electronics today

JANUARY 1979 INTERNATIONAL

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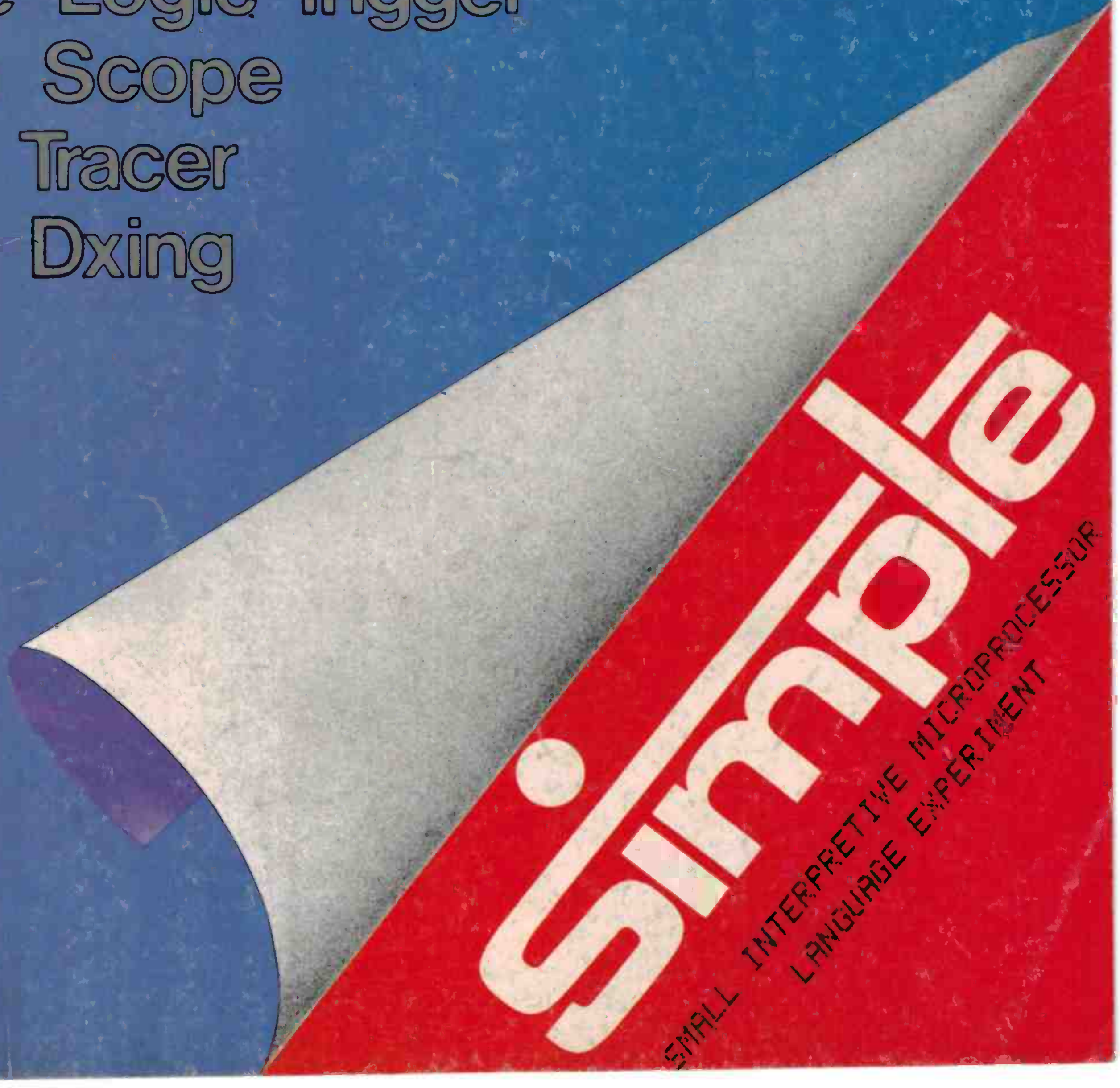

AUSTRALIAN OWNED AND PRODUCED

January 1979, Vol. 9, No. 1

electronics today INTERNATIONAL

Editorial: Les Bell

Managing Editor: Collyn Rivers

Cover: The SIMPLE language and interpreter for the 8080 microprocessor is an interesting introduction to the construction of interpreters.

PROJECTS

Special Software Project

FEATURES

NEWS & INFORMATION

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News Digest

Electronic Ruler

National Panasonic has developed a unique electronic ruler incorporating an 8 digit calculator with memory functions. The ruler will measure straight or curved lines by means of a small wheel fitted to one end, and the resultant measurement can be fed directly into the calculator as a basis for computations. It is convenient for measuring distances on maps or charts, and in warehousing, textile, carpentry and engineering activities.

The electronic ruler, designated Model JE-8210 U, is available from electrical retailers, discount houses and department stores throughout South Australia at a recommended retail price of $63·50. Distribution will probably be extended to other States at a later date.

Townsville MICSIG

The Townsville Chapter of the Australian Computer Society has formed a Microprocessor Special Interest Group. Three meetings had been held when we heard from the group's secretary in late November. Speakers have been Mr. J. Sokoll from Brisbane and Dr. W. Caelli from Canberra, and a 'show-and-tell' evening was held where members demonstrated equipment they are working on.

Meetings will be held at approximately monthly intervals, and people interested in attending should write to: *MICSIG Secretary, ACS, PO Box 82, Aitkenvale 4814.*

Chess Champion Offer

Unfortunately the closing date of the Chess Champion offer in last month's ETI was accidentally omitted. This offer closes on 1 January 1979.

Extension Speaker

A compact, lightweight, self-contained extension speaker, which operates from the earphone jack of a TV receiver, radio or cassette player is available from National Panasonic. The speaker, which has a built-in amplifier, gives an output of 4 watts from a 16cm woofer and a 5cm tweeter, and it is designed for use in large areas such as halls and conference rooms or in clubs and hotels where there is often a high ambient noise level which makes sound from a single output source difficult to hear. It is also suitable for domestic application with radio-cassettes for outdoor parties, barbecues, etc.

The loudspeaker, which comes complete and ready for installation, is available from National dealers at a recommended retail price of $79.95.

Nationwide Paging System

The Swedish National Telecommunications Administration intends to introduce a new nationwide paging system which will allow the users of pocket receivers to be contacted wherever they may be in the country. Calls to the system go through a central installation in Orebro and are then relayed over the FM network. About 30 seconds after the user's telephone number is dialled, his pocket receiver will beep, requesting him to call his office or follow some other prearranged procedure. A more advanced system stores the callers' numbers at the central installation for up to two hours.

Antiforgery System

Researchers at IBM's Thomas J. Watson Research Centre have refined an earlier system to reject 1.7% of valid signatures while accepting only 0.4% of forgeries. The system, which is designed for access security control, works by tracking acceleration and pressure patterns as the signature is written rather than the contour of the signature. Inventor N.M. Herbst claims that the muscle movements required to produce these patterns are beyond conscious control and thus well-nigh impossible to fake.

Piezo-electric Motor

Soviet scientists at the Polytechnic Institute of Kiev have succeeded in building a piezo-electric motor that converts electrical power into rotary motion. Tests have shown that the movement was continuous even though it was produced with impulse forces, and that the machine is over 50% effecient with 90% efficiency being possible.

Digital Link

Strong RF fields, such as are found around broadcast transmitters, cause problems for digital telemetry links, making the installation of such equipment for remote monitoring of antennas extremely difficult. Now, however, a new system from Flash Technology of America (Nashua, NH) offers two-way digital coupling across an RF gap with 15 kV RMS at 1 MHz, or even higher voltages at lower frequencies. The ElectroFlash Optical link FTB-205-OL uses an optical fibre link to provide complete electrical isolation between the two sides of the link, which are separately powered.

What you don't know can hurt you.

When you're considering buying something as important as a new cartridge or tonearm, it's always wise to arm yourself with the facts.
This advice has never been so pertinent as it is today, because ADC have just made a massive step forward for the whole world of hi-fi.
The Audio Dynamics Corporation have built an enviable reputation throughout the world for pioneering dramatic advances in perfecting the state-of-the-art in stereo reproduction.
Today, this dedication to perfection has allowed the frontiers to be pushed out even further with a new, fully compatible range of cartridges, tonearms and frequency equalisers.

The new ZLM Aliptic cartridges for zero record wear
Tip mass almost 50% less than the XLM MkII.
New tapered cantilever.
New Aliptic stylus shape extends vertical bearing surface on groove wall by 100%, and gives greatly extended frequency response ±1dB from 20Hz to 20kHz and ±1½dB beyond to 26kHz.
Greatly reduces record wear and still prevents dust and dirt being reproduced.

The new XLM Mk III
Many of the design features of the ZLM, but with a tiny, nude elliptical diamond, with ·004″ x ·008″ rectangular shank.

The new VLM Mk III
A budget XLM Mk III, featuring the XLM Mk II nude diamond tip.

The new QLM MkIII series
QLM 36 MkIII, QLM 34 MkIII, QLM 32 MkIII, QLM 30 MkIII.
Incorporates our new design criteria, and innovations such as the Diasa (diamond + sapphire) elliptical tip.

The new LMF-1 & 2 Carbon Fibre tonearms
Brand new low mass tonearms in tapered carbon fibre.

LMF-1
Integrated head for lowest mass.

LMF-2
Added advantage of a unique moulded carbon fibre removable head.

Magnesium Headshell
Weighs only 7.83 grams. An aluminium headshell of the same thickness weighs 13 grams.

The new SS-1 & 2 Sound Shapers
New dynamic frequency equalisers designed by ADC to virtually turn your hi-fi system into a recording studio. Allows you to remix all those record and tape tracks you dislike.

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Please send me full details of the following items from the new ADC range.

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News Digest

Synthesized Sig Gen

The new HP 8662A Synthesized Signal Generator covering the range 10 kHz to 1280 MHz now challenges the signal performance of mechanical and cavity-tuned generators such as the well-known HP 8640B. Since both single side band (SSB) phase noise and spurious signals are highly important in out-of-channel receiver testing, this new generator can now be considered for automatic test applications where its programmability and test flexibility are needed.

A major design objective of the front panel layout was to improve measurement efficiency so that engineering and production test productivity could be increased. By using a micro-processor-based controller, manual keyboard functions, semi-automatic sequences, and external programming all provide exceptional user flexibility.

Signal generator key functions are grouped centrally. Frequencies are key-set to 0.1 Hz (or 0.2 Hz) and levels to 0.1 dB resolution. Values can be incremented or decremented with up/down keys or a rotary knob after keying-in the desired step size. A store/recall function allows up to nine complete front panel control settings to be retained and recalled singly or in a sequence of up to 10 steps. Most increment and sequence steps can be triggered by rear panel inputs.

Start/stop or span sweeps can be selected and five key-set markers plus linear or log sweep are available. By using the sequence function, multiple sweeps can be observed simultaneously.

Full signal generator capability is provided with high performance AM and FM modulation. AM rates to 40 kHz are possible depending on modulation depth and carrier frequency FM deviations to 200 kHz and rates to 100 kHz are available for external modulation inputs. A 400 or 1000 Hz internal source can be selected.

Price of the HP 8662A synthesized Signal Generator is $24,700. For further information contact *Hewlett-Packard Australia Pty Ltd, 31-41 Joseph St, Blackburn, VIC 3130.*

USSR Space Shuttle

The USSR design for a space shuttle takes a somewhat different tack from the US one. The Russian launch booster would take off horizontally, like a conventional aircraft, and land the same way. This scheme was considered by NASA and later rejected, but apparently the Boeing Company has been asked to review the concept.

Drawing Rules

The Standards Association of Australia has recently published a new standard on the preparation of outline drawings of integrated circuits, AS C379.3. The purpose of this part of the standard is to extend the recommended practices for the preparation of drawings for semiconductor devices given in AS C379, Part 1, to provide general rules for the preparation of outline drawings of integrated circuits. Specific information is given on dimensions of integrated circuit packages, the mounting of packages into carriers and the numbering of case leads. Such drawings are intended to indicate the space which an integrated circuit package will require on a printed circuit board together with any other dimensional characteristic required to ensure mechanical interchangeability of electronically identical components.

The standard is technically identical with part 3 and Supplement 3A of Publication 191 issued by the International Electrotechnical Commission and already endorsed by the Association as AS C379, Parts 1 and 2. It is probable that the proper use of this part will require reference to AS C379, Mechanical standardization of semiconductor devices, Part 1: Preparation of drawings.

Copies of AS C379.3 ($6.00) may be obtained from the offices of the Association in the state capitals and Newcastle. Postage and handling 80 cents extra.

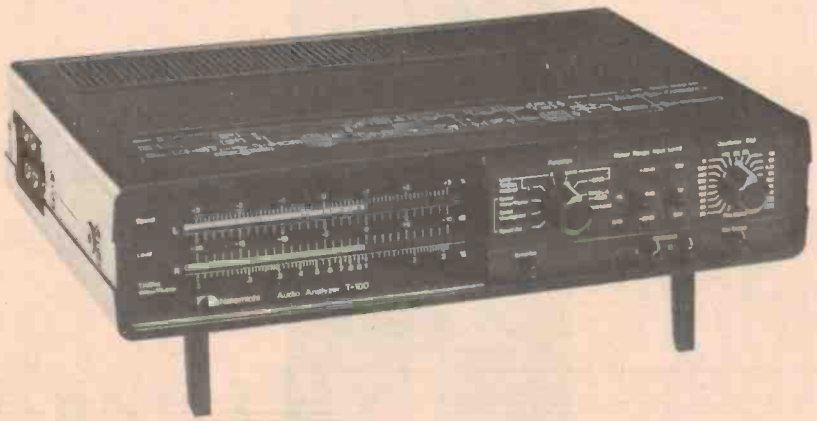
Hifi Bar Graph Displays

Technics is now employing newly developed, all electronic flourescent bar graph level meters in cassette decks. The three latest additions to the Technics cassette deck range, namely the RS-M85, the RM-673 and RS-641 feature these long life, highly accurate FL (fluorescent) meters.

The distinct advantage of the FL meter is that there is no moving parts, as control is electronic, so response time is instantaneous. Also, there is no overshoot, a characteristic of the needle-type meter. The FL meter itself emits light, so there is no difficulty in reading and the left and right channel displays are aligned in parallel for easy viewing and comparison.

For further information on these products, contact the National Technics Hi-Fi Showroom, 31 Market Street, Sydney. Telephone 29-3218.

Nakamichi
T-100 Audio Analyzer



Nakamichi T100 Audio Analyser.

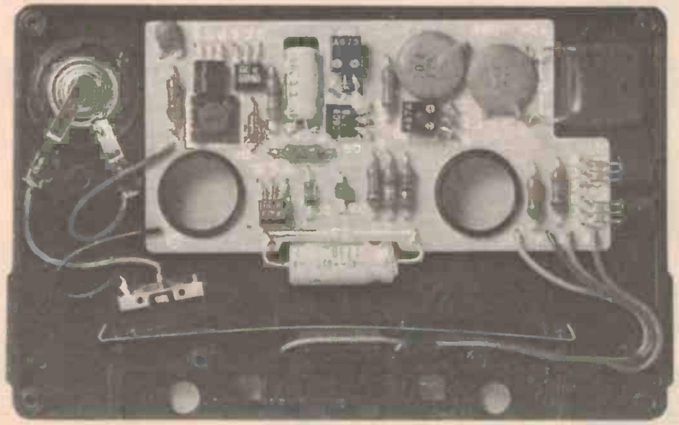
The T100 combines a VTVM, a distortion analyser and a wow/flutter meter. All levels are displayed on a bar graph display which utilises a plasma panel working on the gas discharge principle. This display effectively has zero mass making the system infinitely faster and more accurate than conventional meters. Originally conceived as a tool for the serious tape recorders, the analyser also provides valuable information about pre-amplifiers, amplifiers, turntables, phonograph cartridges, loudspeakers and microphones. The T100 audio analyser will be equally at home in the recording studio, the laboratory, the test bench, the audio showroom and listening room.

SPECIFICATIONS:

OSC: 20-20 kHz. Spot frequencies + pink noise
Level Meter: -80 dB to + 30 dB; Average or peak ballistics.
Wow & Flutter Meter: Measures din peak AWTD or UWTD.
Distortion Meter: Measurement frequency 400 Hz; Range 0.01 percent to 3 percent.
Noise Level Meter: Range -100 dB to -10 dB; 1 HF A Curve; Output impedance: 600 ohms; Input impedance: 50K ohms.
Dimensions: 13½ (W) x 3 (H) x 9½ D inches.
Weight: 4.3 kilograms, 9.5 pounds; Carry case supplied.

TDK
Head Demagnetizer

Inside the HD-01 package.



Why you need TDK'S new head demagnetizer

Every time you use your cassette deck, its record and playback heads build up a magnetic charge, independent of your front panel controls. This charge becomes critical after about 30 hours of use, and begins to cause distortion, loss of response at high frequencies, decreased output level, and midrange noise build-up of 5 to 7 dB. The TDK head demagnetizer cassette solves the problems instantly and restores your heads to top operating condition, so you can get the most out of music.

How to operate the TDK head demagnetizer

Although the TDK head demagnetizer is a sophisticated electronic device as illustrated below, you don't need any technical expertise to use it. It is completely automatic, battery-operated, and portable. Simply pop it into your machine, like any other cassette, with the front side LED facing up. Press the "Play" switch and remove after one second.

Block diagram

POWER DC-DC CONVERTER — CONTROL — OSCILLATION — HEAD

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High Solar Cell Efficiency

Westinghouse Electric Corporation scientists have announced the achievement of high efficiencies in the conversion of solar energy to electricity in solar photovoltaic cells made of silicon.

Efficiencies of more than 15% – the theoretical maximum is 22% – have been achieved with silicon dendritic web, a single crystal form of silicon showing high potential for low-cost production, according to Dr. Daniel R. Muss, manager of solid state research and development at Westinghouse's Research and Development Centre in Pittsburgh.

Under a Department of Energy contract administered by the Jet Propulsion Laboratory (JPL), Westinghouse has been developing the technology of growing silicon ribbon for photovoltaic cells. Dr. Muss said that the achievement of greater than 15 per cent efficiency is an important milestone in the solar photovoltaic programme, in that this is the highest efficiency yet reported for silicon ribbon.

The technique used by Westinghouse forms silicon into a ribbon by drawing the material out of a furnace in a thin strip. The ribbon, or web, is formed by the solidification of a liquid film supported between two silicon filaments called 'denrites' which bound the edges of the growing strip.

This process yields a long, mirror-smooth ribbon free from contamination and essentially ready for solar cell fabrication. Thus, unlike other processes, costly slicing, lapping and polishing processes are not required.

Dr. Muss said both the web growth process and subsequent cell processing are amenable to automation. Westinghouse has been able to achieve cell conversion efficiencies of 15.5 per cent, a very critical factor in determining the overall economics of a solar photovoltaic system.

"Since 1975, the programme has progressed from conceptual design of furnaces through implementation of furnace hardware to laboratory demonstration of web growth at successively greater growth speeds and widths," Dr. Muss said. "For example, early web was typically one centimetre wide and was grown at one centimetre per minute rates."

"Recently," he said, "widths up to four centimetres were achieved. Our analysis indicates that an area output rate of 25 square centimetres per minute will be required for silicon web to meet the cost goal of 50 cents per watt. We expect to achieve this output rate in the laboratory in 1979."

Solar photovoltaic cell costs, not including other required system components, have recently averaged $US12 to $US20 per watt, more than 10 times the cost of electricity generated by conventional means. "The major obstacles to be overcome to substantially lower the costs of these cells are the achievement of an output rate of 25 square centimetres per minute and the development of automated web growth systems capable of continuous operation for periods up to a few days," Dr. Muss said.

"With further development and engineering, and given cell efficiency of more than 15 per cent, our analyses indicate that the 1986 JPL price allocation for sheet production can be reached or bettered with silicon dendritic web," Dr. Muss said.

Synergistic Beer Drinking

At the time of writing, the December session is still a week away so we are unable to report on the evening's events. To refresh your memories, the ETI staff are available in person to talk about anything, electronic or otherwise, on the second Wednesday of the month at the Bayswater Hotel, in Bayswater Road, Rushcutters Bay (just through the King's Cross tunnel, on the left by the Rushcutter Bowl). We'd be delighted to see you and have a yarn over a beer – January's session will be on Wednesday, 10th January. Previous sessions were marked by meagre public attendance, but we are glad to say that everyone who was there had a ball. See you there?

Computer Telex System

A new general purpose system developed by Arbat UK is based on DEC PDP-11 minicomputers and offers a number of new features to subscribers. Intelex automatically answers incoming calls and dials the outgoing ones when it is ready. If a certain subscriber being called has more than one Telex number, the system uses a learning algorithm to discover which one is most likely to answer quickly, and will dial that number first.

The system can also maintain files of information concerning the people and organisations likely to be addressed; up to 999 group messages with up to 99 names in each group can be held, with up to 9 message priorities. The system can also generate amended versions of an original message and route them to the appropriate correspondents.

EUY10E Mosaic Printer

The prices referred to in the Philips Mosaic Printer advertisement in the November 1978 issue, on page 116, were incorrect due to fluctuations in the exchange rate of Japanese currency. The correct prices are available on application to Philips Electronics Components and Materials.

ETI/Unitrex Calculator Contest

The November contest didn't fool many of you – almost everyone realised that the items for sale were house numbers at 58 cents each. Our winner for this month is Mr P H Bell of Ingleburn 2565 who will receive a Unitrex Calculator.

This month's problem was submitted by Mr E Dixon of Mereweather 2291, and goes like this: Using the sixteen numbers 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 42, 43, 44, 45, make a four by four square of these numbers such that any four numbers that are in a straight line or are adjacent either at the corners, the middle four or the left or right side middle four add up to 75.

Seal an empty envelope, write your answer on the back of it, and send it to: Unitrex Calculator Contest (January), ETI Magazine, 15 Boundary Street, Rushcutters Bay, NSW 2011. The closing date is Friday, 2 Feburary 1979.

Errata

Tape Slide Synchroniser ETI 553

On the overlay on page 62 of the October 78 issue, the IC regulator IC1 is shown in the wrong polarity on the component overlay. The correct orientation is with the IC rotated through 180^{o}.

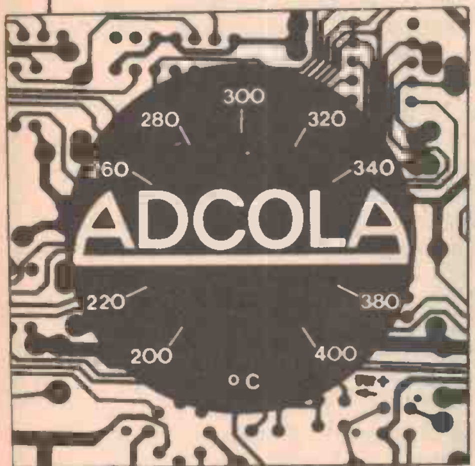
Digital Stopwatch ETI 590

An improvement in operation of the oscillator can be obtained by reducing R6 from 1k to 100 ohms. If non-microswitch type pushbuttons are used, add a $1\mu F$ capacitor between pin 8 (+ve end) and pin 7 of IC15.

S100 VDU ETI 640

Some readers have experienced difficulties with the divider stage IC38, in which all stages of the counter may not reset correctly. A suggested fix is to cut the track between pin 11 of IC38 and the lower end of diodes D8, 9 and 10 on the top side of the board and install a 100k resistor between these two points. This will have the effect of stretching the reset pulse. An alternative cure is to replace IC38 with a Philips type HEF4040.

Soldering printed circuits?



