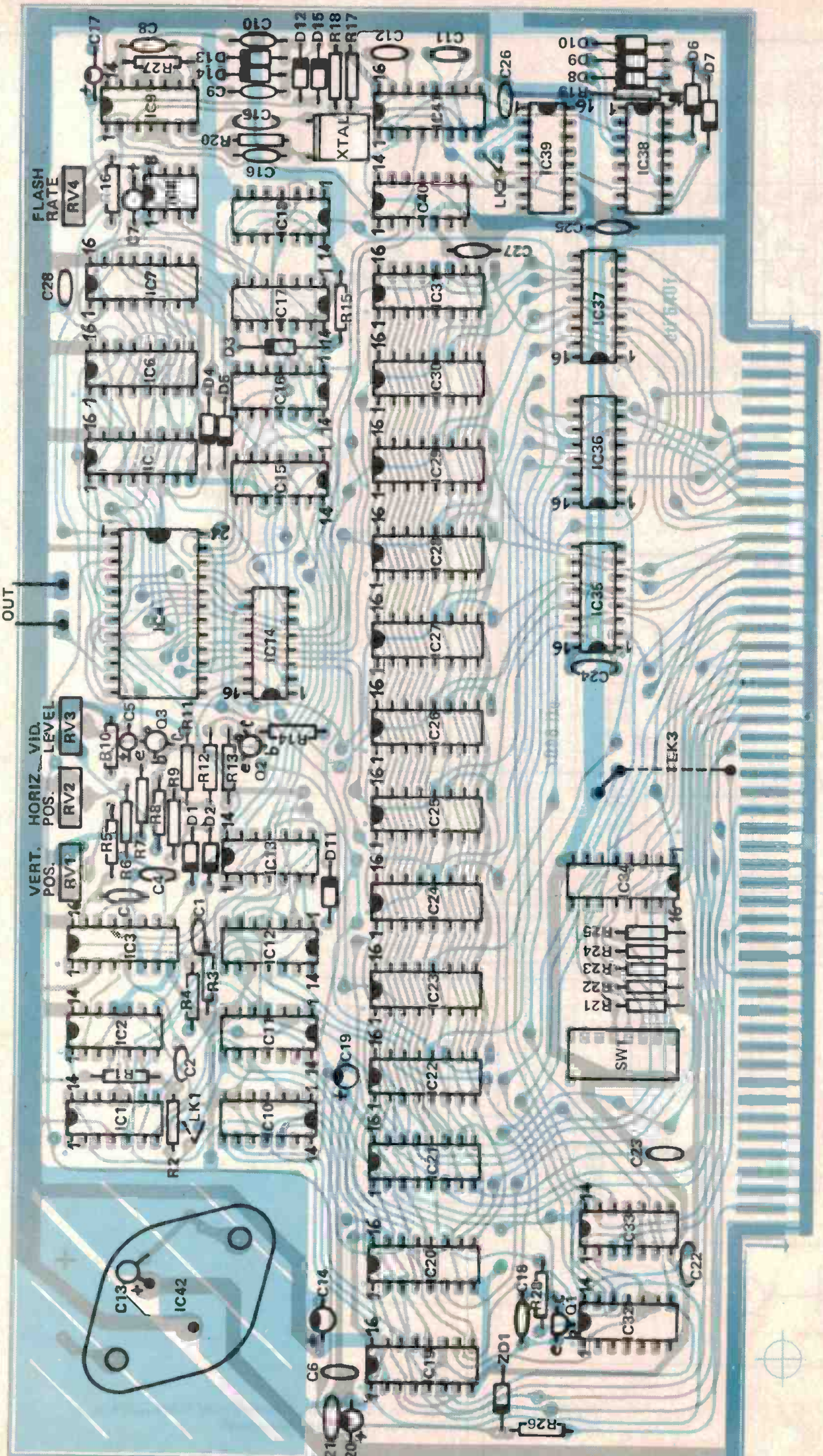


Fig.3. The component overlay. This shows the components on the top side of the board, plus C13 which is on the back of the board. It does not show C29-C39, which are mounted on the back of the board.

simplify construction and improve reliability. Although it is possible to build the VDU on a double sided board by soldering links through the board, we strongly recommend use of the through-hole-plated board. Our prototypes were constructed the hard way, by soldering both sides of the board, and believe me, it's no fun! Although the through-hole-plated board is more expensive, we believe the extra money is well worth spending.

The boards will be available shortly from Applied Technology. For all you diehards who are intent on doing it the hard way, although PCB patterns are not printed in the magazine, they are available from us. Send a large stamped self-addressed envelope to 'VDU PCB's', ETI Magazine, 15 Boundary Street, Rushcutters Bay, NSW 2011 and we shall send the patterns back.

If you are using your own printed circuit board, you should start by soldering links through the board in positions which will later be covered by IC's —i.e. IC4, IC11 and IC16. It is virtually impossible to solder the other links in until most of the other components are in place, so these will have to wait until later, when they can be inserted before the IC's.

Construction should commence with the insertion and soldering of all IC sockets (if used), SW1 and the links. Care should be taken with the orientation of sockets, and later, IC's, since they are not all the same way up. All the resistors should be inserted next, followed by capacitors C1-C28, except for C13 which is later mounted on the back of the board. The diodes and transistors can now be soldered in, followed by the potentiometers, and IC42 with its heatsink. Now the board can be flipped over, and C13 soldered onto the back of the board, followed by C29-C39. These 10 nF bypass capacitors mount on the back of the board, across the supply pins of IC's 2, 3, 5, 6, 9, 11, 12, 15, 16, 17 and 18.

At this point, before inserting any other IC's, it is wise to apply power to the board and check for the correct voltage at the regulator output and also on pin 3 of IC4 (which is not yet inserted). If these points are at +5V and +12V respectively, then proceed to either plug in or solder in the remaining IC's, taking care with orientation, and finally solder the crystal in, being careful not to apply excess heat.

This concludes construction of the VDU, and all you have to do now is work up the courage to switch on!

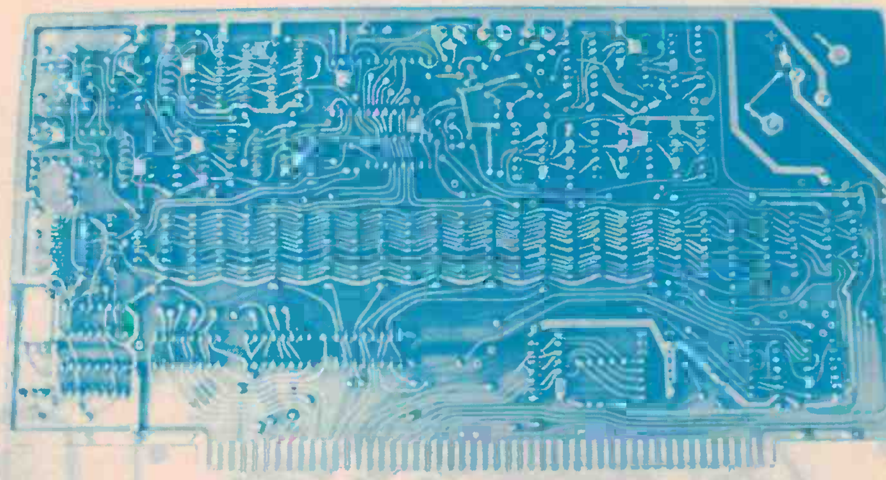


Fig. 4. This photograph shows how the bypass capacitors C29-C39 mount on the back of the board. Since C21-C28, on the front of the board, and C29-C39, on the back, are simply bypass capacitors connected between supply lines and ground, they are omitted from the circuit diagram for clarity.