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Hi-Fi sound from your TV

Studio Electronics unique unit enables a high-quality sound signal to be derived from a television receiver and **fed into your hi-fi system without making any connections to the TV-set.** The Studio Electronics 800 system extracts the audio signal from the 5,5MHz sound intercarrier signal by means of a pickup coil requiring no electrical connection to the set. This system picks up the sound signal for whatever channel the TV is tuned to so that no retuning is required when the channel is changed. The absence of connections to the TV ensures safety with no chance of high voltage shocks or warranty and contract problems with new or rented sets.

DIMENSIONS: 100 x 60 x 55 mm

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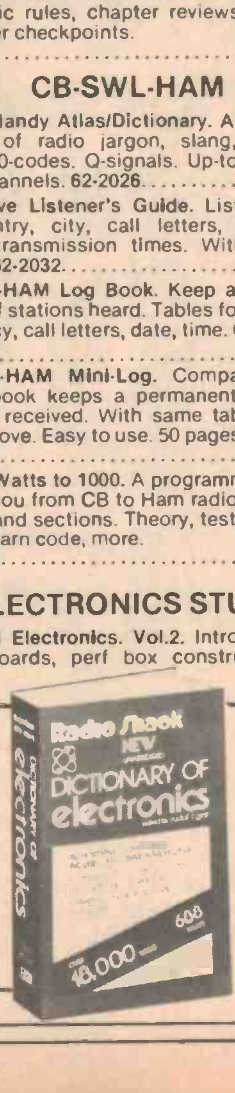

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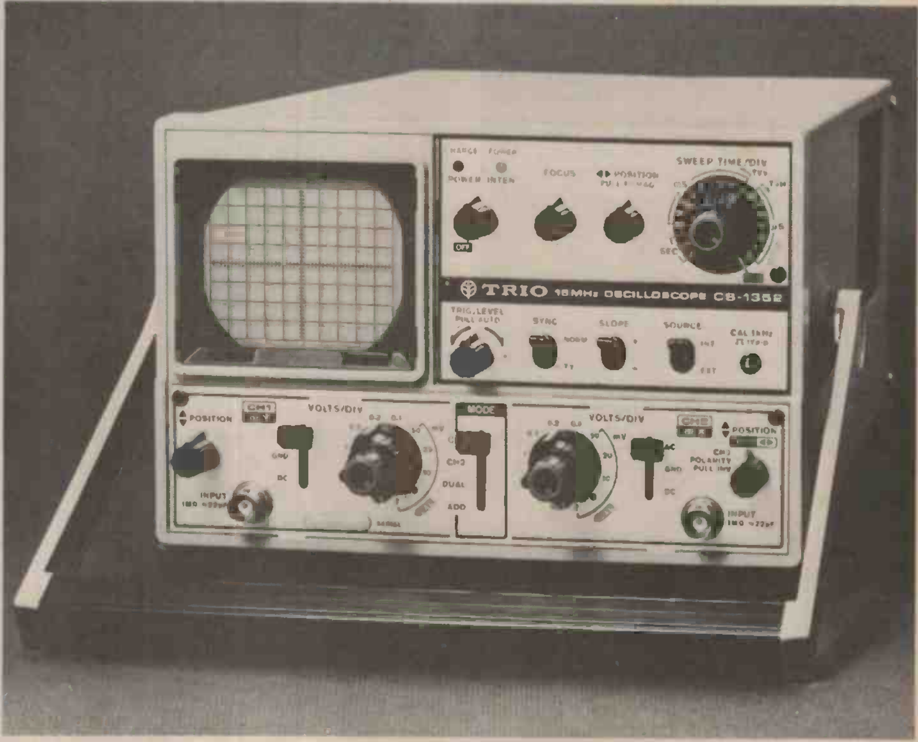
6.95 •Over 20,000 Terms •832 Pages •Illustrated

Contains the latest terms in virtually every field of electronics and computers. Includes pronunciation guide, semiconductor symbols and abbreviations, schematic symbols, the entire Greek alphabet. 68-1030. . . . . 6.95

Use A Scope

We try to convince you you need an oscilloscope.



LET'S FACE IT, compared to some other pursuits, electronics isn't (necessarily) more expensive, it just has a strange balance of payments; ie, what you need to buy to get you going. But it's worth it! We want to encourage you to think about how you're going to develop your interest, so let's try to help with some philosophy. We'll check out what the electronics enthusiast needs to enjoy him/herself, and compare this to other activities in an effort to get you going.

The Basics

What are the tools of the electronics person? The basic tools are very modest: screwdrivers, pliers, soldering iron, wire strippers and a few odds and ends. Fifty dollars and you'd have that about covered. But, and it's a big but, you won't have much fun. You can construct but you can't see what you're doing — electrically that is. Yes, there's really nothing for it, sooner or later you are going to feel you want, absolutely *need* some test equipment. Here's the problem though, many wonder how they can justify the expense of buying something which is a) so exotic and relatively unusual and b) is not even used for construction but just for seeing what you're doing.

Objection a) is easy to answer. If you're special enough to desire a meter or scope there's nothing exotic about it. Objection (b) is tougher to handle. Look at the Sunday mechanic. His couple of hundred dollars invested in tools is used directly to fix or improve his car. And the photographer, his major investment is in the basic picture making tool, the camera. But the poor beginning electronics enthusiast with only a soldering iron is about as well equipped as a photographer whose camera has no viewfinder.

What it all comes down to is that it's time to *stop* regarding meters and scopes as costly accessories, and start looking upon them as time saving, enjoyment enhancing, educational essentials.

What do you really want to do? Probably you've got the idea you'd like to try whipping up a circuit, perhaps one of our designs, or from somewhere else. But what happens? (and how many of us have had this happen?) You get the project together and it DOESN'T WORK. You check it through by eye but don't come up with any wiring mistakes. Are the ICs burned out, transistors on the fritz? Short circuit somewhere? Are the terminals on that pot really the way you guessed? Is that signal getting through?

So after a few years you end up with a big box of dead projects, and your family and friends tolerate your failures. (Which makes your expenditures in electronics even more difficult). How can you financially justify a meter or multihundred dollar scope to fix a $30.00 project? You can't! Why not just get it (them) for your own satisfaction -- *that's* justifiable. As we said they are *essentials,* not accessories.

A satisfied electronics enthusiast sees his hobby as observing interesting things on his scope, enabling him to nurse his projects to life, rather than simply building projects from exact designs and being lucky enough to get them working first time.

The Benefits

What you get with a set of test equipment is of course the pleasure of seeing what you're doing and getting your projects working and adjusted properly. But there are other benefits too. With test equipment you can fearlessly repair radios, TVs, auto electrical systems, appliances, etc, etc. If at present you don't have the knowledge, there's nothing better than a meter and scope to help you learn, with a diagram and perhaps a good book. Fixing is fun! *Anything* can be returned to working order — the challenge is in doing it.

Testing

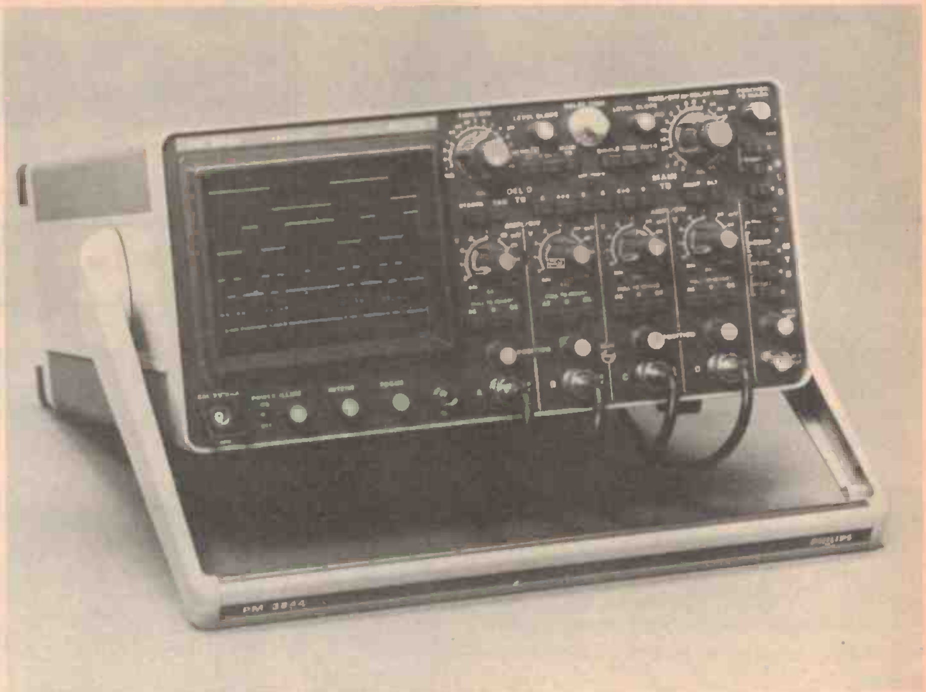
All testing is done to check that a circuit is working properly, to adjust it so that it does, or to find out why it doesn't. If a problem exists you proceed to observing a particular point

Use A Scope

in the circuit where the defect is noticeable. Based on how this point misbehaves compared to proper operation you formulate a theory as to what could cause this mis-operation. Then you devise a test to see if you are correct, perhaps check another location in the circuit, etc. If the result is positive continue along the lines of your theory. If not, modify your theory.

Each test is an observation, to be compared with what you expect to find. Thus you need instruments that let you observe, and a means of establishing expected conditions. Many circuits need no external signals to provide their own expected conditions, such as say a light flasher, while a radio uses easily available radio waves as input. Other equipment, for example an audio amp, requires an input signal to operate fully and thus be tested fully.

From the range of circuits one encounters, it appears most logical to acquire the basic observational equipment first, and leave the signal generators (input condition establishers) until later. Usually a make-do signal source can be rigged up in any case.



Observational Equipment

We are of course back to the multimeter and oscilloscope, plus a few others. The most important factors which pertain to this equipment are that it must not *significantly* affect circuit operation, and it must of course give you a reasonably good picture of what's going on.

The observing machine should provide you with the information you need. This will very much determine what kind of test equipment you purchase in each class.

Multimeters

You are quite likely to be faced with a selection of multimeters from the $30.00 analog (needle) meter to $200.00 digital meters — how do you choose? You ask — what instrument best reflects my projected needs? After basic considerations such as ranges, portability, etc, have narrowed the field, you end up with two major factors versus dollars. The first factor is input impedance. Without any amplifying electronics in an analog VOM, the input impedance is typically 10k per volt, satisfactory for a large number of applications, but not high enough to just stick your probe anywhere without a care. With buffering electronics in either an analog or digital meter, impedance is usually a satisfactory straight 10M ohm. The other factor, accuracy and resolution, usually comes proportional to dollars. You probably need far less than you think. In fact, as a guess, probably 90% of all measurements you are likely to make need no better than 10% accuracy! Look at it this way — most circuits are designed to work with 10% tolerance components, even the AC line voltage may vary from 230V to 250V. Usually if a voltage is within 10% nothing much is wrong. There are of course exceptions such as TTL power supplies. But the point is that to buy .01% accuracy is probably not useful, 1% is quite adequate. In analog meters (which have been in use for years without complaint) just how accurately can you read it anyhow? Figure it out as a percentage!

Oscilloscope

Have you ever been out in snow on a bright day and been blinded by the light? What a feeling of relief you experience when you put on a pair of sunglasses. That's the same feeling you get with your first oscilloscope. You can *see*.

What do you see? Most obviously you can see the shape of the waveform, but the oscilloscope is also an important measuring instrument. It is capable of reading out with reasonable accuracy and resolution (5%) on both amplitude and time axes. What you get as price increases are features which relate to convenience of use, and which increase the accuracy and range of measurement. We study these features in more detail below.

More Metres?

How about frequency, capacitance and inductance; do you need to measure them? Probably not, if you do you can measure them all on the scope.

In the case of frequency you can use the time scale of a triggered scope to find this to probably 2 to 5% accuracy, often close enough. Capacitance and inductance can both be measured using a signal generator and series resistance to figure out the impedance of the component, from which actual L or C can be calculated. If you have to measure a lot of F, L or C or need great accuracy *then* get the appropriate meter.

Logic Probes?

There are a variety of logic probes about with one, four, many inputs. A wide range of designs tells you such information as the logic state of one point, the logic state of many points simultaneously, the logic state of one point for the last n clock cycles, the logic state of all pins of a particular IC etc. It's best to wait and see what your specific needs are before buying one of these. You *can* do the job with a scope (which will also tell you if you have any "½" logic states) but logic probes are designed to ease the job.

In fact, some troubles that are likely to be encountered, especially in microcomputers, are much better handled with an initial poke about with the scope, followed by a custom circuit employing handfuls of LEDs some CMOS latches and a breadboard!

Signal Sources?

A basic sine, square, triangle wave generator can be invaluable as a source of known signals. You'll probably want to be able to set frequency, amplitude and DC offset voltage easily and accurately, and have a sufficient range. Beyond that signal generators start getting specialized.

At a pinch you can build for about $1 a CMOS oscillator to give a square wave output from 0 to 15V, 1Hz to 2MHz. This will get you by in many situations, audio, rf, digital, and very cheaply. You need a suitable scope to "calibrate" it.

In fact there are many simple circuits that will generate a signal for you. The key is that a "signal generator" is really only useful if you *know* what it's generating. This either costs you money to buy a commercial generator, or means you must have a scope to observe the signal from your experimental generator. It seems more and more that the scope is the essential instrument! It is.

Specialized signal generators include audio types capable of sweeping up and down the audio spectrum (hi-fi test equipment) RF generators for radio and TV, picture pattern and colour pattern generators for TV and so forth. They generally make easier things that would otherwise be possible but tedious without them.

Input Impedance

As with multimeters the input impedance is important, but most scopes are satisfactory. Typically this is 1M ohm resistive and a capacitive load of about 35pF. Special scope probes may also be obtained for various tasks to reduce even further the effects of loading.

Triggering

Probably the most differentiating feature between scopes is the means used to stabilize the display. As the electron beam scans across the screen it is deflected up and down by the signal being monitored.

When the end of the trace is reached the electron beam is quickly returned to the start position and the trace is again started. The beam is of course blanked during the "return" sweep.

This process happens so many times a second that the eye cannot see individual traces. With a repetitive input signal, it is desired that each subsequent trace draws exactly over the previous trace, to present the eye with a stationary picture. If this does not occur the waveform will appear to drift sideways, or worse yet may be completely unobservable. So how do you coordinate the sweep with the input signal?

The first method would be to have the sweep oscillator running freely, and hand tune it to give a stable display, a very tedious approach. The second method is called "synchronization", whereby the input signal "influences" the sweep frequency approximately, then the sweep oscillator "locks on" to the input to provide a stable display, while the input signal doesn't vary too much in frequency. The main drawbacks of synchronized sweep are that it only locks over a limited range of frequency (you couldn't observe clearly the signal from an audio sweep signal generator for instance), and you have no means of figuring out the time scaling directly from the scope. If you want to see what the time scale is (say how many cm/ms the beam covers) you must add to the input a reference oscillator signal and work it out from that.

"Triggered" sweep solves most of the problems. The sweep is not generated by an oscillator, but instead by a constant slope ramp generator. At first the ramp is at its initial value, holding the beam off to the left of the screen. Then a particular condition occurs in the input signal, (perhaps it exceeds a certain voltage) which triggers the ramp generator, sweeping the beam across the screen at a constant (known) rate, which you have selected.

At the end of the trace the beam returns and the trigger circuitry awaits a recurrence of the particular condition, to start the beam off again.

Because the particular condition occurs at the same point in the wave each time, each successive trace will be exactly "on top of" the last one, yielding a stationary picture. In addition, since the sweep rate is known the time scale can be read directly from the scope. If the signal frequency should vary, the picture will appear to compress or expand horizontally but still be perfectly visible.

The particular triggering condition may be an adjustable positive or negative voltage, or slope, and many also be automatically taken care of by the scope.

Sweep Speed And Delay

Having already established the virtues of triggered sweep with its ability to allow a direct read-off on the horizontal time scale, what other factors are there?

Our example scopes both have calibrated sweep speeds in "1 – 2 – 5" steps from 1 μs/cm to .5 s/cm. In addition there is an "expansion" mode available, which will "blow up" the horizontal scale by 5 (245 only) or 10 (both) times' Effectively the horizontal sweep speed extends up to .1 us/cm. This expansion mode gets around another problem, discussed below.

The sweep speed is further adjustable between calibrated speeds for occasions where you want to fit a wave form into a particular number of squares on the graticule, such as for easy measuirng of duty cycle.

This feature is also useful in a case where one has say a repeating 8 pulse sequence, and the triggering mechanism cannot distinguish between pulses. One merely adjusts the sweep speed to fit 8 pulses on the display, then the trigger acts on the 9th (first repeated) pulse.

A further problem is encountered when trying to display a waveform such as relatively narrow but widely spaced pulses in reasonable detail.

An example would be a 1 μs pulse recurring every 20 μs. The trouble is that the trigger will operate on the pulse, but by the time the sweep actually starts some of the 1 μs pulse will have been lost. What would be ideal is a trigger that happened before the event, an impossibility of course.

Various fancy schemes have been tried to delay the signal to the display with respect to the trigger. The least expensive solution however, is to use the expansion feature. In this case you reduce the sweep speed to allow the

Use A Scope

display of a second complete pulse with normal sweep width. Then expand to ten times. (This means that the sweep *is* actually ten times the width of the screen, but only a portion is visible). Ajust the horizontal positioning control to locate the pulse as desired. Effectively you are using ten times the sweep speed, and triggering using a preceding pulse and adjustable time delay.

In fact, some scopes incorporate an adjustable time delay on the trigger for exactly this reason, and then they do not need an expansion mode. This is an improvement because the expansion mode display sometimes tends to be dimmer and less well focussed.

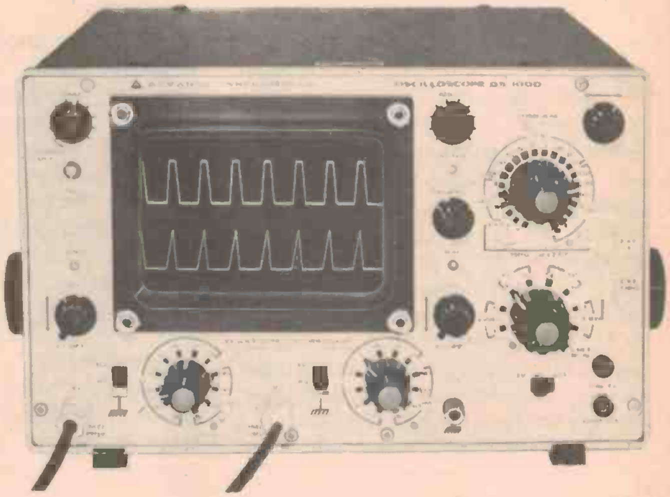
Particularly with digital signals, less so with audio or TV signals, you are likely to find the triggered scope more useful than the older synchronized type.

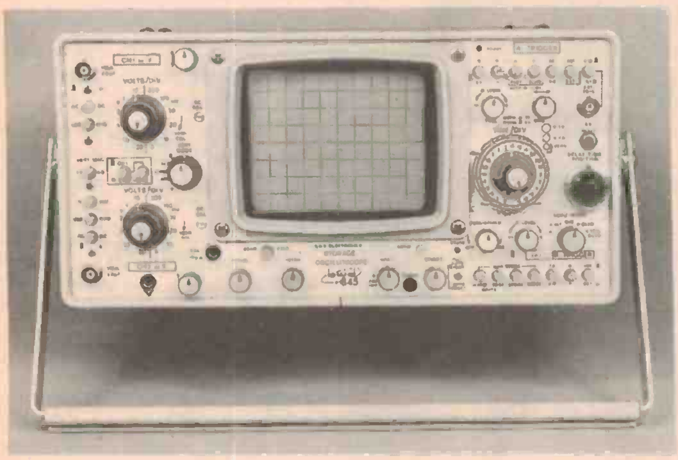
Dual Trace

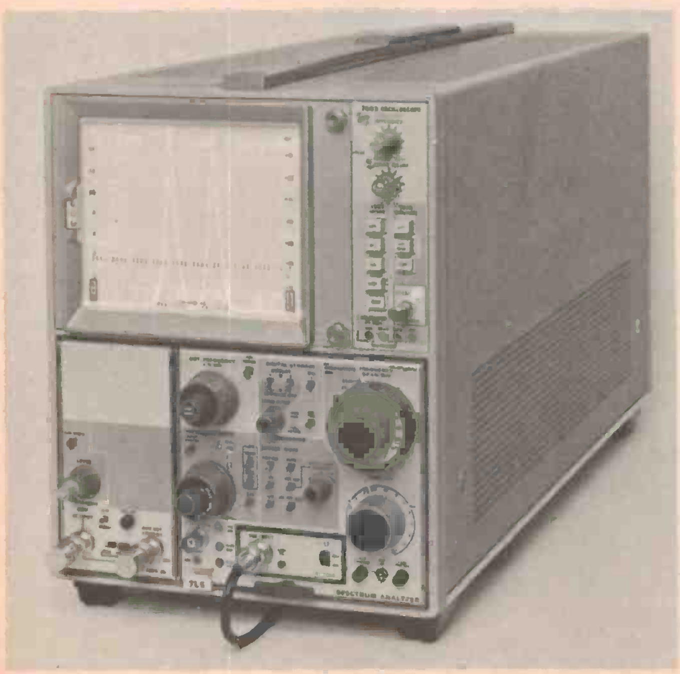
Naturally two traces are better than one, but not just because you can see twice as many traces. The important extra capability this gives you is the ability to see the time relationship between two (or even three) waveforms. Since both traces are triggered from the same signal, points on both waves at the same horizontal position are occuring at the same time. This is very useful for understanding causes and effects that may be only tens of nanoseconds apart.

The dual trace also of course has the convenience of displaying two signals at once such as input and output to an amplifier, perhaps to see how distortion varies with input signal level.

There are three methods of generating the two traces. The first, most obvious and most expensive way is to have two electron guns, with individual deflection plates for each beam, this is known as "dual beam". The second method is to have a single beam draw one trace, then the other "alternating" between the two, but drawing a com-







plete trace each time. In the third method the beam draws both traces in one sweep by alternating very quickly between traces. In this "chopped" mode the beam may draw say .1 mm of the top trace, then .1 mm of the bottom one, then back to the top, etc.

Most moderate price dual trace scopes give you a choice of the alternate and chopped modes (you need both to cover all sweep rates) or automatically select the mode for you.

Input Channels

There is usually a switch which provides you with AC or DC coupled input, or shorts the input (but not the probe!) to ground to position the trace.

At the high frequency end, the important characteristics are the "bandwidth" and the "rise time". The bandwidth is defined as that frequency at which a sine wave display would be reduced in amplitude by 3dB (.707) from its lower frequency size. The rise time is the time between 10% and 90% points on a square wave of a specified size (usually 75% of the scope graticule) assuming a "perfect" square wave input. The rise time is approximately equal to the reciprocal of 2.8 times the frequency, ie: TR = 1/(2.8 x BW), in seconds and hertz. Thus, these two factors are not always both quoted.

In order to check the calibration of the vertical amps a calibrated signal generator is often provided.

An additional capability with many scopes (not just dual trace models) is the X versus Y mode, where the vertical channel operates as before, but the second input drives the horizontal sweep rather than the normal sweep oscillator. This capability is used for comparing two signals ("lissajous" figures) and it's also useful for using the scope as a curve tracer for semiconductors etc.

While X versus Y is available on many single trace scopes, the horizontal channel usually has limited versatility.

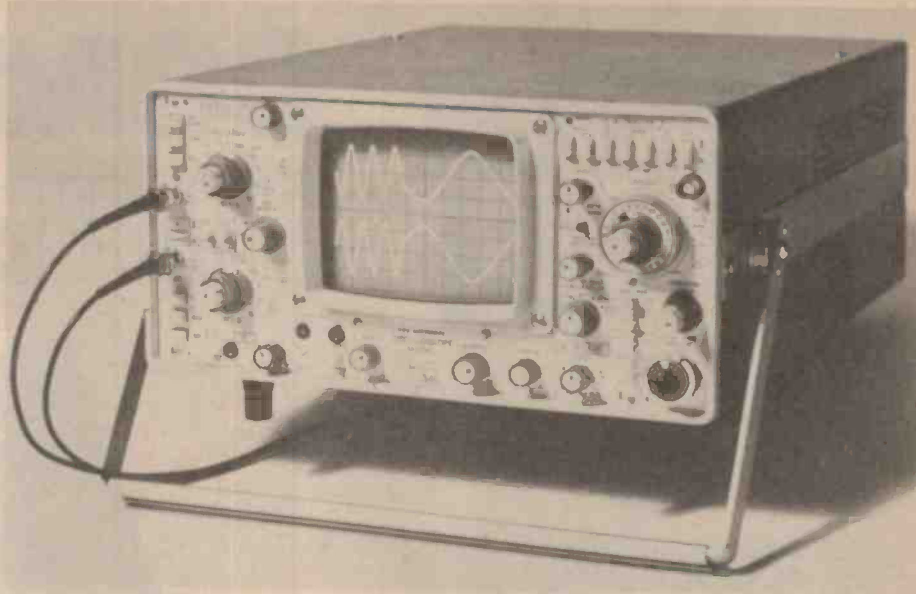
Z Axis

Most oscilloscopes have a facility for modulating the brightness of the trace, which is useful for showing markers, and can even be used for slow scan TV.

Last Details

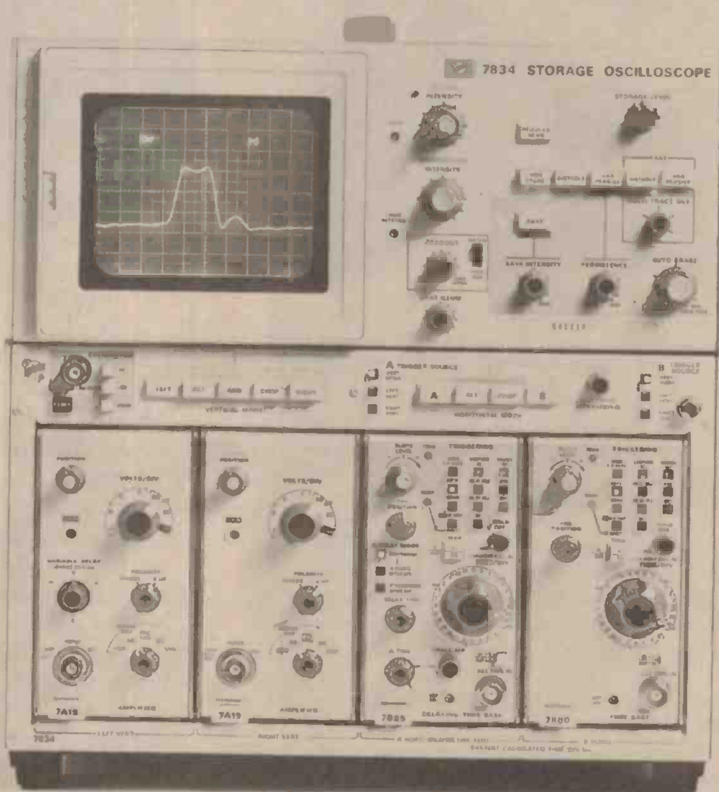
The last few factors relating to choice of scopes are those such as battery power (somewhat rare), service support, choice of connectors, ruggedness of case and so forth.

So how about enjoying yourself. A scope can be a very worthwhile investment, for education, business or entertainment.



The BWD 540 (above) is an Australian-made high performance dual trace oscilloscope.

This Tektronix storage oscilloscope can 'capture' a non-repetitive waveform and display it continuously.



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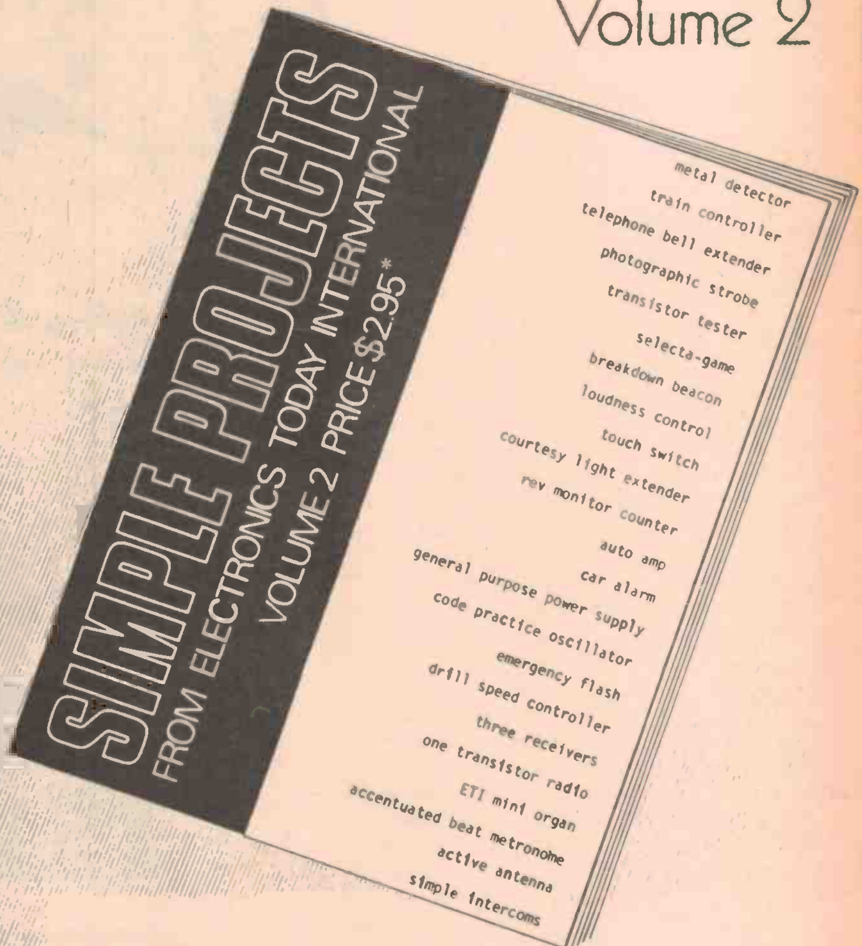

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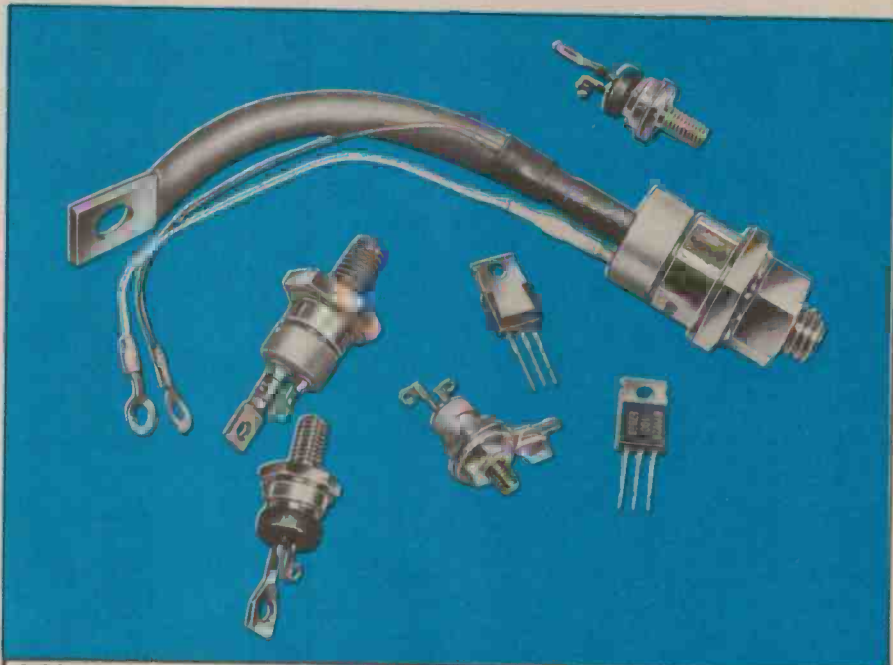
TRIACS

Electronic Components and Materials, PHILIPS

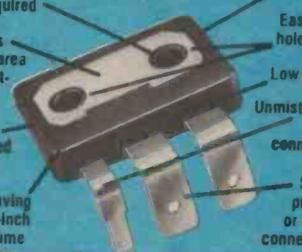
New high quality range for single and three-phase power control.

This comprehensive range offers a choice of commutation characteristics at most current and voltage levels. They are all recommended for new equipment designs, but for applications in the 40A region, attention is particularly drawn to the BTW41-G and BTW41-H series in the SOT-80 "Tripak" encapsulation. Basic data is given in the accompanying chart.



Money-saving Tripack

The Philips Tripack encapsulation used for the BTW41 40A triac is designed for highly mechanised production . . . and consequently favourable prices. Important bonuses are high reliability and simple fixing.



BASIC DATA: In order of current rating

Type No.	Encapsulation	RMS on-state current $I_{T(RMS)}$ max.(1)	Repetitive peak off-state voltage V_{DRM} max.	Non-repetitive peak on-state current I_{TSM} max.	Rate of rise of on-state current dI_T/dt max.	Rate of rise of off-state voltage dV_D/dt max. Normal	Commutating*	Gate trigger voltage V_{GT} min.	Gate trigger current I_{GT} min.
BT137-500 -600	TO 220 plastic	6A	500V 600V	55A	20A/µs	50V/µs	6V/µs (5A/ms)*	[illegible]	35mA
BTW43-600G -800G -1000G -1200G	TO 64 metal (Metric thread)	12A	600V 800V 1000V 1200V	120A	50A/µs	50V/µs	10V/µs (5A/ms)*	2.5V	100mA
BTW43-600H -800H -1000H -1200H		Same as BTW43-600G to BTW43-1200G series shown immediately above except for commutation					10V/µs (12A/ms)*		
BT139-500 -600	TO 220 plastic	15A	500V 600V	115A	50A/µs	50V/µs	4V/µs (8A/ms)*	1.5V	35mA
BTX94-400H -600H -800H -1000H -1200H	TO-48 metal (UNF thread)	25A	400V 600V 800V 1000V 1200V	250A	50A/µs	100V/µs	30V/µs (25A/ms)*	3V	150mA
BTX94-400J -600J -800J -1000J -1200J		Same as BTX94-400H to BTX94-1200H series shown immediately above except for commutation					30V/µs (50A/ms)*		
BTW41-500G -600G -800G	SOT 80 plastic	40A	500V 600V 800V	260A	50A/µs	100V/µs	5V/µs (12A/ms)*	1.5V	75mA
BTW41-500H -600H -800H		Same as BTW41-500G to BTW41-800G series shown immediately above except for commutation					5V/µs (23A/ms)*		
BTW34-600G -800G -1000G -1200G -1400G -1600G	TO 103 metal (Metric thread)	55A	600V 800V 1000V 1200V 1400V 1600V	400A	50A/µs	200V/µs	30V/µs (25A/ms)*	2.5V	200mA
BTW34-600H -800H -1000H -1200H -1400H -1600H		Same as BTW34-600G to BTW34-1600G series shown immediately above except for commutation					30V/µs (.0A/ms)*		

(1) For derating curves see individual data sheets. *The figures in brackets following the dV_D/dt rating show the $-dI/dt$ of the preceding turn off.

For further information contact Philips Electronic Components & Materials or their distributors.

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- AUDIO MIXER
- VCO
- Sub-oscillator
- Noise Generator
- Ext Sig
- Overload Indicator
- NOISE GENERATOR
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- Cutoff Frequency Control (5 Hz-20KHz)
- Resonance (Min-Self Oscillation)
- ENV-1 Control Depth
- Modulator
- KYBD Control
- Envelope Follower Control
- VCA (Voltage Controlled Amplifier)
- Hold Control
- Envelope Switch (ENV-1/ENV-2)
- ENVELOPE GENERATOR 1
- Attack Time Control (1.5 msec-2.5 sec)
- Decay Time Control (1.5 msec-8 sec)
- Sustain Level (0-100%)
- Release Time (1.5 msec-8 sec)
- Gate Trigger Selector Switch (Gate + Trig/Gate/LFO)
- ENVELOPE GENERATOR 2
- Attack Time Control (1.5 msec-3 sec)
- Release Time (1.5 msec-8 sec)
- Gate Selector Switch (Gate/LFO)
- Modulator
- Mode Switch (Random / ∼ / ∿)
- Rate Control (0.2 Hz-25Hz)
- Delay Time Control (0-3 sec)
- Rate Indicator
- Controller
- KYBD/Ext CV GATE Selector Switch
- Total Tuning (+700 cents or over)
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- Total Volume
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- External Control Voltage Input Jack (1 V/1 Oct)
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SOUND

Garrard MRM 101

GORDON KING examines the new Garrard Music Recovery Module for ETI. This machine is designed to remove the transient noise created by damaged grooves on an LP. How effective is it and how does it work? Read on . . . . .

THIS INTERESTING BRITISH innovation is a small, self-contained, mains-powered unit designed for connecting between the left and right outputs of a magnetic pickup and the left and right auxiliary or tuner inputs of a hi-fi amplifier. The unit processes the signals passing through it so that the disconcerting clicks produced by badly scratched records are virtually eliminated. In other words, the unit can be regarded as a record 'scratch remover'.

The basic principle of operation is fairly straightforward. The clicks are processed to form large amplitude pulses which are then applied to an electro-optical fader, which, at the precise moment of the clicks, severely attenuates both audio channels, thereby exchanging the clicks for very short periods of 'silence'. Record clicks have a fast rise-time and the effective slewing-rate is determined by the primary parameters of the cartridge, which are the effective tip mass, compliance and, to some extent, the mechanical resistance or damping of the cartridge.

Provided that the attenuation is large enough, that it switches on and switches off swiftly enough just to straddle the periods of the clicks and that is is accurately synchronised to the occurrence of the clicks in the audio channels, then the effect is singularly dramatic — the loss of information during the time of the attenuation appears to be of little subjective moment.

The effect is akin to tape dropouts, but it appears to be less affected by the accompanying S/N ratio impairment of these. Experimental work has suggested that provided the period of program loss or attenuation does not exceed about 10 ms, then the result is not unduly obtrusive subjectively. The attenuation period of the MRM-101 is a trifle above 2 ms hence the gaps come and go unnoticed.

Built to A Standard

The unit is built into a shallow enclosure and the front forms a brushed aluminium fascia carrying three controls and three light emitting diodes (LEDs). One control is for power on/off, another for suppressor on/off and the third provides a continuous threshold adjustment for the suppressor action. In use, this is set for the best subjective improvement in reproduction.

If the control is too far advanced music peaks as well as scratch clicks may be processed; if insufficiently advanced only very large amplitude scratch clicks will be processed. It is easy to determine the most desirable setting because one of the LEDs flashes each time a scratch is detected. Thus, when playing a record of given mutilation the control is slowly turned up until the suppressor activity LED flashes on all the significant scratches yet remains unaffected by high-frequency music peaks. Another LED merely glows when the mains is switched on, while the third LED signifies that the suppressor mode switch is on.

The rear is equipped with 'phono' type and DIN input and output sockets, making it is a simple matter to connect

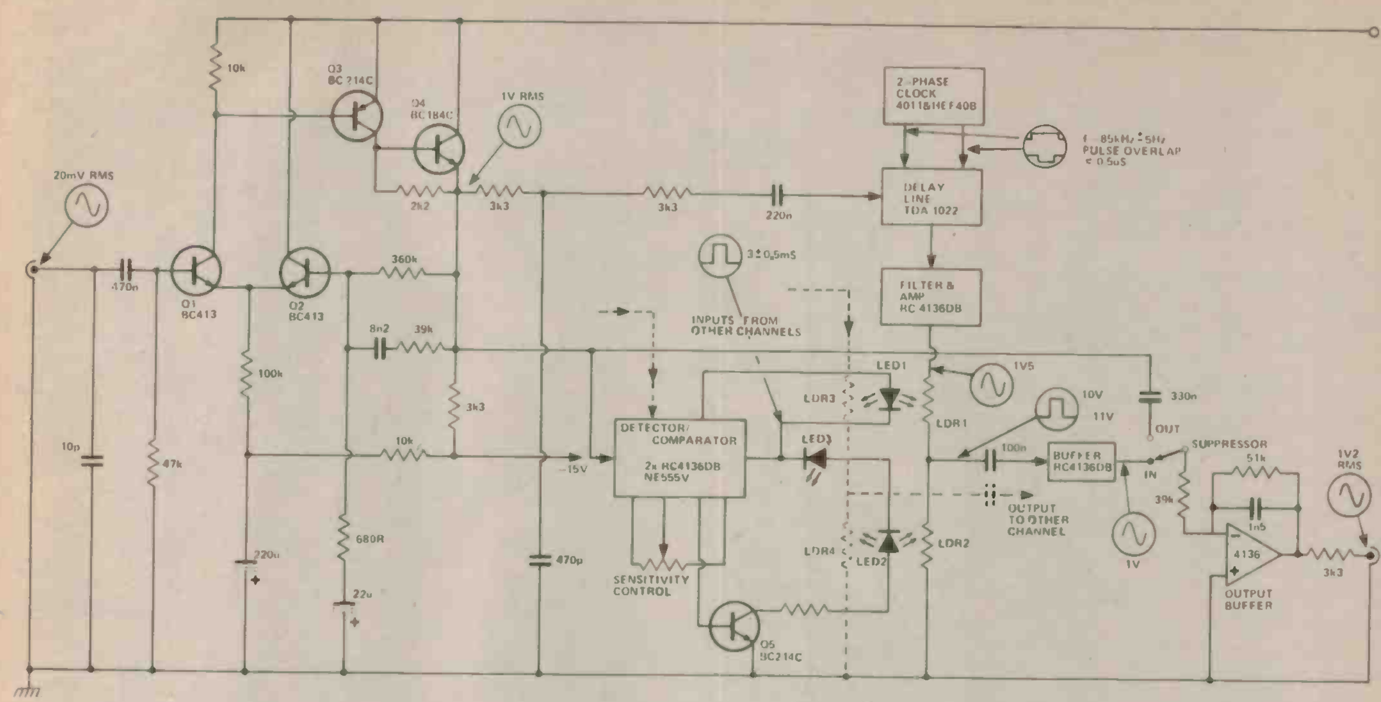
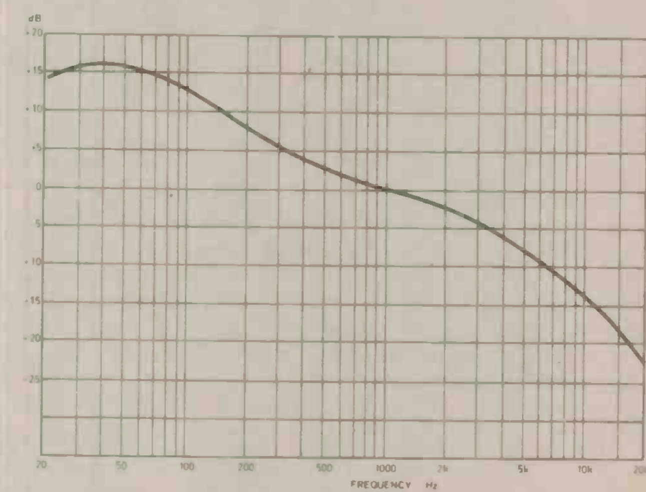


Fig. 1 (above). The block diagram of the Garrard click eliminator, MRM101. The pickup amplification and equalisation stages were found to give a very high quality signal output. Note the use of a 4136 quad op-amp.

Fig. 2 (right). RIAA equalisation curve for the unit. Channel balance was an excellent 0.25 dB!



the unit to virtually any contemporary hi-fi amplifier. There is sufficient output to drive a power amplifier direct, but to control the volume this would need its own volume control. Not all power amplifiers are equipped with a volume control, so it is a pity that Garrard did not see fit to include an output gain control. When driving from the unit direct to our power amplifier high quality reproduction was achieved.

Operations

Operation of the unit can be appreciated from the diagram of fig. 1. This is partly schematic and partly in *simplified* block format. With the suppressor off, the signal is directed from the output of the front-end, which is a partly equalised preamplifier composed of Q1-Q4, to the output buffer amplifier (RC4136DB), which provides the remainder of the RIAA equalisation.

Equalisation of the front-end is provided by the usual frequency-selective feedback arrangement which gives the 'bass boost' requirements of 3180 and 318 μs. The 75 μs de-emphasis equalisation is provided by the 51k resistor and 1n5 capacitor in the feedback path of the output buffer. The circuit as a whole is also engineered to cater for the more recent IEC-98/4 specification corresponding to a 20 Hz additional turnover, equivalent to a time-constant of 7950 μs.

A Gain Gained

Front-end gain is about 34 dB at middle frequencies and an extra 1.6 dB is provided by the output buffer. The circuit has some desirable aspects, including the differential input stage Q1, 2 and the 'Darlington' stage Q3, 4 which provides a high input impedance and low output impedance from Q4 emitter. Operating in the 'suppressor off' mode extremely good quality pickup signals are obtained.

The split equalisation, where the de-emphasis is provided at the output, helps to provide a high S/N ratio, and the circuit overall demonstrates an input overload threshold of about 37 dB at 1 kHz ref. 2 mV input.

Accuracy of the overall RIAA equalisation is revealed by the pen chart response in fig. 2. This is maintained within 0.25 dB between the left and right channels over the entire spectrum. With the suppressor on the accuracy is almost the same, but our sample did exhibit a very mild error round 15 kHz which was subsequently proved to be caused by a poor tolerance component. The tolerance in this area is being tightened by the manufacturer.

To the onset of peak clipping the amplifier is capable of providing an output of 9 V RMS at middle and low frequencies, with adequate reserve up to 20 kHz resulting in an output slewing rate of round 0.15V/μs, which will accommodate all disc material played on top-flight pickups. With the suppressor active the output is reduced by approximately 10 dB, but this is still more than adequate, even when driving direct to a power amplifier. The measured S/N ratio was 75 dB (CCIR/ARM weighting) ref. 7 mV RMS input.

Lines of Frequency

The spectrogram in fig. 3 gives an excellent impression of the spectra purity with a 200 Hz signal of 2V RMS *output level.* Ripple components are below our measuring floor of −90 dB,

and the only harmonic of significance is the 2nd at −79 dB, corresponding to 0.0112%!! With the suppressor active the distortion is greater, as shown by the spectrogram in fig. 4, again at 2V RMS output. The 2nd harmonic again predominates, but this time it is −50 dB (0.3%). The 3rd harmonic is down at −59 dB (0.112%), while all subsequent harmonics are at levels of insignificance.

The relatively high value of 2nd harmonic distortion is not disconcerting. Indeed, recent tests have suggested that a controlled amount of even-order non-linearity can, in fact, enhance rather than detract from the reproduction.

There seems to be a tendency for it to 'disguise' the heavy odd-order distortion carried by some program signal sources, including gramophone records, and that this can lead to improved auditioning of some highly specified transistor amplifiers – owing to the resulting 'valve type sound', no doubt!

Circuit Examination

Looking now at the circuit in fig. 1 with the suppressor active, it will be seen that the signal from the front-end is directed two ways. One way is to delay line (TDA1022) and the other way is to the detector/comparator (2xRC4136DB and NE555V).

The detector recognises the whole waveform of a scratch and isolates it from the peaks of the recorded music. Two monostables (one in the NE555V and the other the bipolar transistor Q5) are switched by the scratches to generate pulses of about 3 ms duration and 10 V amplitude (shown on the diagram). These pulses are then caused to operate LEDs 1 and 2, which are optically coupled to two pairs of light dependent resistors (LDRs). One pair relates to the right channel and the other pair to the left channel. Just one channel is shown in the diagram.