PARTS LIST – ETI 640

Resistors — all ¼W, 5%

R1 - R4	10k
R5,6	4k7
R7	22k
R8	330R
R9	100R
R10	330R
R11	150R (see note)
R12	120R
R13	220R
R14	470R
R15	4k7
R16	10k
R17	2k7
R18	150k
R19	47k
R20	150R
R21 - R25	10k
R26	330R
R27	1k
R28	4k7

Capacitors

C1	10n
C2	470p
C3	220n
C4	1n0
C5	22µ tantalum
C6	10n
C7	22µ tantalum
C8	82p
C9,10	1n0
C11,12	2n2
C13	22µ tantalum
C14	1µ
C15	20p
C16	68p
C17	100n
C18	10p (see note)
C19,20	22µ tantalum
C21 - C28	10n (see text)
C29 - C39	10n (see text)

Potentiometers

RV1,2	50k trimpot
RV3	10k trimpot
RV4	50k trimpot

Semiconductors

IC1,2	7473
IC3	74LS221
IC4	MCM6574
IC5,6	74LS157
IC7	74LS165
IC8	NE555
IC9	7404
IC10 - IC12	7493
IC13	7490
IC14	74LS153
IC15	7493
IC16	7400
IC17	7486
IC18	7474
IC19 - IC21	74LS157
IC22 - IC31	21L02-1
IC32	74LS04
IC33	74LS10
IC34	8131
IC35 - IC37	8097
IC38,39	CD4040
IC40	74LS92
IC41	74LS221
IC42	LM309K
Q1	BC108
Q2	2N2894 or 2N4258
Q3	BC108
D1 - D11	1N914
D12 - D15	OA91
ZD1	12 V, 400 mW zener

Miscellaneous

X1	12 MHz, HC18/U crystal
SW1	8-way BOSS or Utilux DIL switch
PCB	ETI 640 (see text)

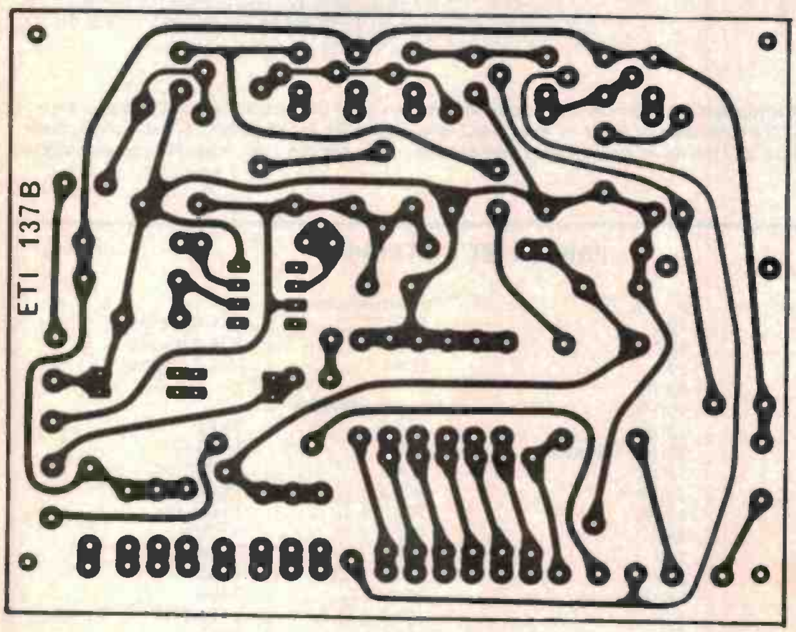
Heatsink for IC42, solder, wire, etc.

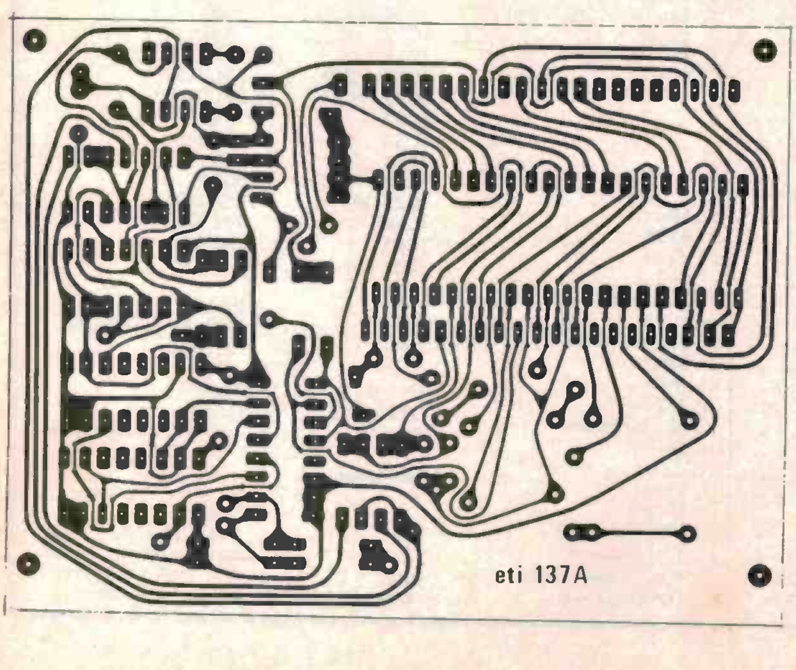
PCB's

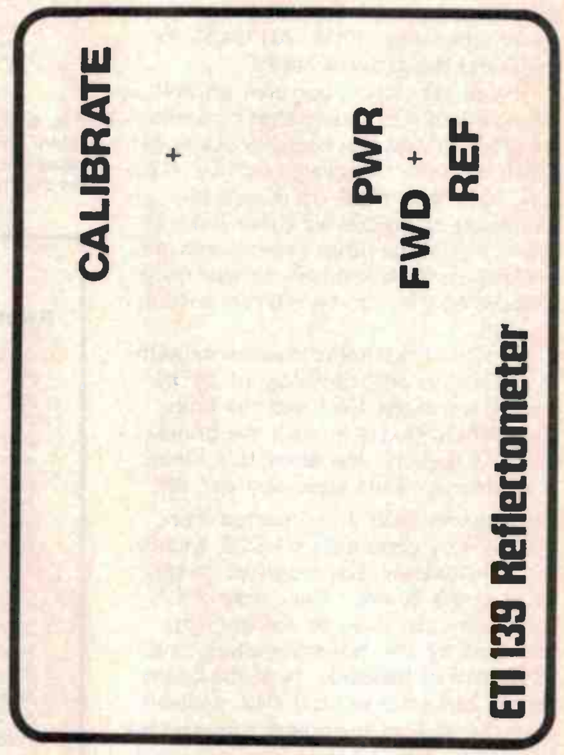
ONCE AGAIN, there's two pages of blue in the mag, and we've published the PCBs on a page by themselves. We are continuing previous experiments with PCB making directly from the page, and are glad to report that, provisionally at least, the experiment is successful. It is possible to make PCB negatives in Scotchcal 8007 by exposing it directly through the page to UV light. Actinic blue fluorescent bulbs are ideal for this: around 20 minutes exposure at 3-4" will produce a good negative.

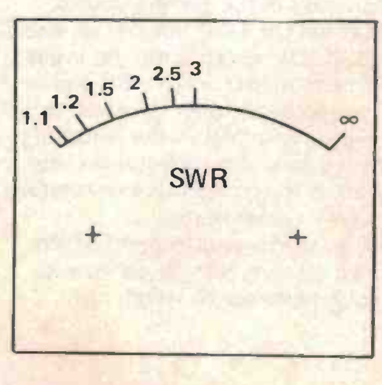
We haven't yet tried this process using direct exposure of a negative photo resist; this is a matter for further experimentation.

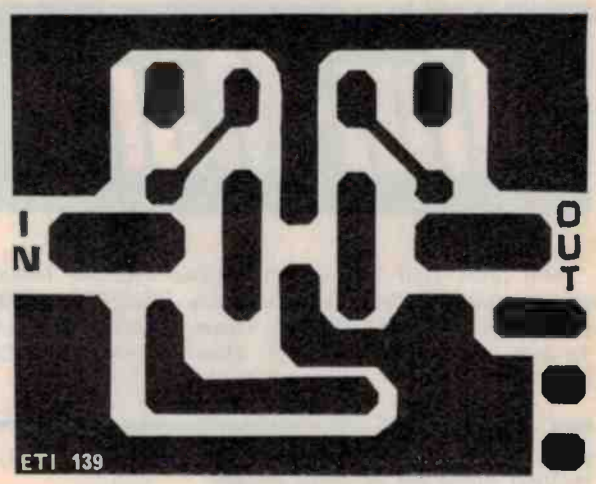
Commercial organisations are reminded that ETI PCB patterns are copyright and reproduction for commercial use is expressly forbidden. Readers are free to make individual copies for their own use.