The LDRs associated with the other channel are drawn in broken line, as also are the inputs and output of the other channel.

Each pair of LDRs forms an attenuator (called a fader) and is arranged to control the level of the audio signal emanating from the delay line prior to the signal arriving at the first buffer (RC4136DB). This part of the circuit is deliberately simplified for the sake of description, but in practice the degree of attenuation amounts to some 50 dB in the audio signal channels each time a pulse occurs.

Now, since it takes a little time for the pulses fully to develop, the signals in the audio channels proper need to be delayed slightly so that the scratch pulse on the music signal arrives at the fader at exactly the same time as the pulse created by the detector and associated circuits.

Hold it a Minute

The delay is provided by a 256-stage TDA1022, which is two-phase-clocked by a pair of ICs, HEF4011 and HEF40B. The clock is running at 85 kHz, and the overlap of the two associated waveforms (shown in the diagram) ensures the required delay time. The net result is that each time a scratch click occurs the audio channels are faded by about 50 dB for a period a shade over 2 ms.

This straddles the time of the 'real' scratch click, thereby eliminating it.

LED3 is the suppressor activity indicator on the fascia which, being in series with a fader LED, flashes in sympathy with the suppressor action.

The detector circuit includes auto and manual threshold control, while a filter in the amplifier IC, RC4136DB, following the delay line eliminates the spikes and spurious signals

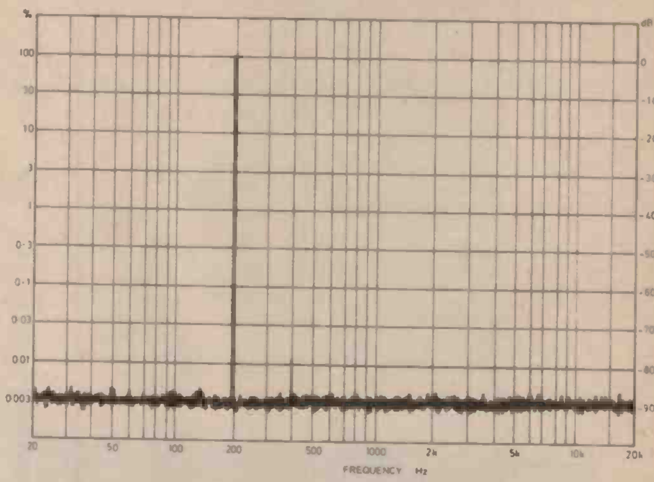


Fig. 3 Spectrogram of the 200 Hz drive signal, suppressor switched out.

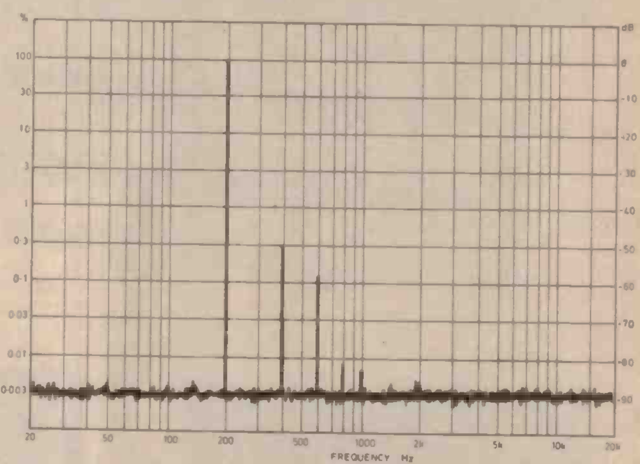


Fig. 4. Spectrogram of the 200 Hz drive signal with the suppressor active.

produced by the delay line action. It should be noted that although the maximum clipping output is less in the suppressor mode than in the direct mode, the gain of the amplifier sections remains the same in both modes.

It is thus possible to achieve A/B comparisons without level change by switching between the two modes.

Successful

The sample unit has been operating very successfully for several months under typical domestic conditions in our test hi-fi system. It certainly removes the very disconcerting staccato clicks caused by badly scratched records.

It does not, however, remove the general background noise from worn or dirty records.

Such noises occur in almost continuous manner, so advancing the threshold control to achieve a response to these noises would lead to the elimination of a substantial proportion of the music.

Operated as the designers intended, the unit constitutes a valuable item of record playing hardware which, at the probable selling price of $190 or so, would soon pay for itself, records costing what they do today.

In spite of the rise in distortion with the suppressor active,

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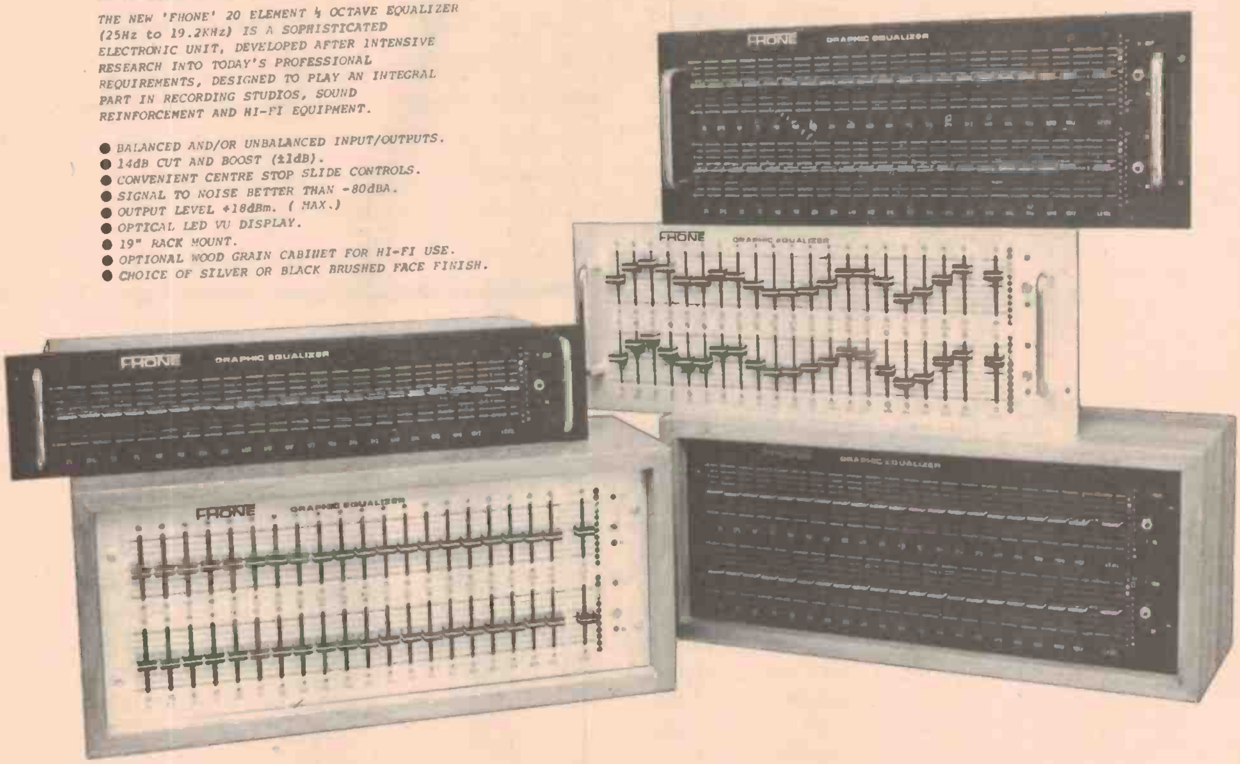

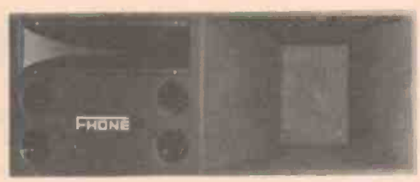

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the reproduction is very satisfying provided the threshold control is not over-advanced.

In the suppressor off mode, the unit can be regarded as a top-flight RIAA-equalised preamplifier of potentially high audio output which could, if required, be connected direct to a power amplifier, thereby bypassing the circuits and tone controls of conventional preamplifiers, which are regarded by some enthusiasts as an impairment to 'musicality'.

Cable Feedback

Although acoustical feedback (below the howl-round threshold) is currently being blamed for one aspect of adverse auditioning of some record decks, we have recently isolated other, probably more important, causes of auditioning differences.

We have discovered that signal from the power amplifier section can get back to the high gain pickup input via a common impedance or by magnetic induction (from the loudspeaker cables, for example) or electrostatic coupling somewhere.

The degree of response to the delayed spurious signals of this nature can be *as great as, if not greater than, the spurious and delayed signals attributable to mild acoustical feedback!*

Perhaps this is one reason why the 'special' loudspeaker and source cables are receiving acclaim, because the improved shielding of these cables is reducing the amount of signal back-coupling.

During experiments with the MRM101 we found that by using this unit for disc signal amplification the degree of back-coupling was substantially reduced with respect to certain integrated power amplifiers. Food for thought at least . . .

Garrard are represented in Australia by *Studio Electronics Pty Ltd, Box 1055, Burwood North, NSW 2134,* who will supply further information on request.

SOUND BRIEFS

Servo Tone Arm

Sony has developed a new **electronically controlled tone arm** using servo mechanisms instead of counterweights and springs to apply tracking and antiskating forces. Motion-sensing transducers generate signals which enable the servos to compensate for arm-cartridge resonances and record warps. Production is believed to have commenced – or at least be about to. Price with turntable is expected to be $750 – $1,000.

Mini Audio

Expect to see a number of companies producing **mini-size audio components**. Technics have already produced such a range – shown at the 1978 CES in Sydney – meanwhile Pioneer, Yamaha and Sanyo are all reported to be developing such equipment themselves. Philips are also preparing to launch their 110 mm (4 1/3") **super-fi digital minidisc**.

AGS has Strathearn Agency

Strathearn Audio Ltd (Belfast Northern Ireland) has appointed AGS Electronics in Sydney as their **sole distributor in Australia**.

Products to be marketed here initially include Strathearn's budget-priced ST 400 turntable, their **high-technology SM2000 turntable** and the recently introduced Twenty-one Thousand speaker system.

This speaker system has a very unusual mid-range high frequency driver which uses a **lightweight Mylar membrane** stretched across a moulded frame. A conductive (aluminium) strip is bonded to the membrane, and the magnetic field provided by rows of bar magnets on either side of the frame. As the membrane is driven uniformly over its entire radiating surface – from 500 Hz to beyond 20 kHz, **phase remains constant** throughout this range.

The system uses two low frequency enclosures plus two of the mid-range/high frequency units described above.

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Writing For ETI

ABOUT A THIRD of the articles published in ETI are written by outside contributors. Some of these contributors are full-time technical writers, others write in their spare time and might send in just one article a year. Some are academics who, like our special correspondent Associate Professor Sydenham, appreciate that it *is* possible to write for a popular magazine like ours without losing status.

Most published articles are commissioned. Every now and again we'll publish an unsolicited article but that's rare. If you think you've got a good idea for an article, it's best to telephone ETI's editor (Les Bell: (02) 33.4282) and tell him what you have in mind. If the matter seems of interest he'll probably suggest you send in a synopsis together with something you've previously had published - or at least a few sample paragraphs of whatever you have in mind.

All magazines have various criteria for accepting or rejecting outside material. Conventions we at ETI require our contributors to conform to are:

1. You must know what you're writing about. If we have to check out the basics of your article then it's quicker, easier and cheaper to write it ourselves!

2. Unless you are VERY, VERY GOOD your copy must be typewritten using double spacing and wide margins. That's even more important to us than a contributor's odd spelling or grammatical error.

3. DON'T get *too* hung up about grammatical errors. Grammar is largely linguistic good manners. If you're a *real* slob it'll probably show up in your writing! (Minor slobbery we'll fix!)

4. We use the Systeme Internationale, except for the odd unit which slips through. We expect contributors to do at least as well.

5. Photographs, where applicable, *must* be in focus. Ideally they should also be of high contrast, black and white, printed on gloss paper. Generally we cannot reproduce previously published pix - firstly the copyright almost certainly belongs to someone other than the contributor - secondly, unless they are printed exactly the same size, Moire fringe patterns will be formed as one set of dots doesn't *quite* coincide with another.

6. Line drawings must be similar in style to those used throughout the magazine. Circuit drawings are almost always redrawn by our staff artists.

Constructional Project Articles

Constructional projects are occasionally accepted. This type of contribution poses unusual problems. To a really experienced professional design engineer, the actual circuit design and development is the easy bit. Most of the cost and effort lies in preparing that design for publication.

We are *always* interested in hearing from prospective project contributors. And we pay very well indeed for the material which we accept. But please believe there's a very great deal more to this part of the magazine than sitting down with a soldering iron and a handfull of bits.

Again, before getting down to serious writing it will pay to ring the editor and discuss the proposed project.

An ETI staff artist pastes up pages.

What's it Worth?

With the exception of press releases, contributed material is always paid for. The rate varies. It depends on the amount of work that has gone into the article - naturally qualified by how much we feel readers will value/enjoy it. And it also depends on the amount of work we need to do to it ourselves before it can be published.

Press Releases

With very few exceptions, technical press releases from public relations companies are so incredibly incompetent and inept that one of these days we're going to print a page-full as they are received just so the agencies' clients and our readers will believe it themselves!

There are about three good technical agencies in Australia. If you care enough about your press releases you probably know who they are. If you are not using one of these agencies then we suggest you write your own press releases.

Our rules for press releases are these:

a) Please don't put everything in upper case (capitals). Especially don't use upper case everytime you mention the product name or characteristics.

b) Don't keep plugging the manufacturer's name.

c) Write — 'the manufacturer *claims* that the product has etc'. Don't say, 'the product *has*'. We can't print a statement like that as our readers may think that ETI has made the statement.

d) Most people want to know what a product is and if they can use it - clear, factual, helpful information is more likely to be read rather than lists of specs that the reader mightn't understand.

e) Do please include an address to which enquiries may be addressed - or wherefrom goods may be purchased.

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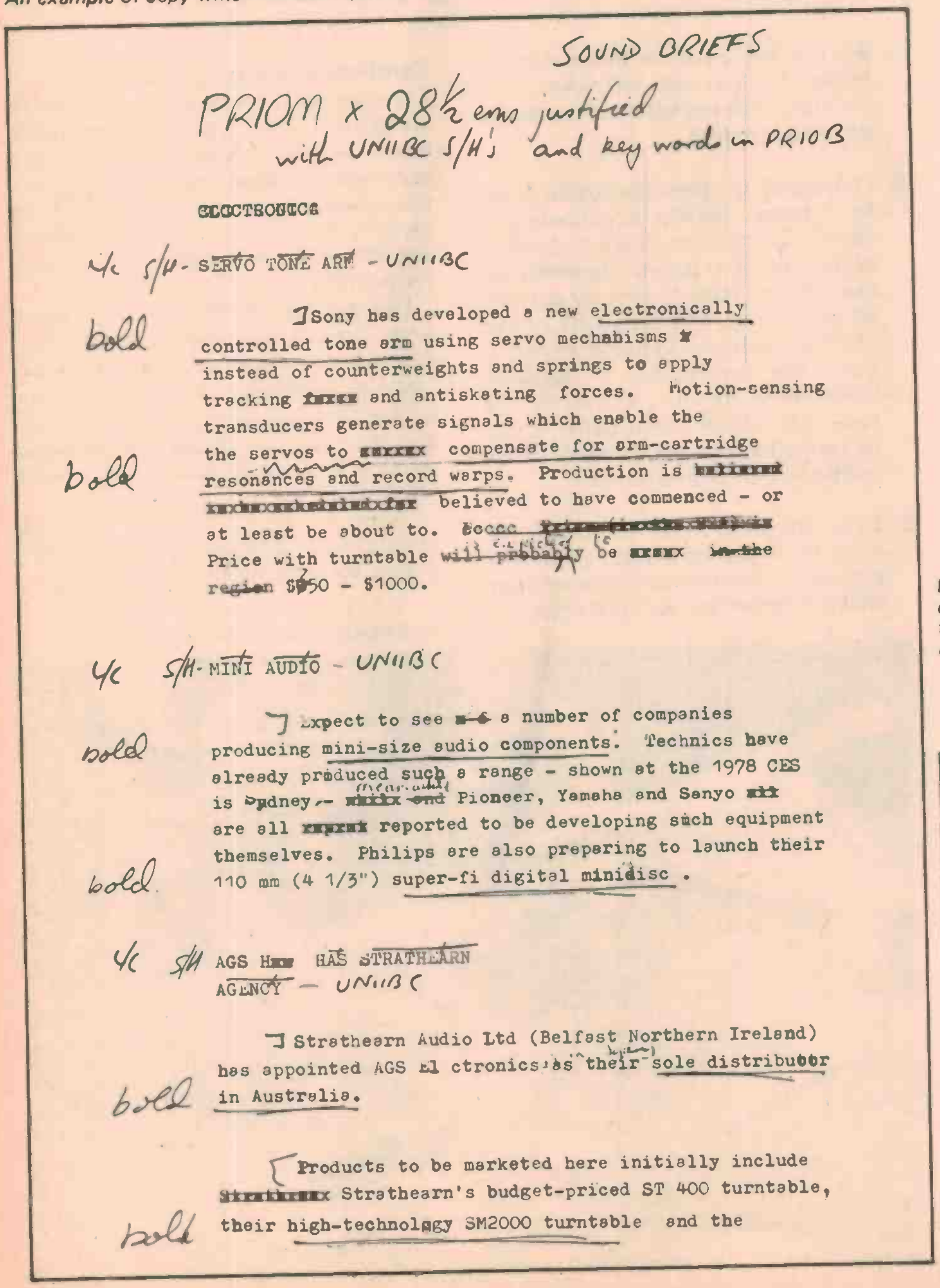
SOUND BRIEFS

PRIOM x 28½ ems justified
with UNIIBC S/H's and key words in PRIOB

ELECTRONICS

l/c S/H - SERVO TONE ARM - UNIIBC

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Sony has developed a new electronically controlled tone arm using servo mechanisms instead of counterweights and springs to apply tracking and antiskating forces. Motion-sensing transducers generate signals which enable the the servos to compensate for arm-cartridge resonances and record warps. Production is believed to have commenced - or at least be about to. Price with turntable is expected to be ~~in the~~ ~~region~~ $750 - $1000.

bold

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bold

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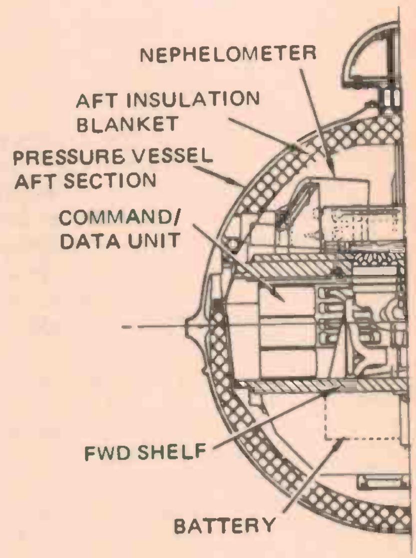
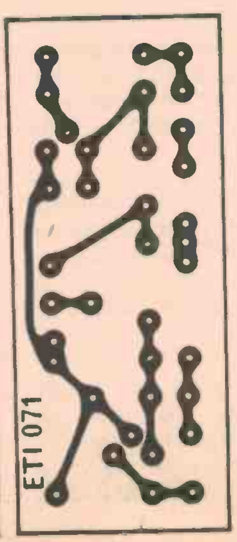
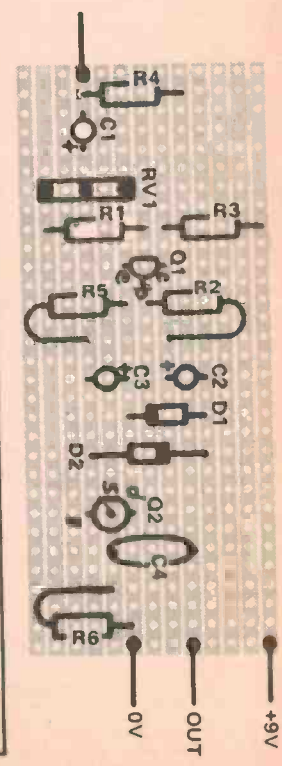


We don't expect drawings to be done to this standard - just clear roughs will do.





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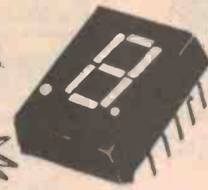

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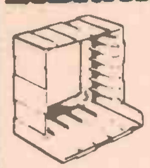

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PARTS FOR NEW KITS

CAR STEREO BOOSTER AMPLIFIER (See January EA)

Complete kit, including instructions .... Cat K-3493 $29.50

SEPARATE PARTS:

PC Board (only) .... Cat H-8356 .. $3.50
TA7214P IC .... Cat Z-2504 .. $7.00
Zippy Box .... Cat H-2752 .. $3.75

PLAYMASTER AM/FM TUNER (See Nov/Dec EA)

Complete kit, including instructions .... Cat. K-3494 .. $159.50

SEPARATE PARTS

Pre wired and aligned tuner module .... Cat. F-4610 .. $59.00
Set of 4 PC Boards .... Cat. H-8357 .. $9.75
Signal strength meter .... Cat. Q-2100 .. $4.95
Tuning meter · centre zero .... Cat. Q-2095 .. $4.95
Most other electronic parts for this project in stock.

MODEL TRAIN CONTROLLER (See October EA)

Not produced as a kit — all parts available from stock:

PCB only .... Cat. H-8355 .. $3.75
Zippy box .... Cat. H-2752 .. $3.75
2N3055 transistor .... Cat. Z-2145 .. $0.95
2N3053 transistor .... Cat. Z-2130 .. $0.80

UNIVERSAL MOVIE MIXER (See September EA)

Complete kit, including instructions .... Cat. K-3492 .. $49.50

SEPARATE PARTS:

PC Board (only) .... Cat. H-8354 .. $2.95
50k A curve 45mm slider pot .... Cat. R-1980 .. $0.85
Knobs to suit slider pot .... Cat. H-3780 .. $0.40

FET INPUT AC-DC VOLTMETER (See September EA)

Not produced as a special kit · all parts available ex-stock:

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1mA MRA-65B panel meter .... Cat. Q-2060 .. $12.50
Fabricate your own meter scale using the Scotchcal process:
8005 black Scotchcal photo-sensitive aluminium .. Cat. H-5694 .. $6.00
CA-3140 FET op-amp .... Cat. Z-5417 .. $2.50

VARI WIPER Mk 2 (See September ETI)

Not produced as a kit · most parts available from stock:

Relay .... Cat. S-7125 .. $4.80
C106YI SCR .... Cat. Z-4315 .. $1.00
2N2646 (DS2646) unijunction .... Cat. Z-1786 .. $1.20

UPGRADED 40/200MHz FREQ. COUNTER (See August EA)

Same style as previous kit, but new circuitry means it is easier to build, set up and is more sensitive. Basic counter is 40MHz — by adding a single 95H90 IC the range is extended to 200MHz.

Complete kit for 40MHz, inc. instructions .... Cat. K-3437 .. $99.50
95H90 IC to extend range to 200MHz .... Cat. Z-5360 .. $12.50

SEPARATE PARTS:

PC Boards (set of two high quality boards) .... Cat. H-8346 .. $8.50
MC-10116L IC (triple differential amplifier) .... Cat. Z-5415 .. $1.95
MM-5369M IC (oscillator · divider) .... Cat. Z-5781 .. $7.50
74C926 IC (4 digit counter) .... Cat. Z-5414 .. $6.50
3.579545MHz crystal (new low price) .... Cat. K-6031 .. $3.00
LT-303 7 segment display .... Cat. Z-4103 .. $1.50
All other components are normal stock lines at all of our stores.