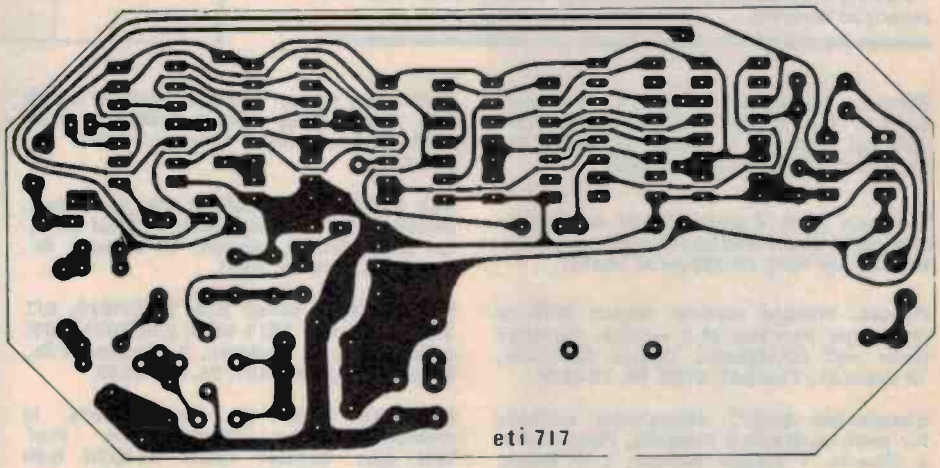


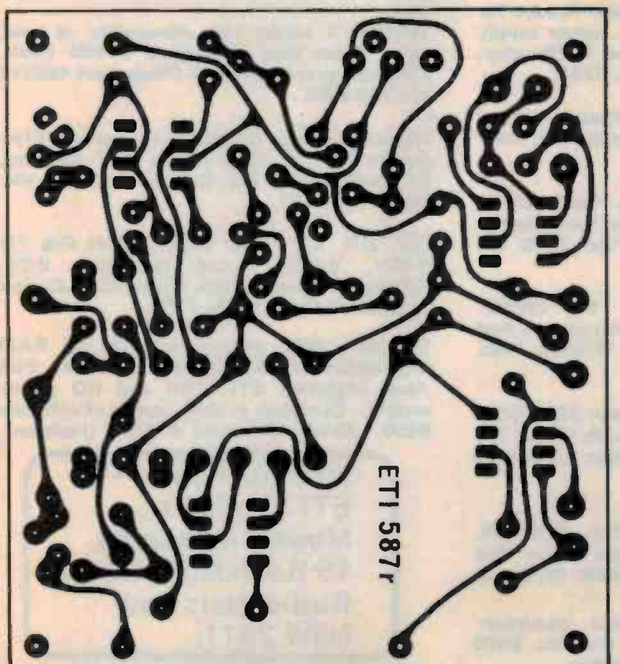


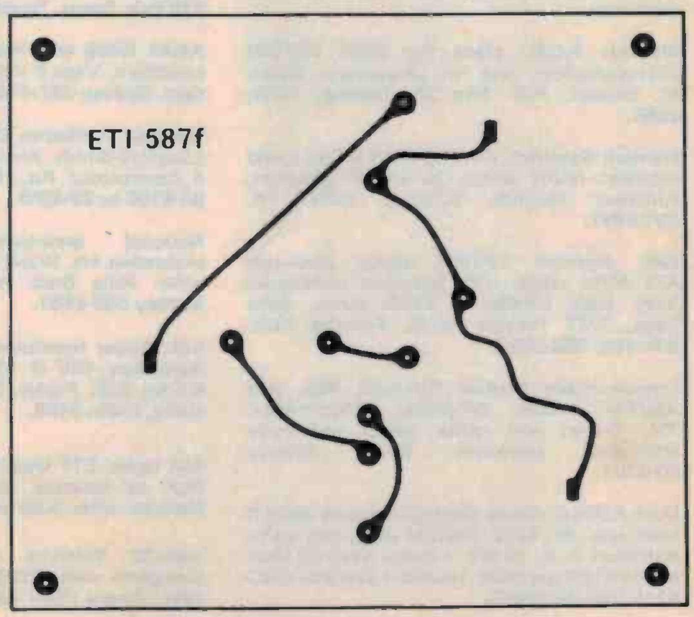





IN
OUT
ETI 139


eti 717


ETI 587r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Wanted: Specifics. on JRC NMR1030G radio receiver. Geoff Swan, 20 Cashel Crescent, Killarney Heights, Sydney, 2087. Ph. 451-9097.

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AVO valve tester, transistor analizer & 200 plus valves many boxed $150. D. King, 4/67 Elouera Rd., Cronulla, 2230. Ph. 523-9726.

Sell: CMOS 4017, NE555, LEDs, Transistors, switches. All in good condition. Send S.A.E. for price list. G. Aydon, 46 Dickens St., Hamilton, Victoria. 3300.

For sale back issues: E/A 1960-1976; E/T 1971-1976; P/E 1971-1976; P/W 1971-1975. Information: G. Sampson, 7 Homewood St., Nunawading, Vic. 3131. Ph. 878-8945.

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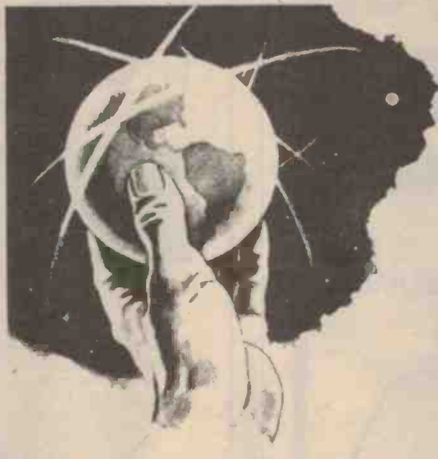

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- Display modes (CH1 CH2 DUAL)

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Bandwidth	DC to 10MHz (-3dB)	Calibrator	1Vpp (AC line freq square wave)
Deflection factor	10mV div to 20V div	Intensity modulation	Less than 5Vpp
Input R,C	1MΩ, 22pF	Phosphor	P31
Risetime	35nsec	Power	AC 100 120 220 240V 50 60Hz, 20W
Overshoot	Better than 3%		
Sweep time	1μs div to 0.5s div	Dimensions	W260 × H190 × D375 (mm)
Magnifier	× 5		
Linearity	Better than 3%	Weight	8.0kg

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▪ SPECIFICATIONS

Bandwidth	DC to 15MHz (−3dB)	Calibrator	1Vpp (1kHz square wave)
Deflection factor	10mV/div to 20V/div	Intensity modulation	More than 20Vpp
Input R,C	1MΩ, 22pF	Phosphor	P31
Risetime	23nsec	Power	AC 100/120/220/240V, 50/60Hz, 23W
Overshoot	Better than 3%		
Sweep time	0.5μs/div to 0.5s/div	Dimensions	W260 × H190 × D385 (mm)
Magnifier	× 5		
Linearity	Better than 3%	Weight	8.4kg

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▪ SPECIFICATIONS

Bandwidth	DC to 30MHz (−3dB)		
Deflection factor	5mV/div to 5V/div	Calibrator	0.5Vpp (1kHz square wave)
Input R,C.	1MΩ, 24pF	Intensity modulation	More than 5Vpp
Risetime	11.7nsec	Phosphor	P31
Overshoot	Better than 3%	Power	AC100/120/220/240V 50/60Hz, 25W
Signal delay	160nsec		
Polarity	CH2 can be inverted		
Sweep time	0.2μs/div to 0.5s/div	Dimensions	W260 × H190 × D375 (mm)
Magnifier	× 5		
Linearity	Better than 3%	Weight	8.5kg

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CB from Phodis

Phodis is a well-known name in vehicle accessory such as car radios, cassettes etc as well as other consumer equipment – photographics, Hi-FI, domestic lighting ect.

They have just released a P & T approved 18 channel AM rig, the "Speed King" model ACT-1842.

This rig is claimed to have good channel separation, not suffering from adjacent channel 'bleedover', as well as good sensitivity.

It features an RF gain control, PLL synthesizer and a generous-sized panel meter for easy reading of signal strength and RF output.

The mic connection is on the front panel (still on the left side though!) and the rig has the usual complement of controls along with ANL, PA facility etc.

Phodis' head office is located in Sydney but they have a Victorian branch office and representatives in other states. They service all their own equipment and have what is reputed to be a top service set-up.

For more information, contact Phodis at *5 Campbell St., Artarmon, 2064, (02) 439-8900.*

6A Supply

St George Communications, one of Sydney's long-established communications firms, has just released a 13.8volt DC regulated mains supply that will deliver 6 amps continuously and up to 8½ amps surge.

It's just the thing for running several mobile rigs plus a number of associated accessories on the bench.

The supply is fully protected from overload and even includes circuitry that protects your equipment should the series-pass regulator transistor fail!

The supply will retail for around $90 and the company welcomes dealer and retailer enquiries.

Contact St George Communications, 271 Goulburn St., Darlinghurst, 2011 (02) 212-3712.

200 Channel Scanner

The US company, Redco, have recently released a channel scanner for those makes of CB rigs which use the Uniden 858 PLL system.

The simple modification to the rig, allowing attachment of the device, enables the receiver coverage to be extended from 26.055 MHz up to 28.045 MHz, giving 200 channels every 10 kHz between 26 and 28 MHz.

For Novice or other amateurs with CB rigs converted to 28 MHz, full coverage of the 10 metre band is possible.

The scanner is called the "Digi-Scan RDS-1" and is suitable for use with such rigs as the President Grant mobile, President Washington base, Cobra 138XLR, Realistic TRC 457, 458, 448 and the Robyn 510D, 520D and some of the Fanon/Courier range among others.

The Digi-Scan features a large five-digit LED digital readout using 13mm high LEDs. It displays the frequency to the last 1 kHz with a resolution of 1 kHz.

It has two channel/frequency selection systems. The SCAN switch will step the receiver through each channel at a rate of 12 channels per second. It utilises a spring-return switch, marked UP/DWN for the scan function.

Alternatively, you can step up or down one channel at a time using the STEP switch.

The unit operates from a supply voltage range of 10.5 to 16 volts DC and draws 500 mA at a nominal supply voltage of 13.8 volts. Overall size is 102 mm long by 153mm deep by 32mm high.

President Electronics (Australia) is distributing the Redco Digi-Scan RDS-1 which retails for around $180.

The Redco brochure includes the following note: "The Digi-Scan Model RDS-1 is designed for receiver use only and is protected against transmission with an automatic shut-off feature".

Philips' 27 MHz CBs

Apart from producing the FM320 UHF CB rigs, Philips are also importing two 27 MHz models, the AM101 and AM201.

The AM101 is an AM rig featuring PLL synthesizer, LED digital channel display, RF gain control, ANL and noise blanker and a three-function panel meter.

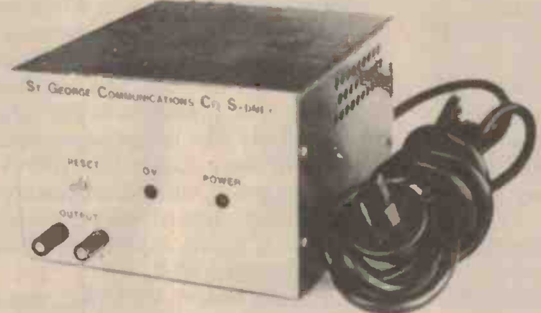
The mic plugs conveniently into the front panel, but on the left-hand side, on both.

Both rigs have the front panel finished in silver and grey and all the control knobs are of the flat-sided variety.

The AM201 is Philips' up-market SSB/AM transceiver. It has a full omplement of controls, as you'd expect of a sideband transceiver in the price bracket, and similar features to the AM101.

Philips provide a six-month warranty with these rigs and an Australia-wide service network.

Continued P. 104..................



AMATEUR COMMUNICATIONS

Evening-type TEP extended to 432 MHz?

Recent record-breaking contacts on the 144 MHz band apparently supported by evening-type (or Class II) trans-equatorial propagation between Australia and Japan, Puerto Rico and South America, have been hot news in amateur circles amongst those who are keen on VHF/UHF DX.

However, no sooner was the upper frequency limit of Class II TEP extended to 144 MHz, previously established as being in the 100 MHz region, than evidence of the possible extension of this ionospheric propagation mode even higher in frequency – to 432 MHz – has come to hand.

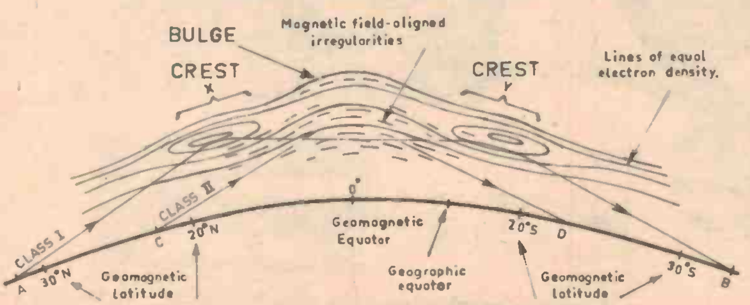
YV5ZZ, located in Venezuala, is reported to have heard an Argentinian station, LU3AAT on 432.1 MHz in February during an opening when Argentinian stations were heard working Caribbean stations and stations in the northern countries of South America.

However, two-way contact was not established, but this seems only a matter of time.

The world terrestrial distance record for 144 MHz was established by LU5DJZ and KP4EOR on the 12th of February this year over a distance of 6400km (3977 miles).

LU5DJZ, located at Mar Del Plata – 400km south of the Argentinian capital, worked KP4EOR at 0015 GMT on 144.1 MHz with signals over 5 by 9 both ways. Single sideband was used by both stations, LU5DJZ running 400 watts PEP to a stacked array of two eleven element yagis and KP4EOR used 800 watts PEP to an array of four stacked nine element yagis.

Readers wanting to know more about transequatorial propagation are referred to "VHF Transequatorial Propagation" by Roger Harrison VK2ZTB in the June 1973 issue of ETI (p.88).



The propagation modes of class I and class II TEP.

Moonbounce News

Al Katz, K2UYH, moonbouncer extraordinaire, has earned the *worlds first WAC* (worked all continents) award *entirely using moonbounce on 432 MHz*. Naturally, his Australian continent contact was the Dapto Moonbounce project, VK2AMW, about which more shortly.

Since Al's achievement, six others followed in fairly rapid succession. These were (to date): VE7BBG, W1JR, I5MSH, K3PGP, PA0SSB and SM5LE. It shouldn't be long before ZE5JJ makes the grade. Next band the moonbounce gang are going to try cracking WAC on is 1296 MHz!

The Dapto Moonbounce project buildings and equipment were severely damaged by vandals in February, necessitating closure of the facility, pending the finding of a new site.

Eight years of dedicated work by a small group has been senselessly destroyed and one of the world's leading 432 MHz EME stations put off the air. It is hoped that, with the co-operation of the University of Wollongong and the generosity of local amateurs, the project will be successfully relocated and re-equipped.

The Ron Wilkinson Achievement Award

This award has been created as a memorial to the late Ron Wilkinson, VK3AKC. Through the generosity of his widow, Mrs Mary Wilkinson, the award will take the form of (a) a certificate, (b) $50 cash, (c) books to the value of $50 and (d) WIA subscription paid for one year. Mary donated $1,100 to fund the award, which has been invested; interest from this to meet the costs of the annual award, supplemented by funds from the WIA.

Ron Wilkinson, VK3AKC, was a man of many achievements. He won the marathon Ross Hull Memorial VHF contest (held during every summer) several times, held a number of VHF/UHF distance records at various times and was one of the world's foremost moonbounce stations on 1296 MHz, achieving a number of records in that field also.

The award is to be made annually during the month of March – nominally on the 3rd of March, relating to the previous calendar year as far as practicable.

The award is for "special achievement in any facet of amateur radio". For example: Development of state of the art techniques, microwave activity, involvement in clubs or WIA affairs, notable public service, achievement in using satellites etc.

The award is only available to amateurs from VK call areas. Individuals may nominate or make personal application (to their WIA state division) by 31st October each year.

The WIA executive will nominate the recipient by 31st January. Preference will be given to WIA members. The award will be announced in Amateur Radio (WIA journal) in March – 3rd March is the birthday of the late Ron Wilkinson.

Joint awards can be made, with a division of the award.

The recipients for 1977 were Wally Green VK6WG of Albany, WA, and Reg Galle VK5QR, of Enfield SA, for their world record-breaking 1296 MHz contact early in 1977.

Another UHF record for VK

January was certainly the month for breaking records. Apart from the 432 MHz record-breaking contacts between VK6 and VK3 mentioned in previous issues, Wally Green VK6WG has contacted Reg Galle VK5QR on 2304.1 MHz. The distance between Albany (VK6) and Enfield (VK5) is some 1,900km, stretching the existing world record of 760km by some *two and a half times!*

Reg, VK5QR, used synthesized SSB running about 4 watts output to a one-metre diameter dish located about 10m off the ground.

Wally, VK6WG, used CW. The drive was derived from an SCR522 (good gosh!) at 128 MHz, multiplying nine times to the final which employed a 2C39A as a doubler giving about 3 watts into a 2 metre diameter dish.

Signals were S8/9 both ways and the QSB observed was at a slower rate on 2.3 GHz than on 1296 MHz. At times, the signals were stronger on the higher band, even though more power was being used on 1296 MHz.

Congratulations gents. Another world record for the VKs!

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SWL COMMUNICATIONS

Winter Brings Good Listening on "Tropical Bands".

Our cold winter months are the best time to tune to the "tropical bands" if the varied and exotic sounds of Latin America and Africa are what you want to hear. The shortwave bands of 90 metres (3200-3400 kHz) and 60 metres (4750-5060 kHz) are used almost exclusively by stations within the tropics, being mainly for Home Service coverage due to the generally poor performance of mediumwave broadcasts in tropical areas.

Latin American signals are best between 0500 and 1200 GMT, travelling via the short path across the south Pacific. Some of the stronger signals to watch for are the two outlets of Radio Reloj de Costa Rica on 6006 and 4832 kHz, The Colombian station Radio Cinco (Villavicencio) on 5040 kHz, Radio Chinchaycocha at Junin, Peru on 4860 kHz, and Radio Santa Fe in Bogota on 4965 kHz. The above mentioned are currently operating 24 hours, and many more stations sign-on between 0900 and 1100 GMT for their morning programming. Most stations concentrate on musical programming, with advertisements and occasional news bulletins. As programmes are for local audiences, programming is in Spanish.