NEW 10 GAME TV GAME KIT (See July EA)

Complete kit, including instructions .... Cat. K-3491 .. $49.50

SEPARATE PARTS:

PCB (only) .... Cat. H-8344 .. $3.95
Fully built RF modulator .... Cat. K-6040 .. $3.00
Fully built audio modulator .... Cat. K-6042 .. $4.50
AY-3-8600 IC .... Cat. Z-6852 .. $15.00

TANK TV GAME (See October ETI)

Complete kit, including instructions .... Cat. K-3475 .. $39.50

SEPARATE PARTS:

PCB (only) .... Cat. H-8620 .. $3.85
AY-3-8710 IC .... Cat. Z-6856 .. $17.50
Fully built RF modulator .... Cat. K-6040 .. $3.00
Fully built audio modulator .... Cat. K-6042 .. $4.50

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D&G Sales	44 Brown Road, Newcastle NSW. Ph 691-222
GM Electronics	99 Fitzmaurice St, Wagga NSW. Ph 21-3044
Trilogy Elec. Supplies	40 Princes Hwy Fairy Meadow NSW Ph 83-1219
Crystal TV Rentals Pty Ltd	66 Crystal St, Broken Hill NSW. Ph 6897
Lismore Kitronics	Magellan St & Bruxner Hwy Lismore NSW Ph 878-361
Langman's Sound Centre	Shop 15, Treasure Island, Coffs Harbour Jetty NSW. Ph 521-570
Sumner Electronics	95 Mitchell Street, Bendigo VIC. Ph 43-1977
Citcom Electronics	Hopkin's Arcade, West St, Mt Isa QLD. Ph 434-791
ADS Electronics	312 Oxley Ave, Margate QLD. Ph 204-1276
Advanced Electronics	5a The Quadrant, Launceston TAS. Ph 31-7075
Aero Electronics	123a Bathurst St, Hobart TAS. Ph 34-8232
Hutchesson's Comm. Centre	5 Elizabeth St, Mt Gambier SA. Ph 256-404
Gawler CB Centre	51 Hillier Road, Evanston SA. Ph 222-149
Altronics	105 Stirling St, Perth WA. Ph 328-1599
Hocks TV Rentals	87 Hannan St, Kalgoorlie WA. Ph 211-906

464/EA19

Project 141

LOGIC TRIGGER

Debug complex logic circuitry with this unit.

WHEN USING AN oscilloscope to examine or fault find digital circuitry, it is often desirable to see what happens just before a pulse or edge occurs. An example of this is when measuring the propagation delay in a ripple counter. Here it is easy to trigger on the last output but the edge of the counter input which initiated the change in the output may have occurred over 100 ns earlier. Even with the delay line built into modern oscilloscopes the edge is too early to see.

Triggering on the input waveform allows this edge to be seen but if the output pulse occurs only once every thousand or so pulses it will not be seen. With this unit, the output of all the stages in the divider can be examined and a pulse can be generated anywhere in the cycle. By selecting a pulse very close to, but before, the edge in question and using it to trigger the oscilloscope (use ext trigger) both the clock waveform and output waveform can be seen.

With the advent of microprocessors it has become increasingly difficult to fault find as things happen (e.g. the CE input to a memory may go low) only when a particular address is given. As the address bus is always in motion it is almost impossible to trigger the scope on any one address. Again with this unit the address bus is interrogated along with the necessary write or read lines, and its output can be used to trigger the oscilloscope only when the correct sequencer is received.

SPECIFICATION - ETI 141

Modes	Asynchronous or synchronous
No. of inputs	12 address, 1 clock
Loading	
address	0.4 UL (TTL)
clock	0.4 UL (TTL)
Pulse extension mono	10 ms
Pulse indication	LED
Minimum pulse detectable	<40 ns
Propagation delay	<45 ns
Trigger (synchronous)	positive or negative edge of clock input
Set up time (synchronous) address to clock	<40 ns
Output	logical "1" when input agrees with switch setting and/or clock (synchronous only)
Power requriement	+5V @ 50 mA

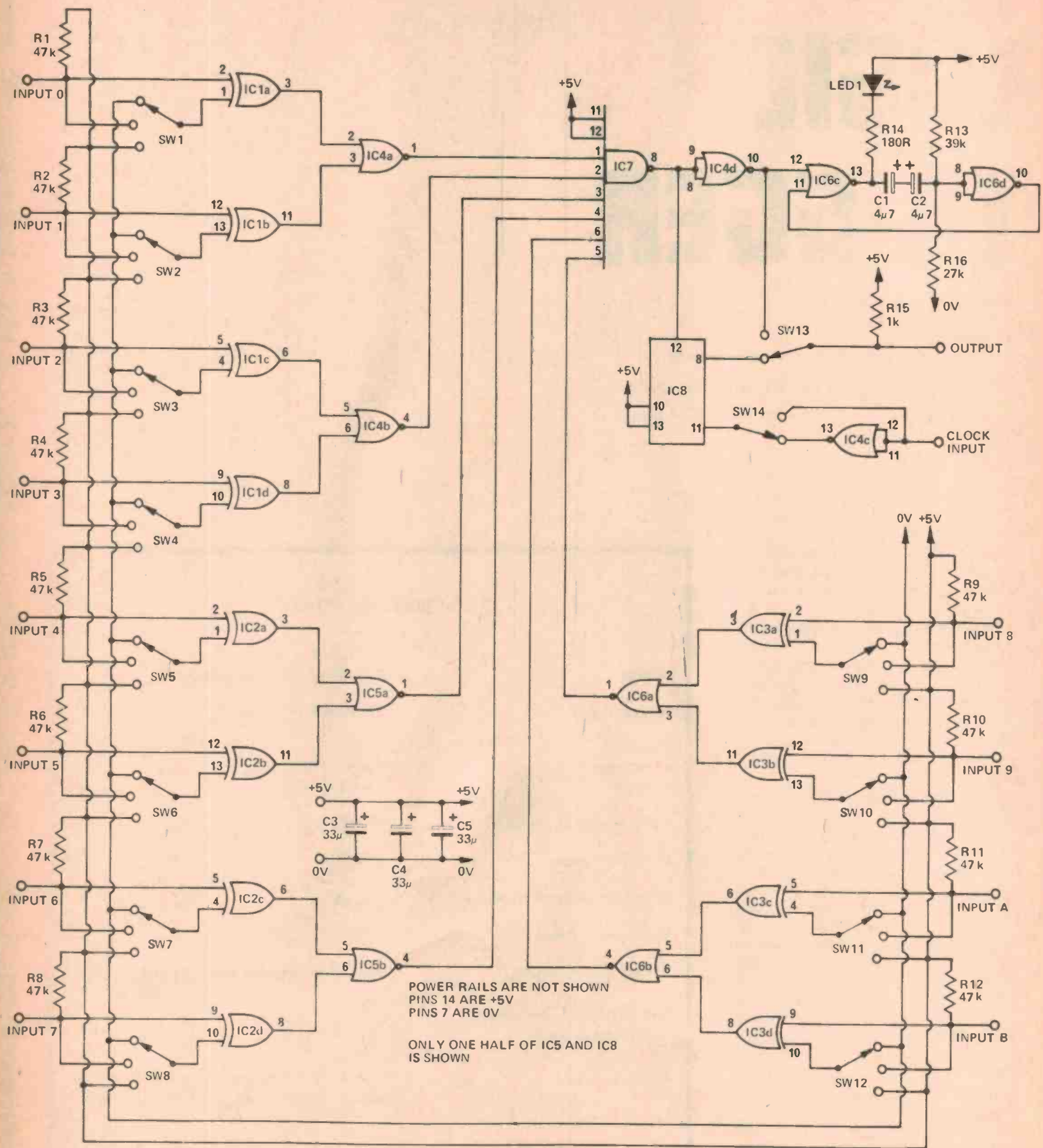


Fig. 1. Circuit diagram of the Logic Trigger.

PARTS LIST – ETI 141

Resistors all ½ W, 5%

R1–R12 . . . . 47k
R13. . . . . . . 39k
R14. . . . . . . 180R
R15. . . . . . . 1k
R16. . . . . . . 27k

Capacitors

C1,2 . . . . . . 4μ7 25V electro
C3–C5 . . . . . 33μ 16V tantalum

Semiconductors

IC1–IC3 . . . . 74LS86
IC4–IC6 . . . . 74LS02
IC7 . . . . 74LS30
IC8 . . . . 74LS74

LED 1 . . . . . Red LED

Miscelaneous

PC board ETI 141
Twelve 3 position slide switches
Two 2 position slide switches
Front panel
Box to suit

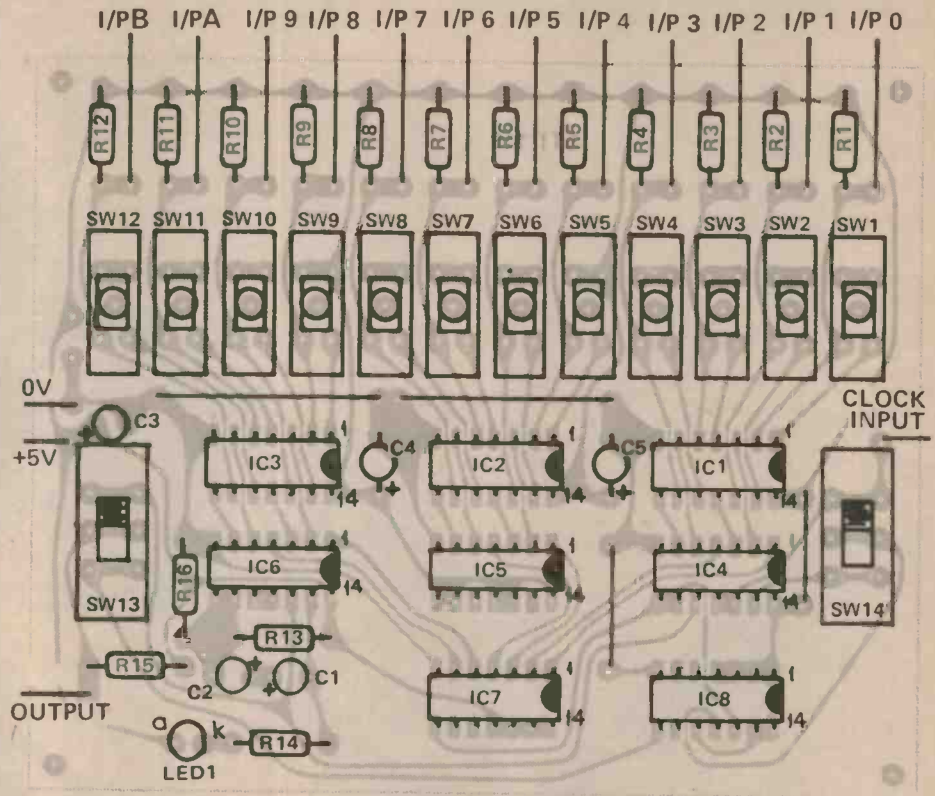


Fig. 2 Overlay of the PCB

HOW IT WORKS - ETI 141

The twelve inputs are compared to the levels set on the slide switches SW1-SW12 by the exclusive OR gates IC1-IC3. These ICs have a high output only if the two inputs differ. If they are the same, either both low or both high, the output will be low. If the two inputs are joined together, as when the switches are in the don't care position, the output will always be low.

The outputs from the exclusive OR gates are combined in pairs by the NOR gates IC4-IC6. If the 12 input signals match the preset selection, the output of all 6 NOR gates will be high. If any one is not in agreement with the selection one or more of the NOR gates will have a low output.

These NOR gate outputs are combined by IC7 which is an eight input NAND gate. The output of this gate will low only if all 12 inputs match. The output of this IC is inverted by IC4/d to provide the asynchronous output.

This output also triggers the monostable formed by IC6/c and IC6/d. This gives a 10 ms long pulse to light the LED indicating a pulse was received. If it is a steady state signal the LED will stay on.

The output of the NAND gate, IC7, also joins the data input of IC8 (D type flip flop). This IC is toggled on the positive edge of the clock waveform transfering the data to the output. This is the synchronous output. To allow for either positive or negative synchronization an inverter is used on the clock input and either polarity can be selected by SW13.

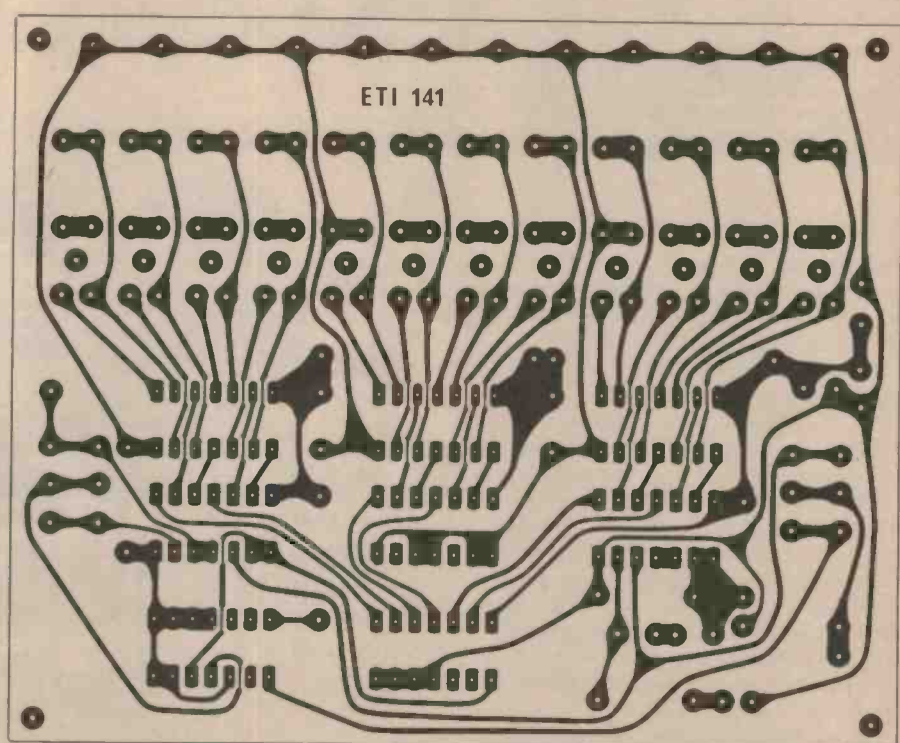


Fig. 3 PCB pattern shown full size.

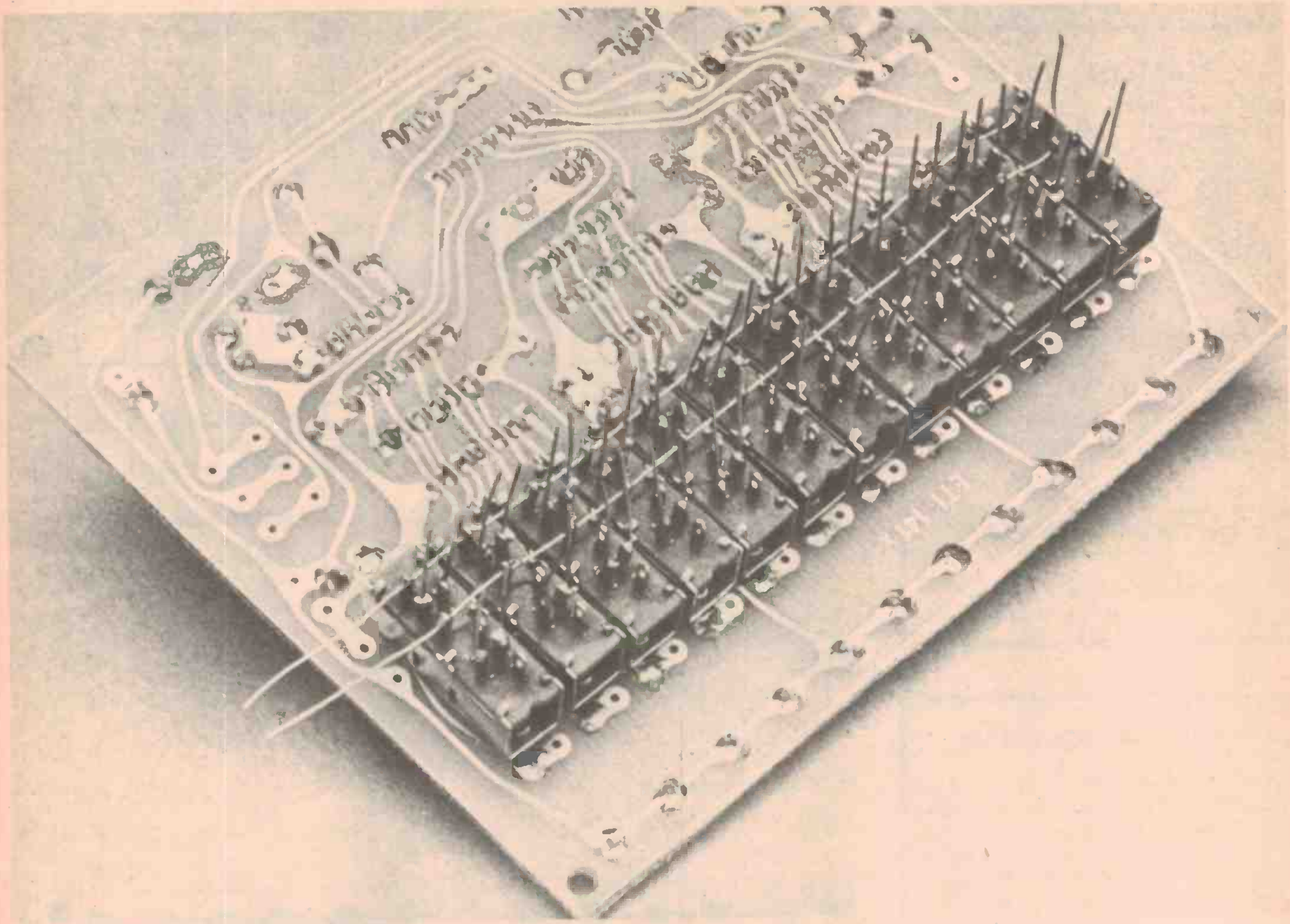
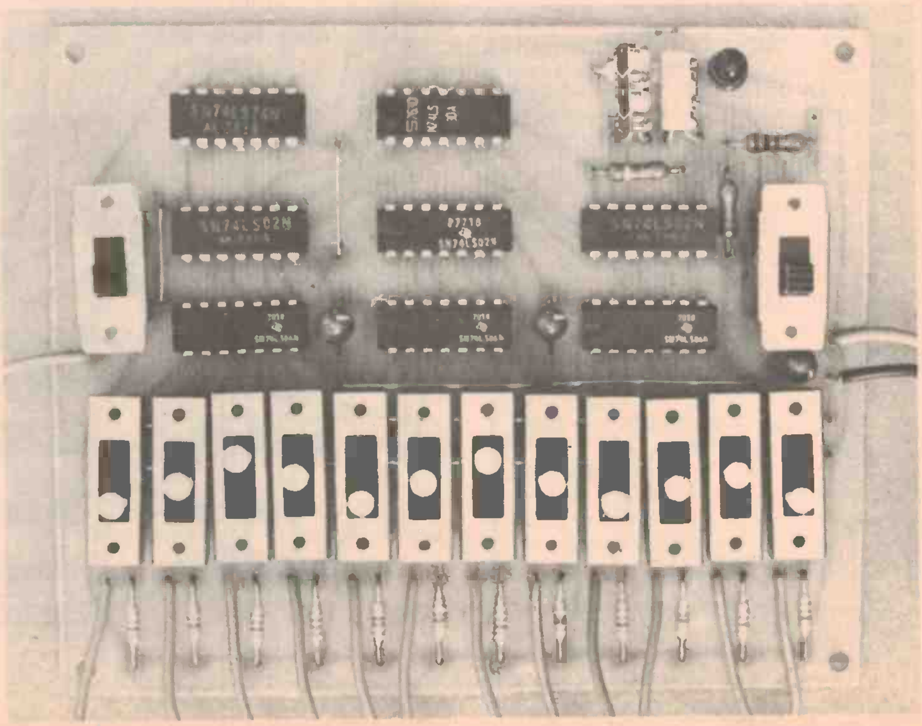


Photo showing how the slide switches are wired prior to installation. While our photo shows them on an assembled pc board it is best if they are wired before the board is assembled.



Construction

We mounted all the components on the pc board including the switches. The only difficult (fiddly) bit is the wiring of the three position slide switches which have to be preassembled before fitting to the pcb. The wiring is shown in fig.3.

To aid this we have provided 12 holes in the pcb the size of the toggle of the switches; if the switches are initially placed upside down in these holes the board will act as a template to provide the correct spacing. We have also used two wires of the second pole of the switch to provide mechanical support. While only a single pole switch is needed the only ones readily available (from Dick Smith) are two pole.

The swtiches can now be mated to the pc board with the two longitudinal wires being terminated in the holes provided at the end of the switch bank.

Project 143

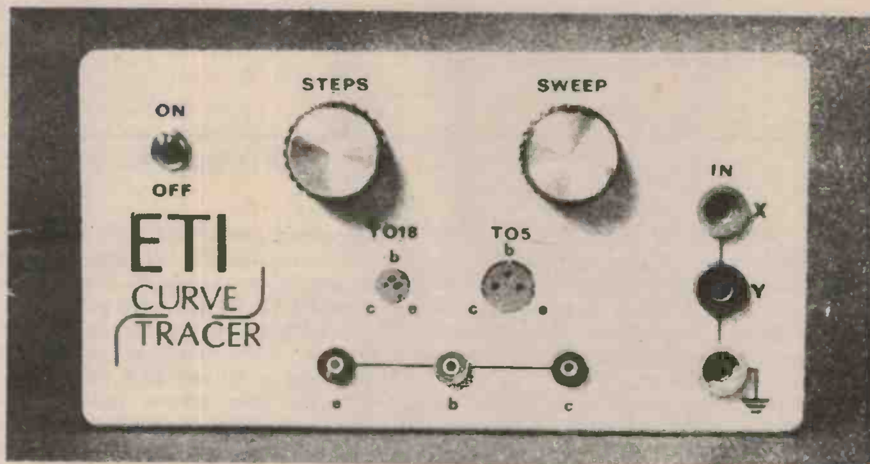
Curve Tracer

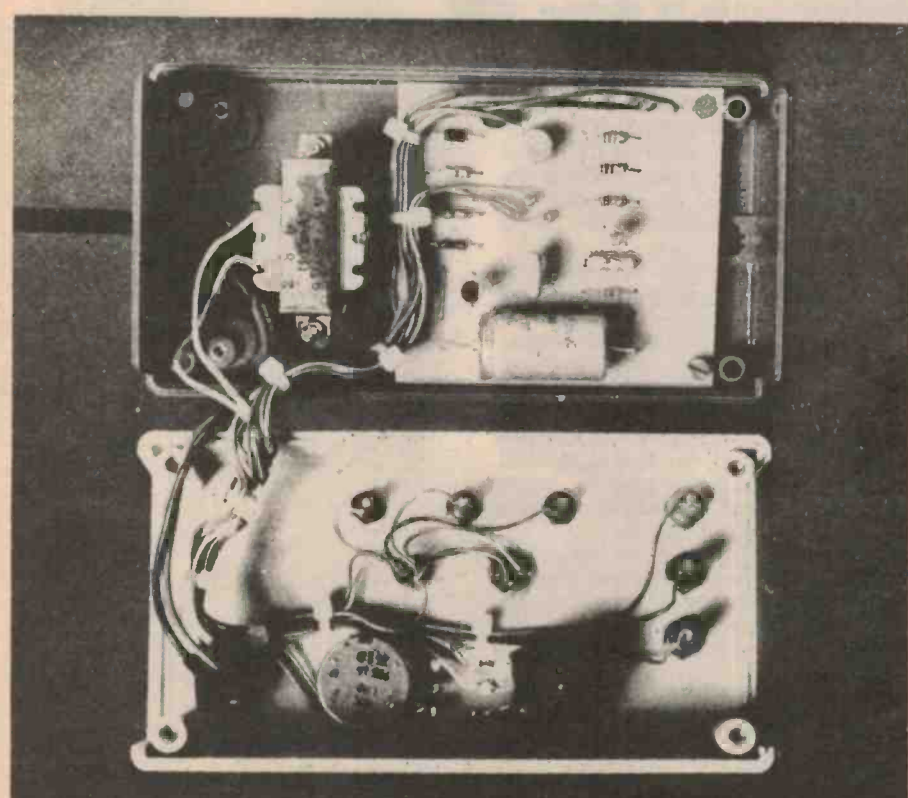
Display the dynamic characteristics of a variety of semi conductor devices with our curve tracer. Design by J. H. Adams.