Tropical band signals from Africa also peak between May and September, with East African signals appearing on 60 metres from about 1500 GMT in east Australia. Stations audible from about this time include Radio Tanzania at Dar es Salaam on 5050 kHz, and on 90 metres the first signals to appear are Radio Madagascar on 3290 kHz. African signals remain audible until their evening sign-off times, which vary between 2000 GMT for east African outlets, and 0000 GMT for west African countries. Signals in this 1500-0000 GMT time span from Africa reach Australia via the Indian Ocean, and constitute short path reception. During winter, a number of West African stations are also audible on 60 metres between 0600 and 0800 GMT, these signals reaching us via the long paths across North America and the Pacific. The best of these signals include Nouakchott (Mauritania) on 4845 kHz, the two Ghanaian outlets on 4915 and 4980 kHz, and Lome (Togo) on 5047 kHz.

3rd Anniversary for Radio Monitors International

The special 3rd anniversary edition of Radio Monitors International will be broadcast at 1100 GMT on Sunday May 28 in the external service of the Sri Lanka Broadcasting Corporation on 11835, 15120 and 17850 kHz. Special greetings will be broadcast from Ian McFarland of Radio Canada International's DX program, from Mr. Jens Frost of the World Radio and Television Handbook Company, and from Bob Padula of the Australian Radio DX Club and Arne Skoog of Radio Sweden's DX show. Main feature of the show will be a report on broadcasting in Antarctica. Future topics of interest to DXers to be covered in Radio Monitors International include "Independent Shortwave stations in the USA" on June 4, and "Broadcasting in the Cook Islands" in the June 11 program.

Spain Extends Transmissions

Radio Exterior de Espana has extended transmissions hours for its Australian service and may now be heard between 0800 and 1130 GMT on weekdays, and 0800-1200 GMT on weekends, on 11910 kHz with programs in Spanish.

Spain is also making greater use of its relay facilities at Tenerife in the Canary Islands, with frequencies of 15365 and 11880 kHz being used for Spanish programs for the Americas between 1400 and 2000 GMT every Sunday, while 11880 kHz is used daily for broadcasts to the Americas between 2145 and 0000 GMT.

"DX Guide" Coming Soon

A New book to be published in Denmark in May by the World Radio and Television Handbook Company will be of great interest to all shortwave enthusiasts wishing to improve their knowledge and enjoyment of the hobby. The book, entitled "World DX Guide" will contain 192 pages with 28 chapters covering all major fields of shortwave listening. Topics covered include: First steps in DXing, shortwave propagation, ionospheric variations, details of shortwave and mediumwave receiving antennas, plus specialised topics such as DXing particular frequency bands. The Australian Radio DX Club will be co-ordinating advance sales of the "World DX Guide" in Australia. To obtain a copy, please forward either $11 for airmail delivery from Denmark, or $9 for seamail postage, to: ARDXC Stationery Department, PO Box 215, Glenroy, Victoria, 3046.

Voice of Greece

The overseas service of the Hellenic Broadcasting Corporation airs both morning and evening services for reception in Australia. The morning service is currently scheduled between 2100 and 2150 GMT on 9760, 9655, and 6140 kHz, while transmission continues on 9655 kHz until 2250 GMT. A news bulletin in English may be heard at 2155 GMT every day. The evening service from Athens is aired from 0900 until 0950 GMT daily on 15160 and 9655 kHz, with English news at 0915 GMT. A feature of most transmissions is a wide selection of Greek music and songs.

Broadcasts from Lebanon

The overseas service of the government station, Radio Lebanon, may now be heard between 0130 and 0330 GMT on 11825 kHz. Programmes include an English language segment at 0230 to 0300 GMT. The station controlled by the Christian Phalangists, known as the Voice of Lebanon, currently transmits on 6550 kHz and provides good reception after about 1400 GMT in east Australia. The station plays much western pop music, with occasional English announcements, though most programs are in Arabic.

CB COMMUNICATIONS

Top-line meter

The JD model 178 meter is a top-line, multi-function meter for hams and CBers. It measures SWR, RF power, modulation percentage, field strength and includes an antenna matcher.

This feature-packed instrument covers the frequency range from 1.5 to 144 MHz, has an accuracy of ±5% or better on SWR and ±10% on the power and modulation measurements.

The model 178 is rated to handle powers up to 100 W but has sufficient sensitivity to give correct indications on transmitter powers as low as 3 W.

Overall size is 160mm by 60mm high by 65mm deep and the front panel slopes backwards for easy reading of the meter and access to the front panel controls.

The JD model 178 is imported by International Foreign Trading Agencies of Australia (IFTA) and is available through a large number of retail outlets throughout Australia. If you'd like to find out more information, phone or write to *IFTA, 21 Gilbert St., Dover Heights, 2030, (02) 371-5673.*

News Digest

Optical Fibre Contract

A contract to further develop optical fibre technology has been awarded to Amalgamated Wireless (Australasia) Limited.

The contract from Telecom Australia follows an earlier Telecom contract to AWA which culminated in the successful first Australian field trial of optical fibre communication late last year.

The AWA Research Laboratory at North Ryde began work on optical fibre communication five years ago.

A team of scientists and engineers is working on this project under Dr. D.R. Nicol, recently appointed head of AWA's Physical Laboratory, which forms part of the Research Laboratory.

A Good Sort

Distributive Partitioning Sort is a new method of sorting computer data which has been shown, in runs on CDC hardware, to run 30 times faster than conventional sort routines. Its creator, W. Dobosiewicz, wrote it in an Algol-like language, and it was coded in FORTRAN and run on a CDC 6400. It is believed that DPS could be improved to 200 times faster than 'classic' sorts.

Safety Seismometer

Through structure like dams and atomic power stations, engineering has increased the potential danger of consequential damage from earthquakes. This has been recognized, and efforts are being made accordingly to guard against this heightened risk by continuous monitoring of ground shocks in the more immediate proximity of such structures. Incessant vigilance allows counter-measures to be taken in good time when major shocks occur, like lowering the water level or shutting-down the reactor.

At the request of the safety officials for a nuclear power station, Kistler Instrumente AG have developed a seismometer which measures and monitors constantly the smallest ground shocks and the resulting vibrations in the structure of the station.

It consists of a modified piezoelectric 3-component force transducer which in conjunction with a seismic mass secured to it acts as an accelerometer in three axes (zenith, north, east). The measuring range mounts to 2.5 g and the threshold is below 0.001 g. The rugged seismometer includes a self-test feature and withstands shocks up to 100 g. And, of course, it gives good service in all manner of geophysical investigations.

For further information, please contact: *John Morris Pty. Ltd, P.O. Box 80, Chatswood, NSW 2067.*

Circuit Diagram Standards

The Standards Association of Australia has published a new standard on guiding principles for the preparation of circuit diagrams as Part 4 of AS 1103, Diagrams, charts and tables for electrotechnology.

The purpose of this standard is to give guidance on principles to be used in the preparation of circuit diagrams for the electrical, electronic and similar fields of use. In this regard it is an extension of AS 1103, diagrams. Part 4 demonstrates that a circuit diagram should show, by means of graphical symbols, the electrical connections and functions of a specific equipment without regard to actual physical size, shape or location of the parts. Numerous examples are given to demonstrate the variety of methods which may be used, to illustrate the basic principles of Part 3 and to demonstrate the simplifications which are considered permissible in achieving the main aim without unnecessary detail.

The standard, in its terminology, format and general treatment of the subject is consistent with the recommendations of Publication 113-4:1975 of the International Electrotechnical Commission. In the main the standard is technically identical with IEC 113-4 but some diagrams have been replaced with others having more meaning in the Australian context. Acknowledgement is made for the assistance received from this source.

The series of which this standard forms part is complementary to AS 1100 Drawing practice, and AS 1102 Graphical symbols for electrotechnology. Reference should be made to AS 1100 for relevant information on matters specific to drawing practice which are not covered in this part or in Part 3.

Copies of AS 1103.4 ($6.00) may be obtained from the offices of the Association in the state capitals and Newcastle. (Postage and handling 80 cents extra.)

Intel 8022

This summer will see the introduction of Intel's 8022 microprocessor, which incorporates an A/D converter and 2 K of ROM.

Propagation Predictions

Unfortunately, once again this month we have had to postpone publication of the Propagation Predictions. Our apologies to readers, we hope to have predictions back next month.

Fairchild Microflame

Fairchild have released data on their 9440 Microflame 16-bit bipolar microprocessor. Packaged in a 40-pin package and manufactured using Fairchild's Isoplanar Integrated Injection Logic, the 9440 executes the same instruction set as Data General's NOVA line of computers. In fact, this is the subject of a suit filed by Data General against Fairchild alleging violation of contractual rights related to the development of support software for the microprocessor. Although Fairchild has not yet formally responded, we were interested to see in Fairchild's annual report under 'Contingencies' that the company 'intends to defend this action diligently'.

The 9460 runs off a 5 V supply and is TTL compatible. The 16-bit information bus carries addresses, instructions and data in multiplexed form. There are 2192 different instructions, with eight addressing modes, and 16 priority interrupt levels. Operation is static, with up to 12 MHz clock speed. Comprehensive software is available, including a BASIC interpreter, and a disk operating system and FORTRAN compiler will be available shortly.