THIS DESIGN WILL allow the dynamic voltage current characteristics of diodes and transistors to be displayed on the screen of a DC 'scope capable of taking an external X input.

The performance of the unit will not be up to that of a commercial machine. However the unit will give a good indication of the dynamic performance of a wide range of semiconductor devices (as the photograph shows) at a price that is a fraction of commercial equipment.

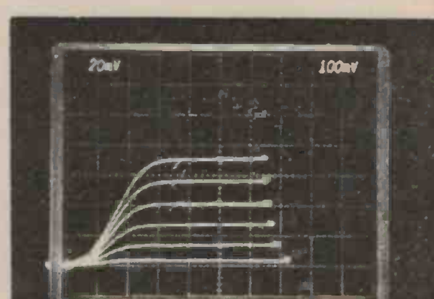
Construction of the curve tracer is straightforward. Mount all the components on the PCB according to the overlay. The internal layout of our prototype is shown in the photographs. The unit is mains powered and a battery supply is not suitable for this circuit.





Initially try the curve tracer with a high gain npn transistor, a BC108 will be ideal. Connect it to one of the tracer's sockets and connect the unit to the 'scope. Set the Y gain on the 'scope at maximum and set up the maximum required level of collector voltage by adjusting RV1. RV2 will control the number of steps displayed on the screen. The X sensitivity of the 'scope should be 1 V per division.

The performance of the unit is degraded by the slight drop in the DC potential on C1 during the 10 ms sweep and the slight effect of the 100 R sampling resistor, in that its volt drop is included in the observed collector potential.



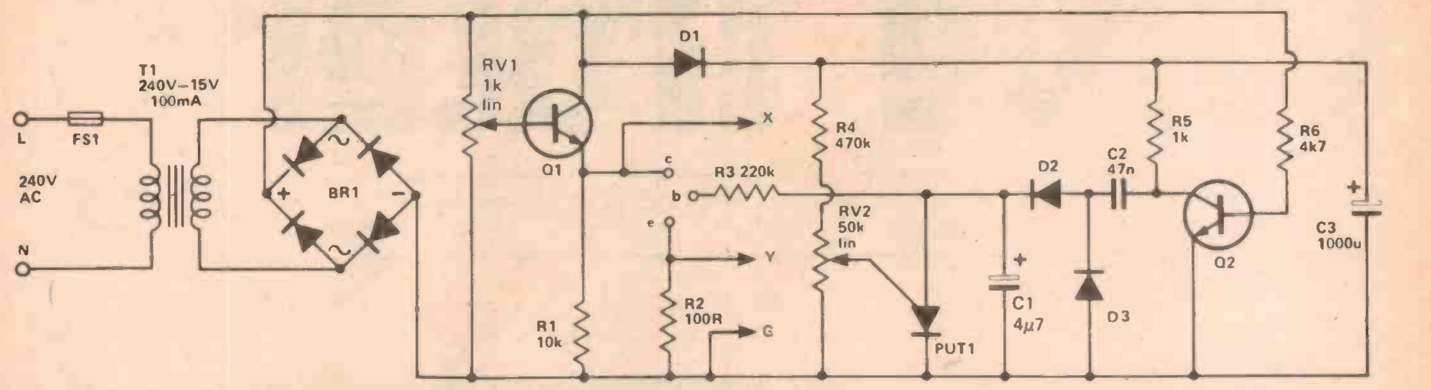


Fig. 1. Full circuit diagram of the curve tracer.

HOW IT WORKS – ETI 143

The principles of the full circuit can perhaps be best explained by consideration of a simpler form of the circuit. Figs. 2 and 3 show circuits for investigating the dynamic characteristics of a diode and transistor (at fixed base current) respectively.

The 'diode circuit' will, unless an inverter is available, produce a trace that will appear upside down.

Operation of this circuit is quite straight forward. RV1 allows the peak value of the AC supply to be adjusted. This is then applied to the device under test via a current limiting resistor as well as to the X input of the 'scope. The current flow in the device at any time is proportional to the voltage developed across a low value sampling resistor in the current path. This voltage is fed to the Y input of scope.

The simple transistor tester functions in much the same way. RV1 allows the base current to be adjusted within the range 10uA to 100 mA.

The characteristics of an N-Channel FET (2N3819) may also be examined with this basic building block. The output characteristics are displayed for a gate voltage selected by RV1. Transfer characteristics (gate voltage vs. Drain Current) may be shown by transferring lead X to the gate terminal and joining the 1000µF capacitor to the 15V supply (observing the change in polarity).

Moving now to the full circuit of Fig. 1 that allows a far more informative display providing, as it does, simultaneous displays of the characteristic curves for several equally spaced values of base current.

The circuit operates as follows: Every 10 ms the collector supply swings up and back, over a half cycle of the full-wave rectified supply. At the end of each half cycle, there is a short period during which the supply potential is below about 0.6 V, and during this time, Q3 turns off, sending a pulse from its collector into the charge store C1 C2 D3 D2. Each pulse increases the potential in C1 by approximately 0.2 V. This would go on until the potential on C1 and 20 V were if not for Q2, the little known and much misdescribed programmable unijunction transistor, PUT. This device is the semiconductor version of a neon lamp, insulating up to a certain p.d. and conducting heavily at potentials above this breakdown value, but with the added advantage that, through a third terminal, this breakdown potential is programmable over quite a wide range. Varying this control potential through the setting of VR2 sets the number of steps that will occur before the potential on C1 is great enough to make Q2 fire, reducing the capacitor's potential to approximately 0.6 V and so re-starting the sweep sequence.

The tracer can hardly be expected to match all the performance of a commercial curve tracer, the prices of which range into thousands of dollars. There are errors, due to the slight droop in d.c. potential on C1, and hence in base current, during the 10ms sweep, and due to the slight effect of the 100R sampling resistor, in that its volt drop is included in the observed collector potential, but as can be seen, these are quite insignificant as regards the final display.

A suitable transistor for the device under test is any reasonably high gain npn transistor, e.g. BC108. VR1 controls the maximum collector voltage, whilst VR2 sets the number of sweeps displayed. With the values given, the difference in base current between one step and the next is approximately given by:

$\frac{1}{5R}$ µA, where R is in megohms.

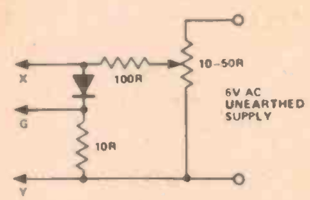


Fig. 2. Simple diode tester.

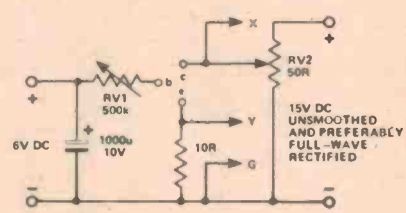


Fig. 3. Fixed current transistor tester.

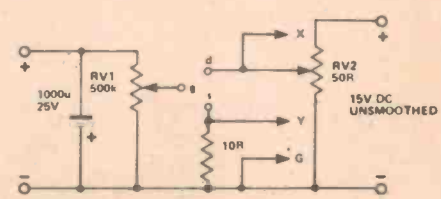
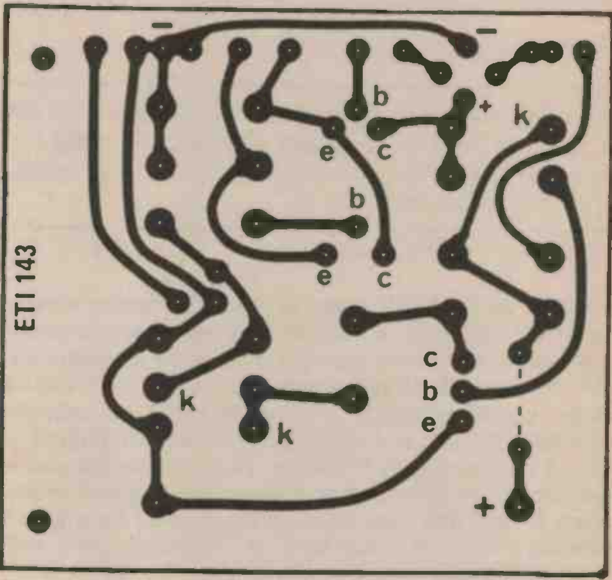


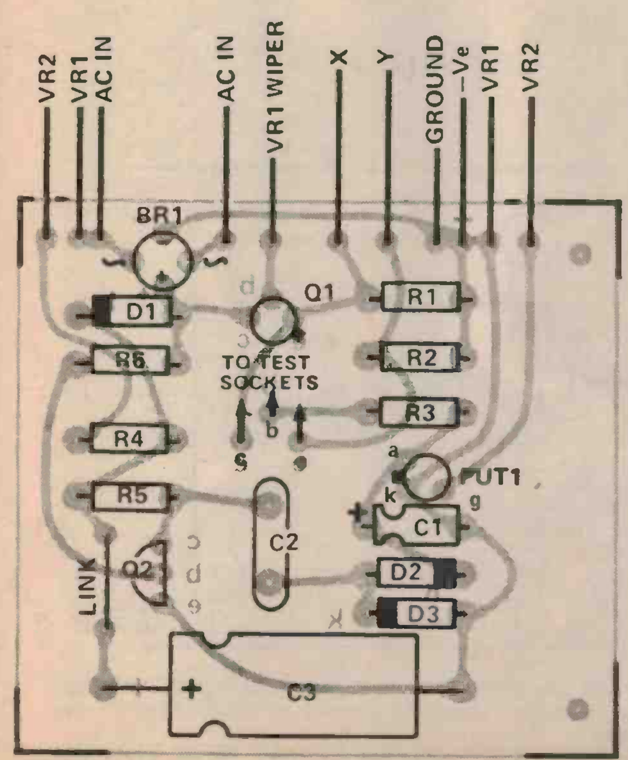
Fig. 4. Circuit for investigating FET transfer characteristics.

PARTS LIST

Resistors		all ¼W, 5%
R1		10k
R2		100R
R3		220k
R4		470k
R5		1k0
R6		4k7
Potentiometers		
RV1		1k lin
RV2		50k lin
Capacitors		
C1		4µ7 25V electrolytic
C2		47n polyester
C3		1 000 25V electrolytic
Semiconductors		
Q1		BFY50
Q2		BC548
PUT1		2N6027
D1		1N4001
D2, 3		1N914
BR1		1 Amp Bridge

Miscellaneous
ETI 143 PCB, case to suit, sockets, knobs, cable, etc.





Gain Control
Part 1

Tim Orr continues his occasional series of circuits, methods and explanations with a detailed look at how gain can be controlled by another electronic signal, be it squarewave, sinewave or voice signal. This leads to some interesting circuits — from ducks to filters!

THERE ARE MANY cases in signal processing where the control of the gain is necessary. Some common examples are automatic volume controls in cassette recorders and in the IF sections of radio receivers. Also in professional audio equipment there is a whole range of compressor, expander, limiter and noise gate devices which find great use in recording and broadcast studios. Maybe you have wondered how the volume of the music drops when the DJ starts to talk and then fades up again when he stops. This process known as voice over or "ducking", uses *voltage control of gain.*

Noise reduction systems such as dolby and dbx employ voltage controlled amplifiers. Synthesisers and sound processors obtain effects such as ring modulation, automatic panning, frequency shifting, dynamic filtering, tremolo and envelope shaping also by the use of this technique.

Gaining Gain

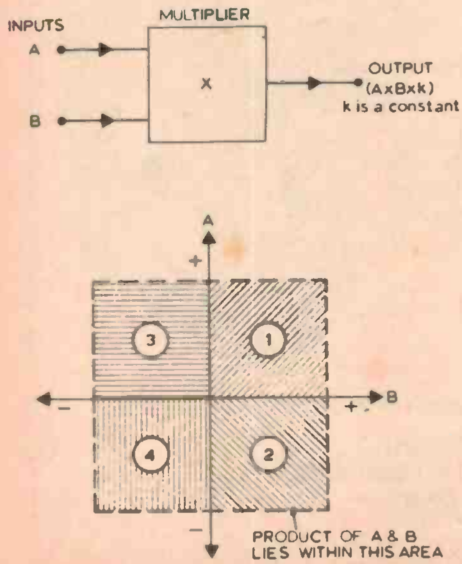
There is a wide variety of methods which can be used to obtain the gain control. This can be anything from constructing the variable gain element yourself from basic parts, to buying ICs or modules designed specifically to solve your particular problem. Generally the solution is some sort of compromise, because unfortunately the problem of making high performance controlled gain cells (multipliers), is rather difficult and therefore the ICs tend to be rather expensive.

However with a bit of care a cost effective solution can usually be produced.

A good example is the AGC in a transistor radio. The transistors in the IF section have an h_{fe} that varies widely with collector current. Thus, by sticking three transistors in series it is possible to vary their overall gain by about 40 dB, (x 100), merely by controlling their collector currents. The AGC stops the audio output of the radio from varying as the radio reception conditions alter.

Electronic Multipliers

When it is required to control the level of one signal with that of another, an electronic multiplier is used. This process is analogous to arithmetic multiplication. If input A is positive, fig. 1, and input B is positive, then the product (the output), will also be positive. If A goes negative then



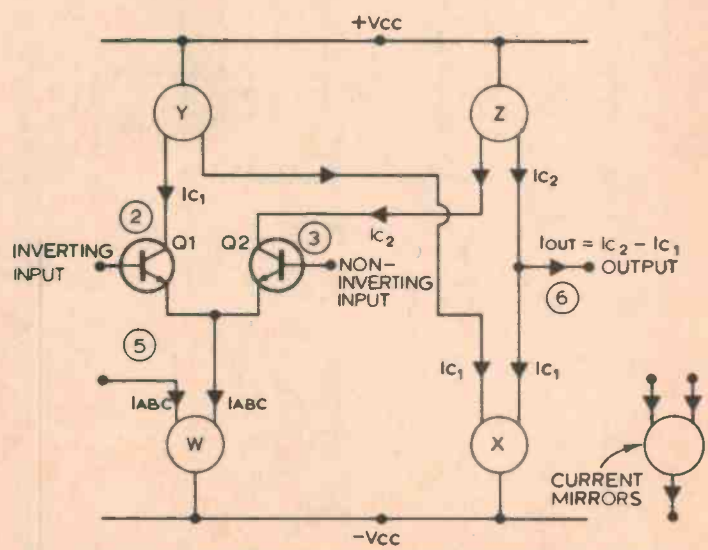


Fig. 1, left: the principle behind electronic multipliers. The graph shows the possible outputs for a variety of combinations of input polarities.
Fig. 2, above: internal workings of a CA3080, an Operational Tranconductance Amplifier.

the product will be negative. If both A and B are negative then the product will be positive thus preserving the arithmetic rules.

If A and B are limited to be only one sign each then the multiplier is known as a one quadrant multiplier. This is the product can only be in one quadrant. If A can be both +ve and -ve, and B only of one sign then the multiplier is known as a two quadrant multiplier. This is what is called an amplitude modulator. The audio signal which is bipolar is A and the control voltage is B.

If A and B can be both +ve and -ve, the product can lie anywhere in the four quadrants and hence the multiplier is known as a four quadrant multiplier. This type of device is found in frequency shifters and ring modulators.

CA3080 – An OTA!

The CA3080 is a two quadrant multiplier, or to give it its full title, it is an Operational Transconductance Amplifier. It has a differential input and a single quadrant current input known as I_{ABC}, (amplifier bias current), fig. 2. The differential transistor pair is used to steer the I_{ABC} current between the two transistors Q2. There is a region where the input differential voltage is linearly proportional to the percentage of current steered between the two transistors. This voltage region is fairly small, being about 20 mV, but using the CA3080 in this area then a reasonably linear 2 quadrant multiplier can be obtained.

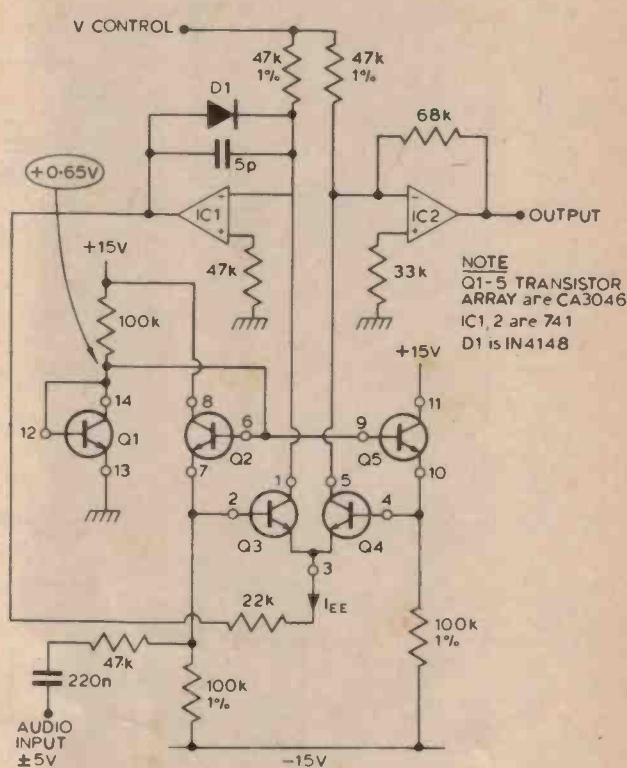
What has happened is that the I_{ABC} current has been multiplied by the input voltage. The produce is the difference between the two collector currents. This difference is extracted by the use of mirrors, current mirrors that is. The current mirrors can be attached to either the +ve or the -ve supply rail.

A current mirror has two input terminals, whatever current flows into one flows into the other — hence the term 'current mirror'.

What we want to do is take the difference between the collector currents of Q1 and Q2. I_{C1} is reflected from mirror Y and then from mirror X and then appears at the output. I_{C2} is reflected from mirror Z and then appears at the output. The two currents are subtracted from each other and the output current is thus $(I_{C2} - I_{C1})$, which is the product of $I_{ABC} \times V_m \times K$, where K is a constant. Note that the I_{ABC} current is also reflected from a current mirror on the negative rail.

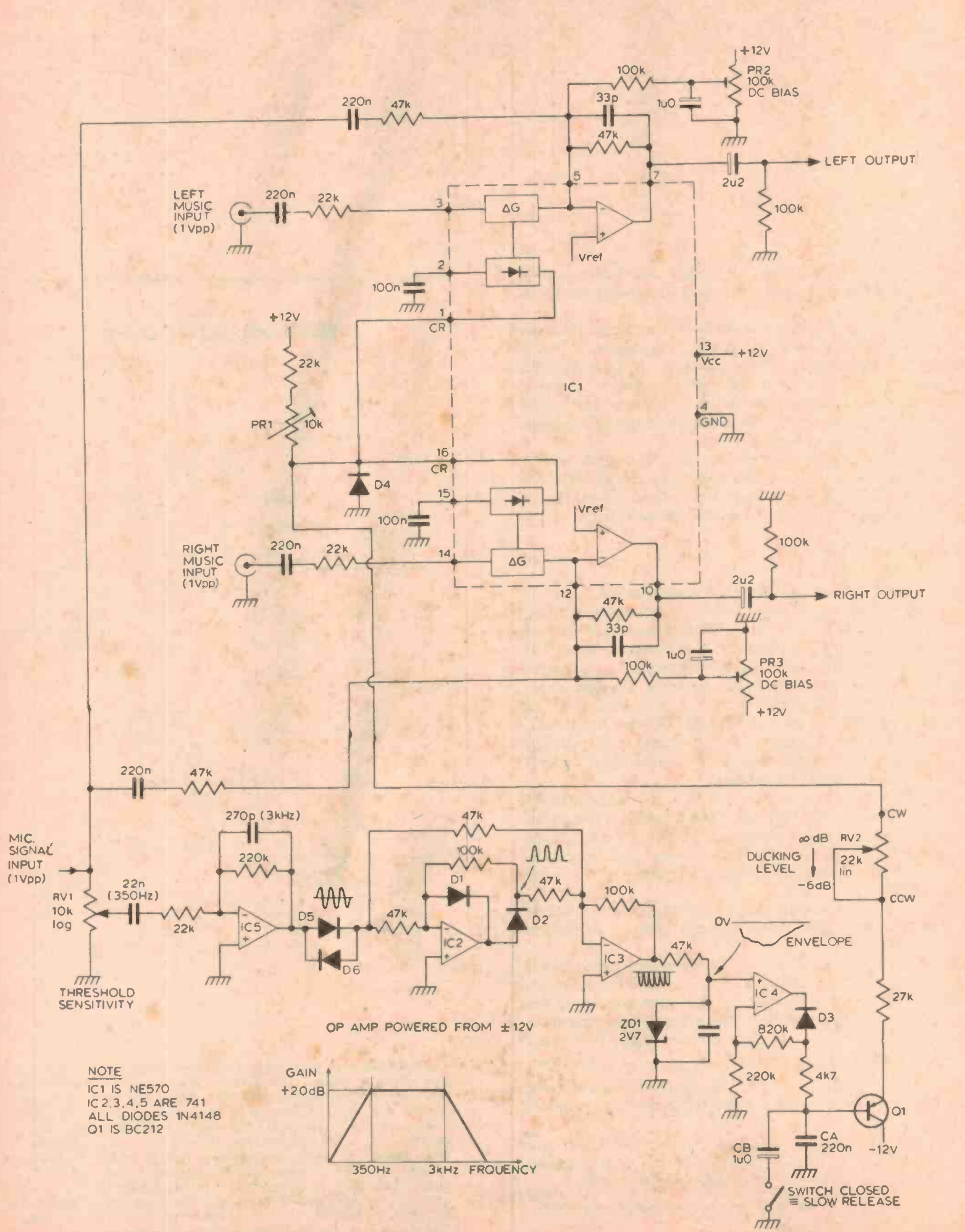
The CA3080 is a low cost two quadrant multiplier and can be used to perform a wide variety of multiplication functions. The linearity of the device holds true for I_{ABC} variations of over three decades. When using this device keep I_{ABC} below 0.5 mA.

VCA Using CA3046 Array



The CA3046 is an array of 5 transistors which are all well matched and relatively cheap. Q3, 4 forms the differential transistor pair, IC1 controls the current and IC2 extracts the differential output current and turns it into an output voltage. The audio input is inserted into the base of Q3 but also connected to this node is the emitter of Q2. Q2 and Q5 serve to predistort the input signal, but they distort the signal the opposite way to which the multiplier distorts it. This is known as distortion cancelling, and it allows a larger signal level to be applied to the multiplier for the same percentage of distortion at the output. The larger input signal allows a higher signal to noise ratio to be obtained. Transistor Q1 is used to bias the bases of Q2, 5 to a suitable operating region.

Stereo Voice Over (Ducking) Circuit for Disco Unit



NOTE
IC1 IS NE570
IC2,3,4,5 ARE 741
ALL DIODES 1N4148
Q1 IS BC212

The circuit operation is as follows. The microphone signal comes via VR1. This pot sets the sensitivity of the circuit to the microphone signal. If it is too sensitive the unit will be 'ducking' every time the DJ breathes. IC5 is an amplifier and filter. The filter has been specifically tailored to fit the characteristics of speech, thus making the ducking unit less sensitive to spurious noise. IC2, 3 forms a precision full wave rectifier, the output of which is low pass filtered and then fed to IC4. This wave form is the envelope of the microphone input signal.

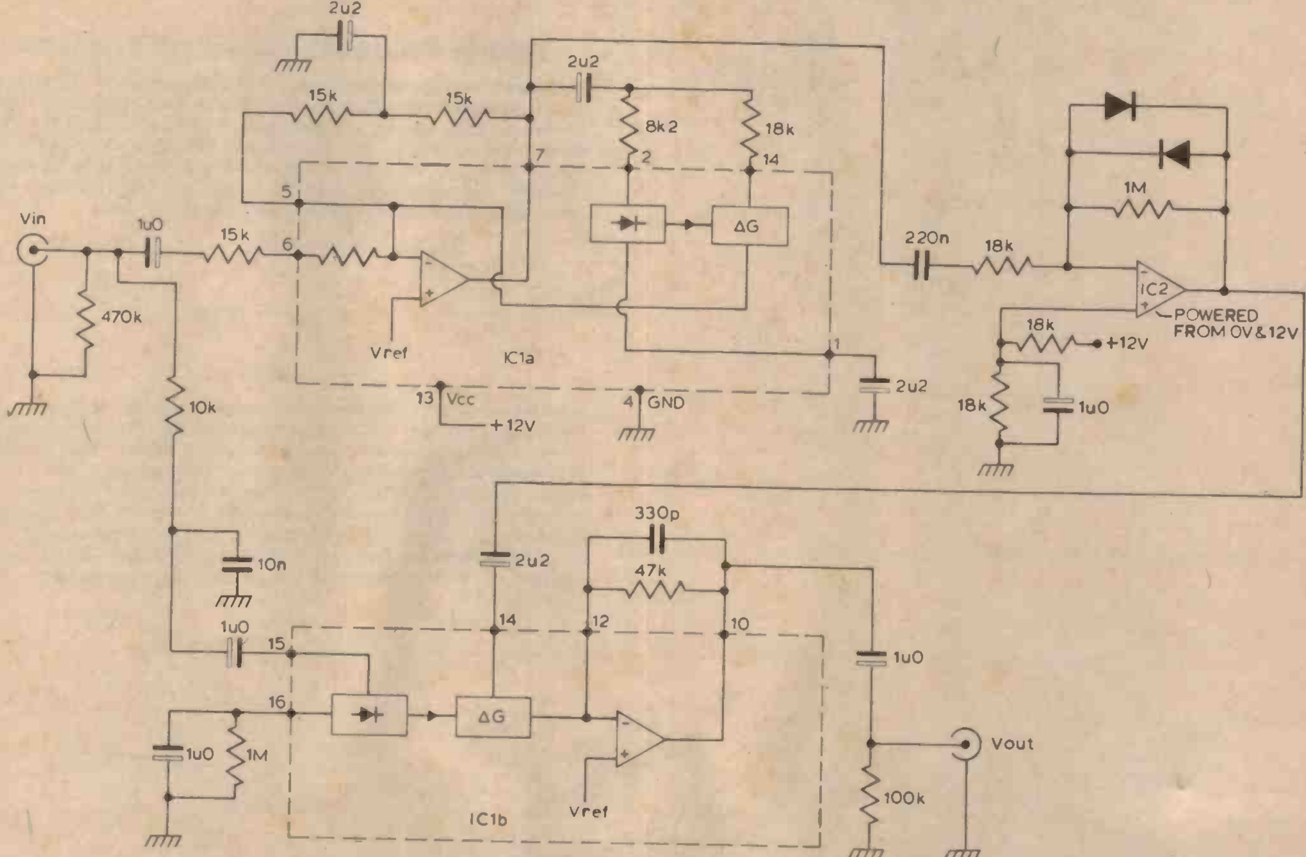
IC4 is a peak, negative going, voltage detector with a gain of x 5. When the DJ begins to speak, IC4 goes negative and in doing so pulls the base of G 1 negative. When the DJ stops speaking the base of G 1 rises back towards 0 V with a time constant determined by CA or CA + CB.

This is the release time and it controls the speed with which the faded down music comes back to full volume. G 1 is an emitter follower and is job is to rob current from the gain cells in the NE570.

This current sets the volume of the two music channels. When the base of G 1 is pulled down to the negative rail, the amount of robbed current is maximum, and when no current flows into pins 1 and 16 of the NE570 and all of it flows into g 1, then both nusic channels are turned off.

To set up PR1, put a large signal into the microphone channel, set RV2 so that it is a short circuit and then adjust PR1 so that the two music channels just close off. PR2 and PR3 should be adjusted so that pins 7 and 10 Of the NE570 are both +6 V.

Clever Fuzz Box



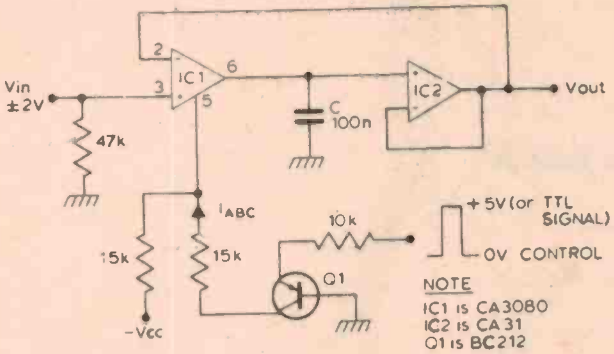
Fuzz boxes are used by guitarists to produce harmonic distortion and sustain. If you want to produce only the distortion, but to retain the original envelope of the signal then this is the circuit for you.

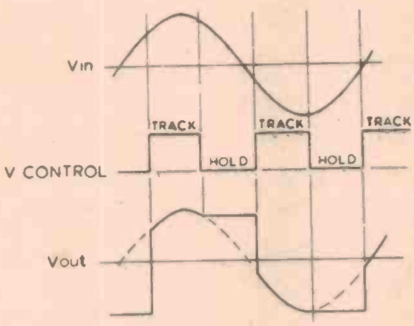
IC1 is a 2:1 compressor as described previosuly. This produces a relatively high level signal which then drives IC2, which is a x 50 amplifier with diode clamping. IC2 produces the distorted (fuzz) found. This is then fed into the IC3 gain cell, the output of which drives the op amp. This gain cell is driven by the rectified original signal (low pass filtered at 1k5 Hz), so that the distorted sound is given the envelope characteristics of the original sound.

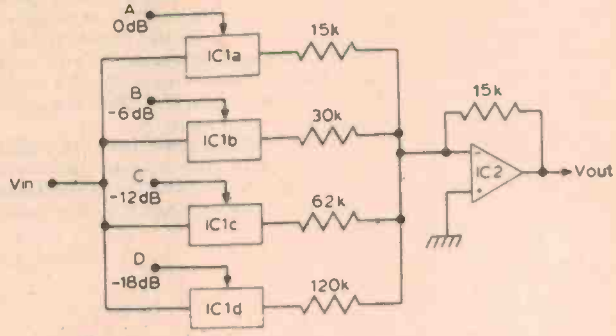
If a fuzz sustain sound is required rather than a dynamic fuzz then IC3 could be modified (by the inclusion of a clamped high gain amplifier driving pin 15) so that it acts as a low level expander. This will squelch the noise at the end of the fuzz period.

Track and Hold

In this example the CA3080 is used as a current controlled switch. When the control voltage is high, I_{ABC} is maximum, (0.44 mA) and the OTA gain is maximum. The voltage at pin 2 of IC1 adjusts itself so that it is the same as that on pin 3, this being due to the 100 per cent feedback via the high input impedance voltage follower IC2. When the control voltage is OV, I_{ABC} is zero and hence the gain of the OTA is zero. Therefore no current comes out of its output and so the voltage at the output of IC2 remains frozen (Hold mode). The maximum differential input voltage is 5 V and this must not be exceeded. The capacitor C should be selected to suit the speed of the operation.







0 ≡ -6V
1 ≡ +6V

A	B	C	D	GAIN
1	0	0	0	0dB
0	1	0	0	-6dB
0	0	1	0	-12dB
0	0	0	1	-18dB

POWERED BY ±6V

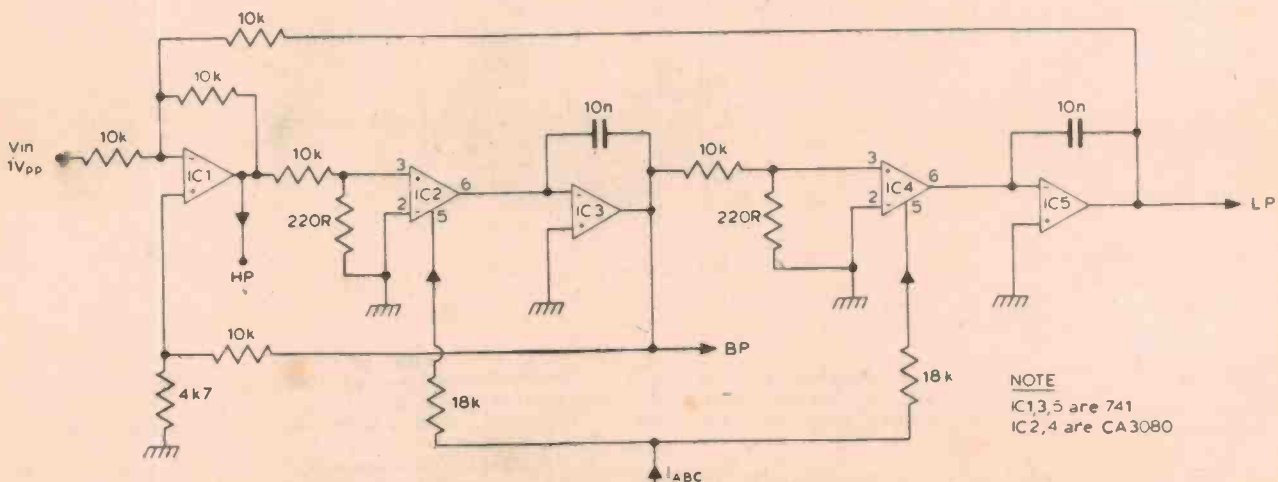
NOTE
IC1 is 4016
IC2 is 741

Voltage Controlled (Switched) Attenuator

The CD4016 is a quad analogue transmission gate. That is, it is a quad voltage controlled switch. When the control is high the switch is ON, having an effective resistance of about 400R. When the control is low the switch is off and ot looks like a 100M resistor. Thus by using 4016 switches it is possible to 'Switch' the voltage gain of an amplifier. The resistors in this example are selected to give 6 dB changes in gain.

Filter

A state variable filter produces three outputs: highpass, bandpass, and lowpass. It is thus a very versatile filter structure, even more so if the resonant frequency can be varied. This frequency is linearly proportional to the gain of the two integrators in the filter. Two CA3080's, (IC2, 4) have been used to provide the variable gain, the resonant frequency being proportional to the current I_{ABC}. Using 741 op amps for IC3 a control range of 100 to 1, (resonant frequency) can be obtained. If CA3140's are used instead of 741's then this range can be extended to nearly 10,000 to 1.



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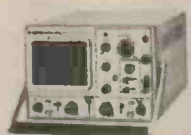

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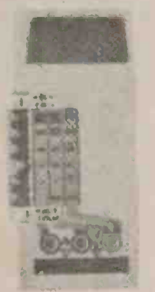

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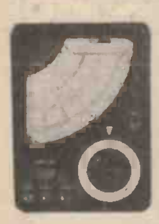
DC VOLTAGE	200 MV 2 V 20 V 200 V 1000 V	100 μV 1 MV 10 MV 0.1 V 1 V	Over 12 Months Better than ± 0.25% of Reading + 1 Digit on All Ranges
AC VOLTAGE	200 MV 2 V 20 V 200 V 750 V	100 μV 1 MV 10 MV 0.1 V 1 V	OVER 12 MONTHS BETTER THAN 45 Hz to 1 kHz ± (0.75% of Reading + 2 Digits) 1 kHz to 2 kHz ± (1.5% of Reading + 3 Digits) 2 kHz to 5 kHz ± (5% of Reading + 5 Digits)
DC CURRENT	2 MA 20 MA 200 MA 2 A	1 μA 10 μA 100 μA 1 MA	Over 12 Months Better Than ± (0.75% of Reading + 1 Digit) On all Ranges
AC CURRENT	2 MA	1 μA	45 Hz to 450 Hz ± (2% of Reading + 2 Digits
	20 MA 200 MA 2 A	10 μA 100 μA 1 MA	± (1.5% of Reading + 2 Digits)
RESISTANCE	200 Ω (Lo-ohms)	0.1 Ω	Over 12 Months Better Than ± (0.3% of Reading + 3 Digits)
	2 KΩ (Hi-ohms) 20 KΩ (Lo-ohms) 200 KΩ (Hi-ohms) 2000 KΩ (Lo-ohms)	1 Ω 10 Ω 100 Ω 1 KΩ	± (0.2% of Reading + 1 Digit
	20 MΩ (Hi-ohms)	10 KΩ	± (2% of Reading + 1 Digit



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RESISTANCE:	0-50K, 0-5M Ohm
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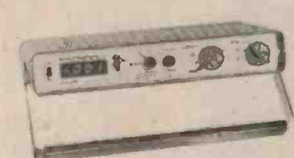

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DC CURRENT	0-50uA 0-10-250mA, 0-10A
RESISTANCE	0-5-50-500K, 0-5M (54-540-5.4K-54K at center)
BUZZER.	
CAPACITANCE:	0.0005-0.2uf (AC 50V range) 0.005-1uf (AC 10V range)
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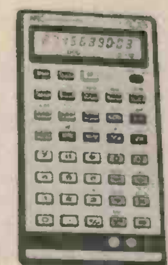

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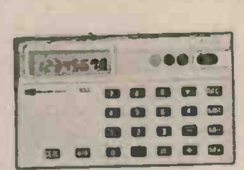

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Simple

A small interpreter for microprocessors, designed by Dr. Tim Hendtlass of RMIT.

PROGRAMMING WITH A high level language interpreter is much easier than programming in absolute machine code, but most interpreters themselves occupy several thousand bytes of RAM. Yet more memory is needed for the user program written in the high level language. This usually restricts people whose microcomputers have only a limited amount of memory to machine code programming.

To help such people explore the world of interpreters, over the past few months I have written a small one for the 8080/8085/Z80 family of microprocessors. It has taken this long because it has been mainly done in short bursts, much of the work being carried out on trams in order to make profitable use of what is otherwise wasted commuting time. Early attempts were based on minimal implementations of BASIC, and were not very successful. While it is possible to fit an integer-only small BASIC into about 1000 bytes the very nature of BASIC does not lend itself to much more shrinking without becoming of very little use at all. Rethinking the problem I decided that the language I wanted had to be small enough to be able to be entered manually, if necessary, whenever you wanted to use it. Also quite reasonable user programs should be able to be run in a pittance of memory. I also decided that it should be coded in a reasonably straightforward way so it should permit users to try out their own additions without having to make any major changes to my code. I gave myself a budget of 256 bytes for the whole interpreter including its text editor and set about seeing how much could be achieved in that. The answer may well surprise you.

I have taken much inspiration from the CAI language PILOT which really lends itself to compact versions. Naturally I have had to omit quite a bit that the full PILOT offers, but I have added a few things too.

Enough background. Here then is a *finished product (it works),* a not too difficult exercise in reading a machine language program (see how it works) and a project for you to add to and modify as much as you like (make it work your way). Since this is not PILOT I have had to find another name for it. As this has been my Small Interpretive MicroProcessor Language Experiment, I have called my language SIMPLE.

Just what is SIMPLE?

If one is not careful confusion will arise because there are actually two things both of which are named SIMPLE. First, there is the actual SIMPLE interpreter which is an 8080 machine language program. This interpreter receives the instructions that actually make it do something in a special language also called SIMPLE. It is this SIMPLE language which will be described in this first part of the article and examples given of its use. A source listing of the actual interpreter and a description of what makes it tick is the subject of the second part, along with some hints on implementing the SIMPLE interpreter on other microprocessors.

For ease of reading for the rest of this first part, Simple means the SIMPLE language unless otherwise stated.

The SIMPLE Language

Simple consists of two basic types of things, commands and statements. Commands are things that are to be done at once while statements are things to be stored away to be done (executed) at some later time. A sequence of statements is called the user's program.

Simple has only five commands. One of these causes the interpreter to start executing the user's program that has been previously stored away. The other four are all to do with entering the user's program and correcting it if it does not do what you want. It is probably better to first consider what statements are available to you, the programmer, and come back later to see just how to get these statements stored in memory.

Simple is a line orientated language, that is the stored program is divided into a series of lines. A line is any group of characters between two carriage returns. Starting at the beginning of the program the first line consists of all the characters up to and including the first carriage return. The second line is all the characters after this carriage return up to and including the next carriage return and so on. There can be one or more statements on a line and statements may themselves consist of one or more characters. The first letter of every statement is called the key letter and serves to identify the kind of statement. Now let's meet some statements.

Six Fundamental Statements

The Type Statement (T)

This must start with a T and then may be followed by any collection of characters you like except *, %, #, $, <– and &. It must end with a carriage return. The effect of this statement when encountered as part of a user's program is to print everything after the key letter T up to the carriage return at the end of the statement.

For example (in the following a carriage return is indicated by (CR)),

T THIS IS THE FIRST LINE (CR)
T THIS IS THE SECOND. (CR)

would produce

THIS IS THE FIRST LINE
THIS IS THE SECOND.

The Accept Statement (A)

This is complete with just an A. It causes a single character to be accepted from the operator and stored internally in the last input character buffer.

simple

The Match Statement (M)

The key letter M must be directly followed by another character. This character is compared with the last character input in response to an ACCEPT statement. If they are the same an internal flag is set to "YES". if they are not the flag is set to "NO".

The Yes Statement (Y)

This is complete with just a Y. When encountered the state of the YES/NO flag is inspected. If it is set to "YES" the statement directly after the Y is executed, but if it is set to "NO" all the rest of the statements after the Y on this line are passed over and the next statement executed is the first statement on the following line.

The No Statement (N)

This is like the Y statement above, except that now only if the flag is set to "NO" will the statement directly after the N be executed, otherwise execution continues with the next line.

The End Statement (E)

This is complete in itself and causes execution of the user's program to be stopped and the Simple Interpreter to sit and wait for a command. When an E statement is found an E is always typed automatically to tell the operator that the end of the user's program has been reached. (Note that the user program pointer (of which more later) is reset to the beginning of the user program when an end statement is executed.)

To illustrate all of the statements so far consider the following (each line finishes with a carriage return, but these are not shown for ease of reading):—

```
T      PLEASE TYPE ME  A  Q
A
MQ
YT – THANK YOU
NT – IS NOT A  Q!
E
```

The first line causes a message to be typed requesting the operator to reply with a 'Q'. The second line accepts a character and the third matches it to see if it is a 'Q'. If it is, the 'yes' flag is set and so the 'thank you' message is typed. Since the 'yes' and 'no' flags cannot be set at once, in this case the program skips the next line and ends. If it was not a 'Q' that was entered the match statement would have given a 'No' answer and so the complaint would have been typed and then the program would end at the E statement. The actual output from the program would be (input from the operator is underlined here just to identify it):—

Case 1.

```
PLEASE TYPE ME A Q
Q – THANK YOU
E
```

Case 2.

```
PLEASE TYPE ME A Q
R – IS NOT A Q!
E
```

More Statements — Jumps and Subroutines

The example above is reasonably trivial deliberately to make it easy to follow and far more complex things can be done with just the six statements introduced so far. However, the power of the language is increased enormously as soon as jumps are introduced. Both backward and forward jumps and subroutine calls are allowed. Subroutines may not be nested, in other words a subroutine may not call another subroutine or itself. It did not seem worthwhile to permit more than one level of subroutine, but if you disagree you can reasonably easily modify the machine code interpreter to permit this. I doubt it will still fit into 256 bytes though.

Both jumping and subroutining require some way to identify the destination and the special character * is reserved for this purpose. This is known as a marker and the first one starting from the beginning of the program is marker one. The next one is marker two and so on. It is optional, if you wish, to precede an * by its number when entering the program. This can help you to understand the program flow. Thus you could enter 3* for the third marker and 4* for the fourth, or you could delete the 3 and 4. It makes no difference to user program execution. Up to nine markers may be used in a program.

The Jump Statement (J)

The marker number must directly follow the J, for example J3. This would transfer control to the statement directly following the third occurrence of an * in the user's program. This can be anywhere at all, at the beginning, middle or end of line.

The Subroutine Statement (S)

Exactly as J above except that the address of the statement after the subroutine call is saved before control is passed to the statement after the target *.

The Return Statement (R)

Complete in itself as just an R. Used at the end of a subroutine to return to the statement after the S statement that brought us to this subroutine.

More things you may do

In Simple it is easy and usually desirable to put more than one statement on a line. No special character is required to separate the statements, but it is advisable to use one to improve the readability of the program. Because of the way Simple has been written any character that comes before A in the ASCII character set and which has not already been allocated some other special function may be used. Thus you could use a space, a comma or a colon to name but three. See Table 1 for the full range of printing characters open to you to use as statement separators. Any number or combination of these may be used between statements to improve program readability. One restriction on using multiple statements on a line; a type (T) statement must be the last one to appear on its line.

To further help improve program readability a comment statement has been introduced. This consists of a leading C followed by anything at all. The line is *always* skipped over on program execution, but will be printed when you list the program. There is no point putting any further statements on a line after a comment statement as Simple will never see them.

Putting more than one statement on a line is more than a convenience; it also permits more complex checks than just the single character match. Suppose you wish to check if the operator has given one of a number of possible answers. This can be done by using the fact that a Y or N comment, if not met, causes the whole of the rest of the line to be skipped. See program 1 which uses this in practice in the third line. In all the program examples shown operator input has been underlined in the sample run for clarity. The & at the beginning of each line of the listing is the command which causes that line to be printed (more of the commands later). If an A has been entered it is matched and the first No test is failed and the program skips to line four arriving with the Yes flag set. If it was not an A a match to E is tried, only if

```
& 1*  T TYPE ME A LETTER
&     A
&     MA,NME,NMI,NMO,NMU
&     YT IS A VOWEL
&     NT IS NOT A VOWEL
&     T DO YOU WANT TO TRY AGAIN? IF SO TYPE 'Y'
&     A,T
&     MY,YJ1
&     E

A TYPE ME A LETTER
S IS NOT A VOWEL
 DO YOU WANT TO TRY AGAIN? IF SO TYPE 'Y'
Y
 TYPE ME A LETTER
U IS A VOWEL
 DO YOU WANT TO TRY AGAIN? IF SO TYPE 'Y'
N
E
```

Program 1 (left). Vowel test.

```
&1* T PLEASE ENTER A LETTER EXCEPT A OR Z
&   A,T
&   MA,NMZ
&   YJ4
&   S2
&   P,T IS THE NEXT LETTER
&   S3
&   P,T IS THE PREVIOUS LETTER
&   J1
&2* X,I,X,R
&3* X,D,D,X,R
&4* T I SAID NOT A OR Z
&   J1

#$ PLEASE ENTER A LETTER EXCEPT A OR Z
D
E IS THE NEXT LETTER
C IS THE PREVIOUS LETTER
 PLEASE ENTER A LETTER EXCEPT A OR Z
Z
 I SAID NOT A OR Z
 PLEASE ENTER A LETTER EXCEPT A OR Z
```

Program 2 (lower left). Alphabet program.

```
&   T PLEASE SPELL THE WORD FOR 2 FOR ME
&   T (HINT IT HAS 3 LETTERS)
&1* A,MT,A,YMW
&   A,YMO,YT IS CORRECT
&   YE
&   T IS NOT RIGHT,SORRY. IF YOU WANT TO
&   T TRY AGAIN PRESS 'Y'
&   A,T
&   MY,YJ1
&   E

#$ PLEASE SPELL THE WORD FOR 2 FOR ME
 (HINT IT HAS 3 LETTERS)
TOO IS NOT RIGHT,SORRY. IF YOU WANT TO
 TRY AGAIN PRESS 'Y'
Y
TWO IS CORRECT
E
```

Program 3 Spelling program.

that fails is a match to I tried and so on. At line four the yes flag is set if the character entered is any one of the vowels, A, E, I, O or U. This program shows a conditioned jump being used back to the start of the program in line eight.