CMOS MPUs On Increase

Although, for a while back there, it looked as though Intersil's IM6100 and RCA's CDP1802 had a small, static market to themselves, interest in CMOS microprocessors is on the increase. Motorola, for instance, has started to offer a CMOS version of Texas Instruments TMS1000, and is planning to produce a version of 6800 in the low-power technology. Texas Instruments isn't lying down, however, and will offer its own CMOS versions of TMS1000 and TMS1200.

Meanwhile, back at RCA, Intel have signed a non-exclusive agreement for RCA to design and produce CMOS/Silicon-on-sapphire versions of the 8085 A, the 8048, the 8155 RAM-I/O and the 8355 ROM-I/O. In return, Intel will get information on the SOS technology.

Intersil will also offer the 8048 in CMOS, while National may follow suit. Mostek are apparently designing a CMOS version of the 3870 one-chip F8, and it seems that just about everyone is planning on getting in on the act.

Japanese Calculator Growth

In the one year period from February 1977 to February 1978, Japanese calculator exports to the US doubled to 848,115 from 423,743 for each monthly period, respectively. The value of the February 1978 shipments was US $19,759,000.

Philips Internal Merger

Philips has merged the activities of two major Divisions to further strengthen the Company's design, development, manufacturing, sales and installation capabilities in audio, video and communications.

Philips Electronic Systems (Vision & Sound) and Philips-TMC (Telephone Division), will combine their strengths in one operational force based at the large Philips manufacturing plant at Moorebank, Sydney.

The Group General Manager of the Philips Industry Oriented Products Group, Mr. W. Griffiths, said today: "We are confident that the technical expertise and commercial experience of both groups will complement one another. The combined group will have greatly increased strength in the developing electronic technologies and in systems applications.

"We have taken a good look at the market needs, and we believe that the combination of the skills and experience of Philips-TMC and Vision & Sound will place us in a predominant position in terms of ability to satisfy these needs."

The head office for Vision & Sound will move to Moorebank from Clayton, Victoria. Stock and some personnel transfers already have been made, and the total move will be completed during April. A Sales and Service centre will be maintained in Melbourne.

114 And Not Out!

This month Tandy Electronics opened two more stores to bring their Australian store total to 114 and still growing. Both stores are situated in Victoria and both held gala celebrations to announce their respective opening dates.

In Springvale the new store is at Shop 3/288 Springvale Road. The other grand opening was in Geelong at Shop 8-11, 171-181 Moorabool Street. The gala occasions featured sensational bargains and free give-aways to all their customers.

The international store count is presently as follows:

Belgium	83
Canada	721
England	124
France	10
Germany	47
Holland	47
Japan	6
United States	5804

Tandy Electronics is pleased with the growth rate and expects more new Tandy stores to open their doors in the coming months.

Micro Operating System

An example of the complexity levels microcomputer software is reaching can be seen in a new BASIC language operating system recently announced by Ohio Scientific. The OS-65U operating system is aimed at business applications and is based on Microsoft's 6502 9.5-digit precision BASIC (as used in PET). The memory file system is claimed to be compatible with future bubble and CCD memories without modification. In the meantime, OS-65U supports one to four floppy disks, one to four 75 Mbyte hard disk drives, multiple terminals, multiple line printers and other I/O devices.

File syntax is similar to other extended BASIC's, including OPEN, CLOSE, PRINT and INPUT statements. Other tricks include multiple-level password security that can lock out programs or data files from users, or prevent modification. The OS-65U runs on any Ohio Scientific disk-based 6502 CPU with 32K or more memory and costs $199 (US) per CPU licence.

New Switch as Security Aid

Breaches of high security enclosures can be detected by an inertia switch developed by a British Company. The firm, Inertia Switch Ltd, utilised its methods for aerospace applications and has adapted it for industrial and commercial uses.

The switch consists primarily of two essential elements, a loop of protection devices (sensors) and an analyser or control unit. The sensors are attached to various parts of the perimeter structure such as fence or wall, doors or window frames, and are wired with a power source to remote control equipment. The circuit is broken when a sensor – a small gold-plated ball sitting on a contact – is disturbed by the frequency of vibration or shock to trigger off an alarm.

Featured are flexibility and ease of installation, compatability with other detection systems including direct dialling, and avoidance of false alarms caused by environmental factors such as wind and traffic.

Texas Fibre Optic Link

One of Houston's city libraries has been linked to a nearby computer by a fibre optic link. The link, which was installed by Univac to join library CRT's to a Univac 1900 Computer Assisted Data Entry processor, has been operating for several weeks without problems. The optical cable is about as thick as a lead pencil, although the actual fibre is pin-sized, and was laid in existing underground conduits by the city. The 900m data link runs at 2,400 bit/sec.

Ideas for experimenters

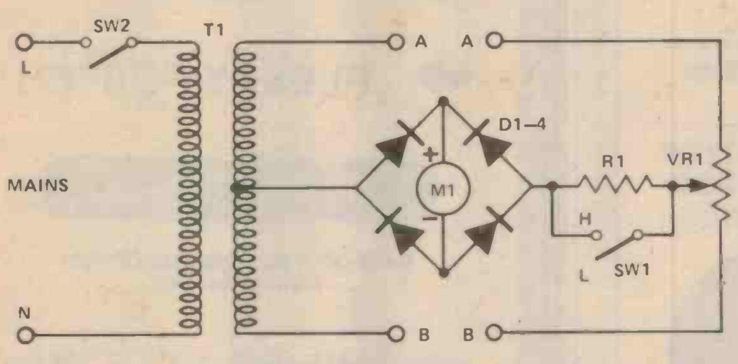
These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.
Electronics Today is always seeking material for these pages. All published material is paid for — generally at a rate of $5 to $7 per item.

Capacity checker

This bridge was originally designed to find values for odd, unmarked or undecipherable capacitors. While not being of great accuracy, it does give a very good indication as to the value of the capacitor.

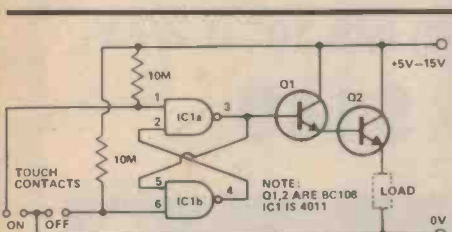
A known value component is placed across terminals A—A, polarity is not important, but polarised capacitors must not be used, and cannot be tested. The capacitor under test is inserted in B-B, the unit is switched on and VR1 rotated until a maximum value reading is obtained on meter M1. At this point, a reading is taken from the calibration scale on the pot which initially must be calibrated in ratios, i.e.: 1000:1, 100:1, 10:1, 1:1, 1:10, 1:100 etc. The unknown value is then calculated from this reading. Original calibration is from known values.

To increase the range of the circuit switch SW1 has been included to bypass R1. Since the frequency used is 50 Hz from the mains, ranges are limited; if another source were used, driving an audio output transformer, the versatility of the unit would then be further increased.



	H	L
10n	X	
100n	X	X
1u		X

M1 = 100uA
D1–4 = 1N4001
R1 = 25k
VR1 = 10k Lin
T1:240V/3V–0–3V



Low Current Touch Switch

The cost of many CMOS ICs is now lower than a mechanical on/off switch. Using only one half of a 4011, plus a couple of general purpose transistors, a touch operated switch can be constructed which is ideal for many battery powered projects.

Assuming that the inputs to the remaining half of the 4011 are tied low, the current drawn in the off state is almost negligible and battery life is hardy affected.

Touching the 'on' contacts with a finger brings pin 3 high, turning on the darlington pair and supplying power to the load (transistor radio etc). Q1 must be a high gain transistor, and Q2 chosen for the current required by the load circuit.

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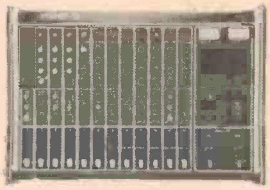

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Ideas for experimenters

Channel splitter for radio control

This circuit is designed to replace the electromechanical reed units used as channel-splitters in radio controlled models.

The circuit is based on the MC 1310P integrated circuit, a chip that is primarily a stereo decoder for use in stereo radio tuners. When used as a stereo decoder, the MC 1310P automatically switches itself from the mono mode to the stereo mode whenever its input contains the 19 kHz subcarrier of a stereo multiplex signal at a sufficiently high level (16 mV), and switches back to the mono mode when the 19 kHz subcarrier ceases to be present. Pin 6 of the integrated circuit drives a stereo indicator lamp to give a visual indication of whether the circuit is operating in the stereo or mono mode.

It is this lamp driver facility of the MC 1310P that makes it an ideal chip to use as a channel-splitter. When used as a channel-splitter the circuit is not tuned to the 19 kHz of the stereo decoder but to the audio frequency that the circuit is required to detect, and the lamp driver output from pin 6 is used to drive a power transistor controlling a motor or other device.

The output from the detector of a radio receiver is amplified by the BC 108 and then fed into a series of MC 1030P channel-splitters (connected in parallel) each tuned to a different audio frequency.

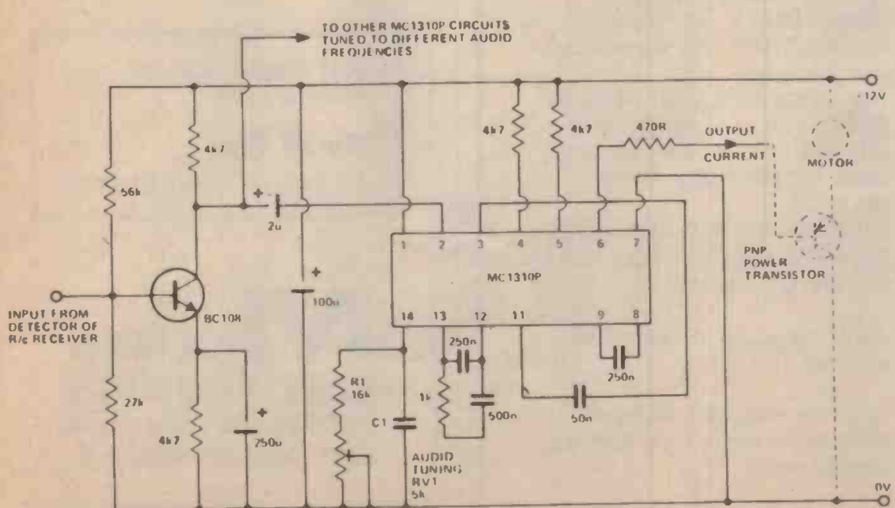
The audio frequency to which the channel-splitter responds is determined by the tuning circuit R1, VR1 and C1, and is given by the formula:—

$$f = \frac{1}{2\pi \quad C1\,(R1 + RV1)}\ \text{Hz}$$

The value of C1 is chosen to give the required tuning range for the preset RV1. For example, if C1 is 10,000 pF, then the tuning range is approximately 750 Hz to 1,000 Hz.

The output is a switched current output between Pin 6 of the chip and the positive supply rail. This current should not exceed 35 mA and so a 470 ohm resistor is inserted in the output connection from Pin 6 as short circuit protection. If a voltage output is required then a resistor can be connected from Pin 6 to the positive supply and the voltage output taken from Pin 6.

The MC1310P is triggered when the input to Pin 2 contains its tuned frequency at a level greater than 16 mV. It can be triggered by noise if the noise level is greater than 16 mV. Some radio control transmitters tend to transmit noise when they are not transmitting a tone, and if this is the case the transmitter should be modified to prevent noise being transmitted. This could be done by making the transmitter transmit an extra unused tone whenever it is not transmitting one of the used audio tones.



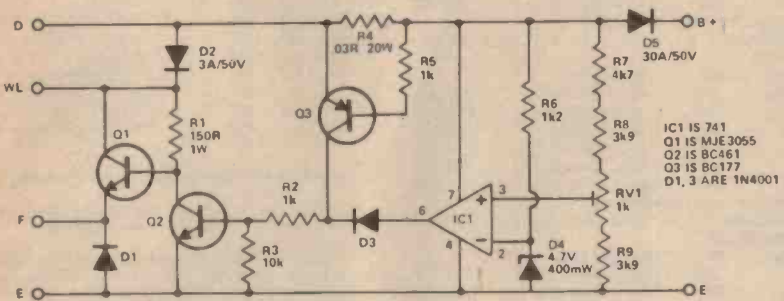
Ideas for experimenters

Car Voltage Regulator

This circuit provides solid state control of battery charging. The field winding of the dynamo is initially energized via the ignition light as in a conventional system. Current flowing down the WL lead passes through Q1 to the F lead then to the field coil. Once the engine has started, current from the dynamo passes through D2 to Q1. The ignition light goes out because the WL lead rises in voltage to that of the battery. Current also passes through D5 to the battery. The battery voltage is sensed by ICI, which is wired as a comparator, once the voltage of the non inverting input rises above that of the inverting input (Held at 4.6 volts by D4) the output goes high. Current then flows through D3 and R2 to the base of Q2 turning it on. This then pulls down the base of Q1 turning it off and cutting off the current to the field winding. The output from the dynamo then drops bringing down the battery voltage. This holds the battery voltage constant. The battery voltage is adjusted by RV1 to approximately 13.5 volts.

Under cold weather starting the battery voltage drops very low. Once the engine has started the internal resistance of the battery is also very low, which would draw excessive current from the dynamo causing possible damage. To limit the current R4 is inserted in the main power lead from the dynamo, the resistance of R4 is chosen so that at maximum current (Typically 20 amps) 0.6 volts is developed across it, this then turns on Q3. When Q3 turns on current flows from the power rail through R2 to the base of Q2 turning it on, which in turn turns off Q1 and cuts off current to the field winding. The output from the dynamo then drops.

No changes have to be made to the existing wiring. The circuit can be housed in an old regulator box, Q1, Q2 and D5 should be mounted on a heat sink.



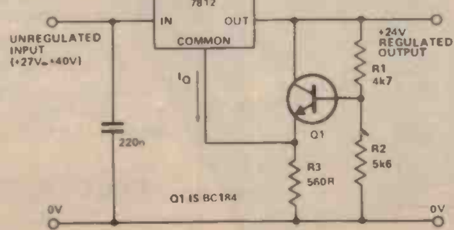
Increasing Regulator Outputs

It is often necessary to arrange an integrated circuit 3-terminal voltage regulator to give a higher output voltage than that set by the regulator alone. The normal way of doing this is to connect the "common" terminal to the mid-point of a potential divider hung between the regulated output and ground. The regulator voltage now appears across the top divider resistor; hence, if for example equal divider resistors are used, the output voltage is twice that maintained by the regulator between its common terminal and output.

The problem with this method is that most IC regulators (eg the 78-series) have a small quiescent current (approx 10mA) flowing out of the common terminal to ground. The magnitude of this current is not closely controlled, and hence the total output voltage becomes somewhat unpredictable due to this extra current flowing in the bottom half of the divider. Low divider resistor values help, but there are likely to be the complications of heat dissipation and inefficiency.

The circuit above avoids the problem by using transistor Q1 to generate a low impedance at the regulator common terminal by emitter-follower action, while transferring the voltage derived from a relatively high-resistance divider network. The value of R3 is not critical, but must be low enough to accept the highest likely quiescent current without causing Q1 to turn off.

The circuit shows a practical 24 Volt supply using a 7812 regulator.



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022	— 8c	.22	— 16c
.027	— 8c	.27	— 16c
.033	— 8c	.33	— 18c
.039	— 9c	.39	— 19c
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.056	— 9c	All	
.068	— 10c	values	
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22 uF	6c($3¾)	7c($4)	8c($5)
33 uF	8c($4)	9c($5)	10c($6)
47 uF	9c($5)	10c($6)	11c($7)
100 uF	10c($6)	12c($7)	14c($11)
220 uF	12c($8)	16c($10)	35c($17)
470 uF	16c($12)	22c($16)	45c($30)
1000 uF	22c($18)	30c($25)	75c($50)

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1N4148	—	6c $4.50/100
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Ref. No.	Amps 12v	24v	Wt. Gms.	Secondary Windings	$
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111	0.5	0.25	283	0-12V at 0.25A x 2	4.50
213	1.0	0.5	425	0-12V at 0.5A x 2	5.00
71	2	1	793	0-12V at 1A x 2	7.20
18	4	2	1020	0-12V at 2A x 2	9.00
70	6	3	1538	0-12V at 3A x 2	11.40
108	8	4	2268	0-12V at 4A x 2	15.00
116	12	6	2722	0-12V at 6A x 2	16.80
115	20	10	5300	0-12V at 10A x 2	24.90

15/30 Volt Range: Primary 220-240 volts: Secondary Windings 0-12-15v at 5 amps, 0-5-9-15v at 5 amps. Voltages obtainable: 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30, or 12-0-12 or 15-0-15.

Ref. No.	Amps 15v	30v	Wt. gms.	Secondary Taps	$
51	10	5	3120	0-12-15, 0-5-9-15	18.00

30 Volt Range: Primaries 220-240 volts
Voltages obtainable 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30, or 12-0-12 or 15-0-15.

Ref.	Amps	Wt.Gms.	Secondary Taps	$
112	0.5	623	0-12-15-20-24-30	6.00
79	1	737	0-12-15-20-24-30	7.50
3	2	1361	0-12-15-20-24-30	10.20
21	4	2600	0-12-15-20-24-30	12.60
89	10	5670	0-12-15-20-24-30	26.10

50 Volt Range: Primaries 220-240 volts
Voltage obtainable: 6, 7, 8, 10, 14, 15, 17, 19, 21, 25, 31, 33, 40, 50, or 25-0-25

Ref.	Amps	Wt.	Secondary Taps	$
102	0.5	737	0-19-25-33-40-50 V	8.40
103	1	1304	0-19-25-33-40-50 V	9.60
104	2	2495	0-19-25-33-40-50 V	12.60
105	3	3176	0-19-25-33-40-50 V	15.00
106	4	4100	0-19-25-33-40-50 V	18.00
107	6	5444	0-19-25-33-40-50 V	26.40

60 Volt Range: Primaries 220-240 volts
Voltages obtainable: 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 or 24-0-24 or 30-0-30.

Ref.	Amps	Wt.	Secondary Taps	$
124	0.5	737	0-24-30-40-48-60 V	7.80
126	1	1361	0-24-30-40-48-60 V	9.60
127	2	2495	0-24-30-40-48-60 V	12.60
125	3	4083	0-24-30-40-48-60 V	18.60
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236	330, 330	198	0-9, 0-9	3.50
207	500, 500	566	0-8-9, 0-8-9	6.30
205	500, 600	1077	0-15-20, 0-15-20	7.20
214	300, 300	623	0-20, 0-20	5.00
221	700 (DC)	737	20-12-0012-20	7.80
206	1A 1A	1304	0-15-27, 0-15-27	10.80
203	500, 500	822	0-15-27, 0-15-27	10.20
204	1A 1A	1417	0-15-27, 0-15-27	14.40

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7404	.16	7464	.35	74160	1.23
7405	.19	7465	.35	74161	.95
7406	.29	7470	.38	74162	1.39
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7408	.22	7473	.35	74164	.95
7409	.17	7474	.31	74165	.95
7410	.16	7475	.49	74166	1.19
7411	.25	7476	.34	74170	1.90
7413	.43	7483	.68	74173	1.49
7414	.65	7485	.88	74174	1.19
7415	.25	7486	.38	74175	.95
7416	.35	7489	2.25	74176	.84
7417	.35	7490	.43	74177	.84
7420	.16	7491	.75	74180	.95
7423	.37	7492	.48	74181	2.30
7425	.35	7493	.48	74182	.85
7426	.22	7494	.75	74185	2.20
7427	.35	7495	.75	74190	1.25
7430	.20	7496	.75	74191	1.15
7432	.23	74100	1.15	74192	.89
7437	.25	74107	.37	74193	.85
7438	.25	74121	.37	74194	1.15
7439	.50	74122	.38	74195	.74
7440	.15	74123	.45	74196	.98
7441	.85	74125	.54	74197	.95
7442	.58	74126	.58	74198	1.69
7443	.65	74132	.75	74199	1.69
7444	.73	74141	.85	745200	3.95
7445	.85	74145	.90	74279	.79
7446	.81	74150	.98		
7447	.59	74151	.68		
7448	.79	74153	.60		
7450	.17	74154	1.20		

LOW POWER SCHOTTKY

74LS00	.36	74LS32	.38	74LS95	2.09
74LS02	.36	74LS40	.45	74LS107	.59
74LS04	.36	74LS42	1.40	74LS164	2.20
74LS08	.38	74LS74	.59	74LS193	2.20
74LS10	.36	74LS90	1.30	74LS197	2.20
74LS20	.36	74LS93	1.30		

LOW POWER

74L00	.29	74L51	.29	74L90	1.40
74L02	.29	74L55	.29	74L91	1.20
74L03	.23	74L71	.29	74L93	1.50
74L04	.29	74L72	.45	74L95	1.50
74L06	.29	74L73	.56	74L98	2.25
74L10	.29	74L74	.56	74L164	2.25
74L20	.29	74L78	.75	74L165	2.30
74L30	.29	74L85	1.09		
74L42	1.39	74L86	.65		

HIGH SPEED

74H00	.25	74H22	.25	74H61	.25
74H01	.25	74H30	.25	74H62	.25
74H04	.25	74H40	.25	74H74	.39
74H08	.25	74H50	.25	74H101	.58
74H10	.25	74H52	.25	74H102	.58
74H11	.25	74H53	.25	74H103	.60
74H20	.25	74H55	.25	74H106	.72
74H21	.25	74H60	.25	74H108	.72

CMOS

4000A	.26	4018A	1.39	4066A	.89
4001A	.25	4020A	1.72	4068A	.44
4002A	.25	4021A	1.18	4069A	.44
4006A	1.35	4022A	.94	4071A	.26
4007A	.26	4023A	.25	4072A	.35
4008A	1.52	4024A	.89	4073A	.39
4009A	.57	4025A	.25	4075A	.39
4010A	.54	4027A	.59	4076A	.39
4011A	.29	4028A	.98	4082A	.35
4012A	.25	4030A	.44	4518A	1.56
4013A	.45	4035A	1.27	4528A	1.56
4014A	1.27	4040A	1.39	4585A	2.10
4015A	1.27	4042A	1.47		
4016A	.48	4049A	.59		
4017A	1.01	4050A	.59		

74C00	.19	74C74	1.04	74C162	2.49
74C02	.26	74C76	1.34	74C163	2.66
74C04	.44	74C107	1.13	74C164	2.66
74C08	.68	74C151	2.62	74C173	2.22
74C10	.35	74C154	3.15	74C195	2.26
74C20	.35	74C157	1.76	80C95	1.15
74C42	1.61	74C160	2.48	80C97	.96
74C73	1.04	74C161	2.49		

CERAMIC DISC CAPACITORS

1pf 50V	56pf 50V	270pf 50V	01uf 1000V
5pf 50V	68pf 50V	390pf 50V	022uf 50V
7pf 50V	82pf 50V	470pf 50V	030uf 50V
10pf 50V	100pf 50V	600pf 50V	050uf 50V
22pf 50V	120pf 50V	820pf 50V	1uf 50
27pf 50V	150pf 50V	001uf 50V	
33pf 50V	180pf 50V	0047uf 50V	
47pf 50V	220pf 50V	01uf 50V	

	(each)	(Minimum 10 per value)
0-100	$.10 ea	$.05 ea
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7438	.19
7440	.13
7445	.49
7495	.55
74123	.25
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LM311 mDIP	.49
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LM739 DIP	.79

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10 EA. OF FOLLOWING VALUES — 50 VOLT

1pf	33pf	82pf	220pf	820pf	.022uf
5pf	47pf	100pf	270pf	.001uf	.030uf
10pf	56pf	150pf	470pf	.0047uf	.050uf
22pf	68pf	180pf	600pf	.01uf	.1uf

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4.7V 5.5V 10V **$ .15 EA.**
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2513

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MM5314 with 6 NS71 .27'' displays 2 P.C. boards — Display board may be remote. Internal or wall transformer can be used. 50-60 Hz, 12-24 hour. Includes all necessary transistors, resistors, capacitors, diodes, 3 switches and complete assembly instructions.
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LM307CN	26	LM381N	1 75	LM741CH	35
LM307H	30	LM382N	1 75	LM747H	79
LM308H	89	LM385K	45	LM747N	71
LM309H	1 05	NE531V	2 90	LM748CN	35
LM309K	99	NE540L	2 90	LM1310N	2 80
LM310CN	1 07	NE546A	1 09	LM1414N	1 59
LM311CN	89	NE550A	75	LM1456CN	1 29
LM311H	89	LM555CN	39	LM1458CN	59
LM311N	89	NE556A	88	LM1496N	89
LM319N	1 13	LM560N	2 95	LM1800N	2 48
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5 5.2, 12 15	1 29	LM565N	1 19	ULN2209	89
LM320T		LM565H	1 39	CA3046	1 19
5, 12 15	1 19	LM566H	1 39	CA3081	1 49
LM322N	1 59	LM566CN	1 19	LM3900N	49
LM324N		LM567CN	1 29	LM7524	79
(LM2902N)	1 52	LM567H	1 49	LM7525	79
LM339N	1 58	LM703H	59	80388	4 59
LM340K		LM703CN	39	75451CN	35
5 6 8 12		LM709N	25	75452CN	35
15 18 24	1 29	LM709H	29	75453CN	35
LM340T		LM710N	59	75454CN	35
5, 6, 8 12		LM711N	39	75491N	71
15, 18, 24		LM723H	55	75492N	85
178 — — Equiv	1 19	LM723N	52		

XR320	1 15	XR2567	1 99	XR4212	1 75
XR2206	2 95	XR4136	1 75	XR4739	1 15
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RL209 Red diff.	.12'' dig.	.12
RLT-T1-03 White diff. no flange	.124'' dig.	.15
RLC200 Red diff Current reg.	.19'' dig	.25
RL4403 Red diff.	.19'' dia.	.15
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2.2 mfd	20V	.25	15 mfd	20V	.45
2.2 mfd	35V	.30	22 mfd	16V	.45
3.3 mfd	35V	.30	33 mfd	10V	.40
4.7 mfd	16V	.30	47 mfd	6V	.40
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6.8 mfd	50V	.40	150 mfd	15V	1.50

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For quite some time, other manufacturers have been trying to produce tape with the qualities of the Maxell UD-XL. At the same time, Maxell have been quietly perfecting an even better series.

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