It is also easy to test multi-letter answers. See program 2. Here the first letter input is matched in line three to T. If this match fails no further testing is done although two other letters are accepted. Only if the correct three letters are entered in the correct order will the yes flag be set at line eight.

For an example of a program which uses subroutines (although it could be written without them) see program 3. This program forms an infinite loop; once started the program can only be stopped by resetting the computer — not usually desirable.

Yet More Statements

The statements introduced so far do not permit you to do anything more with the single character response to an accept statement than match it against one or more approved answers. Simple also lets you save (keep) and recall (get) characters for later use. There are nine storage locations set aside for you to use as single character memories and these are identified by the characters 1 to 9 as explained below.

The Keep Statement (K)

The memory number must directly follow the K with no other character in between, e.g. K3. The contents of the last character entered buffer are copied into memory 3 replacing what was there. The contents of the last character entered buffer are unaltered.

The Get Statement (G)

Again, the memory number must directly follow the key letter G, e.g. G3. The contents of memory 3 replace the contents of the last character entered buffer. The contents of memory location 3 are not altered.

When a character is entered in response to an accept statement it is automatically printed on the terminal as it is put in the last character entered buffer. Now that we can keep and get previously entered characters it is desirable to be able to print whatever character might be stored in the last character buffer at any time. This is done with the P command.

The Print Command (P)

Complete in itself as just P. Causes the current contents of the last character entered buffer to be printed on the terminal.

Even More Statements Still!

As you will have noticed, so far Simple is a mathematical simpleton. There is one group of statements which let you do some very limited maths; sufficient for counting tries or playing some games. Simple has a built-in counter which you may load (L), increment (I) or decrement (D). You also need to be able to inspect the counter contents at any time to see if they have reached some special value. This is achieved by providing an exchange (X) statement, a statement which opens far more scope than might at first appear. X swaps the counter contents for the contents of the last character input buffer — note this is a swap not a copy, so no information is destroyed. Once X has been issued the counter contents may be matched to some special value (using M), kept (using K) and/or printed (using P). The counter and last character input can be replaced in their normal places by a second X statement.

Also the X statement, used with the I or D statements, permits a user response to be cycled up or down. The G and X statements together allow the current counter contents to be replaced by some value previously stored away. These features will be used considerably in the examples at the end of this part.

The Load Counter Statement (L)

The character immediately following the L is placed into the counter replacing what was there. For example, L7 loads the counter with the character 7.

The Increment Statement (I)

Complete in itself. Causes the counter contents to be increased by one.

The Decrement Statement (D)

Complete in itself. Causes the counter contents to be decreased by one.

The Exchange Statement (X)

Complete in itself. Causes the counter contents to be exchanged with the contents of the last character entered buffer.

A few more bits and pieces

Simple was also designed for you to add on to without any major changes to the interpreter source code. This is done through the U or User statement. Until you change two bytes in the source code this will be flagged as an error. More on using this U statement in the second part of this article.

In fact a number of things can be wrong with a Simple program; you might use an illegal key letter or refer to a non-existent memory register for example. If Simple finds such a problem it stops execution, prints a ?, prints the very statement which has caused the trouble, prints the rest of the current line and then reverts to the command mode, sets the entry pointer to the beginning of the user program and waits for you to do something about it. Another possible error is to try to type a line of more than 64 characters. After Simple has typed 64 characters without finding a carriage return, it prints a ? and reverts to the command code.

The Command Mode

Having now discussed the statements you have available when writing a program in Simple, it is time to describe how to get a program into the user memory space and how to start executing it.

The text editor provided as part of the total Simple interpreter is of necessity fairly limited. There are five printing characters reserved for it; anything else entered will be treated as something to be put into the user's program. Characters are put sequentially into the user's program area at the position of the entry pointer using one byte of storage per character. If you enter an incorrect character, entering back space (← or control H) will remove the last character. A number of back spaces can be used to remove a string of incorrect characters.

At any time you can return the entry pointer to the beginning of the user's program area by entering #. An & causes the next line of program in the memory starting at the current position of the entry pointer to be displayed on the terminal and the entry pointer moved to the start of the following line. You can replace a line for one of equal or shorter length by going to the start (#) and displaying (with &'s) up to the line before the one you wish to replace. Then type the new line ending with a % instead of a carriage return. Any characters left from the old line will be erased for you. This also lets you erase a superfluous line if you wish; you do not type in a new line, just enter %.

To run a program enter # to get back to the start (assuming you want to start at the beginning — you may start anywhere you wish), and then enter $ to start the program executing. Provided you end your program with an **E** command, after execution is finished control will be returned to the command mode. An error always brings you back to the command code.

Simple Examples

As mentioned before, Simple is not a mathematical tool — while you can do multi-digit arithmetic on it, it is not easy. However, you can do a wide range of things involving logic trees and/or alphanumeric character manipulations. To conclude this section I give some more examples. The examples are each in two parts; first a listing of the program itself (produced using the & command described above) and then a sample output from the program. For clarity all input from the operator is underlined. You will notice that I have used the optional features of writing a Simple program to make these listings look tidy. Remember if you wish to save memory space you can eliminate all blanks, commas and the number before each marker.

The fourth program shows a simple game of NIM. In this version the computer is unbeatable, but a more complex one can be produced which gives the operator a chance! The fifth (a more complicated program) shows an alphabetic version of HI-LO in which you have to guess the mystery letter from the 'too high' or 'too low' clues. It is almost always possible to get to the answer in five tries — here you are only given four. Note the way of selecting the 'unknown' number based on responses from the user. Unfortunately, there was no room

Program 4. NIM.

```
&    C SET UP THE PROBLEM
&1*  L=,T DO YOU WANT INSTRUCTIONS? Y OR N
&    A,T
&    MY,NJ2
&    T WE START OFF WITH 13 MATCHES AND TAKE TURNS
&    T REMOVING 1,2 OR 3 MATCHES. THE PERSON TO HAVE
&    T TO TAKE THE LAST MATCH LOSES. YOU GO FIRST.
&2*  T THERE ARE NOW 13 MATCHES.
&    J4
&3*  X,P,X,T MATCHES LEFT
&4*  T HOW MANY DO YOU TAKE?
&    A,T
&    M1,NM2,NM3
&    NT EITHER 1 OR 2 OR 3 PLEASE
&    NJ4
&    C HAVING GOT THEIR NUMBER WE WORK OUT OURS
&    M1,YT I TAKE 3
&    M2,YT I TAKE 2
&    M3,YT I TAKE 1
&    D,D,D,D,C WE WON?
&    X,M1,X,YJ5,C IF SO JUMP TO FIFTH MARKER
&    J3,C OTHERWISE BACK FOR NEXT ROUND
&5*  T I WIN - WANT ANOTHER GAME? (Y OR N)
&    A,T
&    MY,YJ1
&    T OH WELL,BEEN NICE PLAYING YOU!
&    E

#$ DO YOU WANT INSTRUCTIONS? Y OR N
Y
 WE START OFF WITH 13 MATCHES AND TAKE TURNS
 REMOVING 1,2 OR 3 MATCHES. THE PERSON TO HAVE
 TO TAKE THE LAST MATCH LOSES. YOU GO FIRST.
 THERE ARE NOW 13 MATCHES.
 HOW MANY DO YOU TAKE?
3
 I TAKE 1
9 MATCHES LEFT
 HOW MANY DO YOU TAKE?
4
 EITHER 1 OR 2 OR 3 PLEASE
 HOW MANY DO YOU TAKE?
2
 I TAKE 2
5 MATCHES LEFT
 HOW MANY DO YOU TAKE?
1
 I TAKE 3
 I WIN - WANT ANOTHER GAME? (Y OR N)
N
 OH WELL,BEEN NICE PLAYING YOU!
E
```

Program 5. HI-LO.

```
#$ PLEASE GIVE ME 3 DIFFERENT LETTERS
ETI - THANK YOU
 YOUR GUESS?
M - IS TOO LOW
 YOUR GUESS?
S - IS TOO HIGH
 YOUR GUESS?
P - IS TOO HIGH
 YOUR GUESS?
N - IS CORRECT IN
4 TRIES!
 WANT ANOTHER GAME? (Y OR N)
Y YOUR GUESS?
E - IS TOO LOW
 YOUR GUESS?
Q - IS TOO LOW
 YOUR GUESS?
S - IS TOO LOW
 YOUR GUESS?
X - IS TOO HIGH
 YOU HAVE HAD 4 TRIES,
U WAS THE CORRECT ANSWER
 WANT ANOTHER GAME? (Y OR N)
NE

&    C GET 3 CHARACTERS TO FORM CORRECT ANSWER
&    T PLEASE GIVE ME 3 DIFFERENT LETTERS
&    A,K1,A,K1,A,K3,T - THANK YOU
&    C WORK OUT CORRECT ANSWER AND SET NO OF TRIES TO 0
&1*  G1,X,G2,S7,G3,X,S7,X,K4,L0,X,K5
&    C SEE IF THEY HAVE USED UP 4 TRIES
&2*  G5,X,I,X,M5,K5,NJ4
&    T YOU HAVE HAD 4 TRIES,
&    G4,P,T WAS THE CORRECT ANSWER
&3*  T WANT ANOTHER GAME? (Y OR N)
&    A,MY,YJ1
&    NE
&    C GET THEIR GUESS,CHANGE R1,R2,R3 TO GET A DIFFERENT
&    C CORRECT ANSWER NEXT TIME.PUT THEIR GUESS IN COUNTER
&    C AND CORRECT ANSWER IN LAST CHARACTER INPUT BUFFER.
&4*  T YOUR GUESS?
&    A,K6,G2,K1,G3,K2,G6,K3,X,G4
&    C WORK OUT OUR REPLY BY CYCLING EACH CHARACTER DOWN
&    C TO A AND SEEING WHICH GETS THERE FIRST.
&5*  MA,YJ6
&    X,MA,YT - IS TOO LOW
&    YJ2
&    D,X,D,J5
&6*  X,MA,NT - IS TOO HIGH
&    NJ2
&    T - IS CORRECT IN
&    G5,P,T TRIES!
&    J3
&    C SUBROUTINE TO CYCLE COUNTER UP WHILE BRINGING THE
&    C LAST CHARACTER ENTERED BUFFER DOWN TO A
&7*  MA,YR
&    X,MZ,X,YL0
&    I,X,D,X,J7
```

Simple

```
;SMALL INTERPRETIVE MICROPROCESSOR LANGUAGE EXPERIMENT

;********************** SIMPLE *********************

;WRITTEN BY TIM HENDTLASS
;OCTOBER 1978
;VERSION 2.1/25/10/78


;FIRST TELL THE ASSEMBLER WHERE THE PROGRAM IS TO START

0000                    ORG     100H

;THE PROGRAM PROPER STARTS HERE

;THIS IS THE MASTER TEXT EDIT ROUTINE

0100 211502     START:  LXI     H,UPROG ;POINT H&L TO THE START OF THE
                                        ;USER PROGRAM AREA
0103 F9                 SPHL            ;STACK WILL START JUST BELOW THE
                                        ;USER PROGRAM
0104 110401     TLOOP:  LXI     D,TLOOP ;TLOOP ADDRESS TO D&E
0107 D5                 PUSH    D       ;AND ONTO THE TOP OF THE STACK
                                        ;THIS LETS US RETURN TO TLOOP
                                        ;WITH A RETURN INSTRUCTION
0108 CDF301             CALL    CI      ;GET (AND ECHO) A CHARACTER
010B 2B                 DCX     H       ;IN CASE IT IS BACKSPACE
010C FE5F               CPI     5FH     ;WAS IT BACKSPACE (5F)?
010E C8                 RZ              ;YES,WE HAVE ALREADY DONE THE
                                        ;NECESSARY CORRECTION,SO BACK
                                        ;TO TLOOP FOR THE NEXT CHARACTER
010F 23                 INX     H       ;IT HASN'T,SO RESTORE H&L AS
                                        ;THEY WERE
0110 D626               SUI     26H     ;WAS IT &?
0112 CA9601             JZ      TYPE    ;YES,SO DISPLAY NEXT LINE AND
                                        ;RETURN FROM TYPE TO TLOOP
0115 3C                 INR     A       ;WAS IT % (25H)?
0116 CA2B01             JZ      PAD     ;YES,GO PAD AND RETURN TO TLOOP
                                        ;FROM THE PAD ROUTINE
0119 3C                 INR     A       ;WAS IT $ (24H)?
011A CA5A01             JZ      EXEC0   ;YES,EXECUTE THE USER PROGRAM
011D 3C                 INR     A       ;WAS IT # (23H)?
011E CA0001             JZ      START   ;YES,BACK TO START-STACK WILL BE
                                        ;CLEANED UP AUTOMATICALLY BY THE
                                        ;FIRST TWO INSTRUCTIONS!

;IF IT WAS NONE OF THESE IT MUST HAVE BEEN A CHARACTER
;TO PUT INTO THE USER PROGRAM.BEFORE WE CAN DO THIS WE
;MUST RESTORE THE CHARACTER THE WAY IT WAS WHEN WE FIRST
;GOT IT FROM THE ROUTINE CI

0121 C623               ADI     23H     ;RESTORE IT AS IT WAS
0123 77                 MOV     M,A     ;PUT IT INTO USER PROGRAM
0124 23                 INX     H       ;AND POINT TO NEXT SEQUENTIAL
                                        ;LOCATION IN USER PROGRAM AREA

;IF THAT WAS A CARRAGE RETURN (CR) WE JUST PUT AWAY WE
; NOW SEND A LINE FEED (LF) TO KEEP THE TERMINAL HAPPY
0125 FE0D               CPI     0DH     ;WAS IT CR?
0127 CC5301             CZ      PLF     ;IF SO TYPE A LF
                                        ;NOTE-THIS MUST BE A CALL
012A C9                 RET             ;IN EITHER CASE BACK TO TLOOP
                                        ;FOR THE NEXT CHARACTER

;THAT IS THE END OF THE MASTER TEXT EDIT ROUTINE.

;NOW FOR THE MAIN SUBROUTINES THAT THE MASTER
;ROUTINE CALLS. IN CASE YOU WISH TO MODIFY THE
;ABOVE NOTE THAT THE INTERPRETER (EXEC) ALSO
;USES THE COM ROUTINE.THE TYPE SUBROUTINE WILL
;BE FOUND AS PART OF THE INTERPRETER


;THE PAD ROUTINE-IT MUST PRECEED THE COM ROUTINE
;AS IT 'FALLS THROUGH' TO IT!

012B 1680       PAD:    MVI     D,80H   ;SET COMMON ROUTINE FLAG = 'PAD'

;THE COMMON (COM) ROUTINE. IF ENTERED WITH D =OR> 80H IT
;PADS THE USER PROGRAM AREA WITH NULLS. IT STARTS AT THE
;LOCATION POINTED TO BY H&L AND PADS UP TO BUT NOT
;INCLUDING THE FIRST LOCATION IN WHICH IT FINDS A CR. A
;CR AND LF ARE THEN SENT TO THE TERMINAL. IF ON ENTRY D
;< 80H IT TYPES THE CONTENTS OF THE USER PROGRAM AREA
;FROM THE LOCATION POINTED TO BY H&L. IT TYPES THE TEXT
;UNTIL A CR IS FOUND.THIS CR IS TYPED AND THEN A LF IS
;ALSO TYPED. IN ALL CASES THERE IS A SAFTY COUNT OF 64
;IN FORCE-IF 64 CHARACTERS HAVE BEEN TYPED OR PADDED
;WITHOUT A CR BEING FOUND A '?' IS TYPED AND THE
;ROUTINE ABORTS TO START

012D C5         COM:    PUSH    B       ;SAVE B&C ON THE STACK
                                        ;TO MAKE SOME ROOM
012E 0640               MVI     B,40H   ;SET A SAFETY COUNT OF 64
0130 7E         COM1:   MOV     A,M     ;GET A CHARACTER TO A
0131 FE0D               CPI     0DH     ;IS IT CR?
0133 CA4E01             JZ      COM2    ;JOB FINISHED WHEN WE FIND A CR
                                        ;SO CLEAN UP BY TYPING BOTH A
                                        ;CR AND A LF
0136 4F                 MOV     C,A     ;COPY A INTO C IN CASE WE ARE
                                        ;TO TYPE
0137 7A                 MOV     A,D     ;GET THE FLAG
0138 07                 RLC             ;MOVE BIT 7 INTO THE CARRY FLAG
0139 D23E01             JNC     NOPAD   ;NO CARRY MEANS DON'T PAD
013C 3600               MVI     M,0     ;IF THERE IS A CARRY WE MUST
                                        ;PAD SO PUT IN ONE NULL

;NOTE- THE LAST INSTRUCTION DOES NOT AFFECT THE STATE
;OF THE CARRY FLAG SO IF THE LAST INSTRUCTION
;WAS DONE THE NEXT ONE WON'T BE.

013E D4F901     NOPAD:  CNC     CO      ;NO CARRY,SO TYPE CHARACTER
0141 23                 INX     H       ;POINT TO NEXT LOCATION TO TREAT
0142 05                 DCR     B       ;64 CHARACTERS YET?
0143 C23001             JNZ     COM1    ;NO,GO AND DO MORE
0146 0E3F               MVI     C,'?'   ;YES,WE HAVE A PROBLEM
0148 CDF901             CALL    CO      ;PRINT A '?'
014B C30001             JMP     START   ;AND ABORT TO START

014E 4E         COM2:   MOV     C,M     ;PUT THE CR IN C
014F 23                 INX     H       ;MOVE OVER THE CR
0150 CDF901             CALL    CO      ;PRINT IT
0153 0E0A       PLF:    MVI     C,0AH   ;LOAD C WITH A LF
0155 CDF901             CALL    CO      ;PRINT IT
0158 C1                 POP     B       ;RESTORE B&C
0159 C9                 RET             ;AND BACK TO WHOEVER CALLED US

;END OF TEXT EDITOR AND IT'S MAIN SUPPORT ROUTINES


;THIS IS THE START OF THE INTERPRETER MAIN ROUTINE

;WHEN WE ARRIVE AT EXEC WE HAVE THE ADDRESS OF TLOOP
;ON THE TOP OF THE STACK AND THE ADDRESS AT WHICH WE
;WISH TO START EXECUTION OF THE USER PROGRAM IN H&L
;ALL THE OTHER REGISTERS ARE AS YET UNDEFINED,BUT
;WILL HAVE THE FOLLOWING USES:-
;D = MARKER COUNTER OR PRINT/PAD FLAG
;E = USER COUNTER
;B = RESULT OF LAST MATCH (AF=YES,0=NO)
;C = LAST CHARACTER THAT WAS INPUT IN RESPONSE TO AN
;      ACCEPT COMMAND

;FIRST WE LOSE THE ADDRESS OF TLOOP FROM THE TOP
;OF THE STACK AS WE NO LONGER NEED IT.

015A D1         EXEC0:  POP     D               ;THERE,LOST IT

;NOW WE PUT THE ADDRESS OF EXEC ONTO THE TOP OF THE
;STACK WITHOUT ALTERING ANY REGISTERS. THIS LETS US
;RETURN TO EXEC BY A SIMPLE RETURN INSTRUCTION.
;OF COURSE WE MUST DO THIS AGAIN EACH TIME WE RETURN
;TO EXEC AS WE 'USE UP' THE ADDRESS GETTING THERE.

015B E5         EXEC:   PUSH    H       ;PUT H&L ONTO STACK
015C 215B01             LXI     H,EXEC  ;PUT ADDRESS OF EXEC IN H&L
015F E3                 XTHL            ;SWAP H&L WITH TOP OF STACK
0160 7E                 MOV     A,M     ;GET A CHARACTER FROM THE USER
                                        ;PROGRAM AREA
0161 23                 INX     H       ;POINT TO NEXT CHARACTER FOR
                                        ;NEXT TIME ROUND
0162 FE5A               CPI     'Z'     ;NO STATEMENT STARTS WITH
                                        ;Z OR ANYTHING BEYOND THAT
0164 D28C01             JNC     ERROR   ;SO IF IT'S > OR = 'Z',IT'S AN
                                        ;ERROR!
0167 D641               SUI     'A'     ;SUBTRACT ASCII A
0169 D8                 RC              ;IGNORE IT IF IT WAS < 'A'

;NOTE,IT COULD HAVE BEEN A CR,A MARKER (#),
;AN OPTIONAL STATEMENT DELINEATOR OR EVEN
;A NUMBER PUT IN BY SOME OTHER LINE ORIENTED TEXT
;EDITOR.IN ANY CASE WE DON'T WANT TO KNOW ABOUT IT
;AT THE MOMENT SO WE JUST JUMP OVER IT.

;WE NOW HAVE THE INDENTIFYING KEY LETTER FROM WHICH
;ASCII 'A' HAS BEEN SUBTRACTED IN REGISTER A. WE LOOK
;UP IN A TABLE STARTING AT TBASE TO FIND THE LEAST
;SIGNIFICANT BYTE OF THE ADDRESS OF THE SUBROUTINE
;WHICH PERFORMS THE ACTUAL STATEMENT. AS THE WHOLE
;INTERPRETER FITS IN 256 BYTES WE ALREADY KNOW THE
;MOST SIGNIFICANT BYTE

016A E5                 PUSH    H       ;WE NEED A LITTLE ROOM
016B 217301             LXI     H,TBASE ;ADDRESS OF FIRST ENTRY
                                        ;IN TABLE TO H&L
016E 85                 ADD     L       ;ADD L TO THE KEY LETTER IN A
                                        ;WHICH IS IN THE RANGE FROM
                                        ;A=0 TO Y=25
016F 6F                 MOV     L,A     ;NOW H&L HAS THE ADDRESS
                                        ;OF THE ENTRY WE WANT
0170 6E                 MOV     L,M     ;NOW H&L HAS THE ADDRESS OF
                                        ;THE SUBROUTINE WE WANT
0171 E3                 XTHL            ;PUT THIS ON TO THE TOP OF
                                        ;THE STACK AND RESTORE THE
                                        ;ORIGIONAL H&L ALL AT ONCE
0172 C9                 RET             ;AND OFF TO THE ADDRESS WHICH
                                        ;WE JUST PUT ON THE STACK

;THE NEXT 25 BYTES CONTAIN THE LEAST SIGNIFICANT
;BYTE OF THE SUBROUTINES THAT ACTUALLY PERFORM
;THE ACTION REQUIRED TO DO THE STATEMENT. THEY ARE
;IN ORDER,A (ACCEPT) FIRST TO Y (YES) LAST
;THE FORM MOD 256 WHICH APPEARS BELOW IS A WAY
;OF TELLING MY ASSEMBLER TO ONLY USE THE LEAST
;SIGIFICANT 8 BITS OF THE ADDRESS

0173 F3         TBASE:  DB      CI      MOD 256 ;A ENTRY
0174 8C                 DB      ERROR   MOD 256 ;B ENTRY
0175 C1                 DB      SKIP    MOD 256 ;C ENTRY
0176 CF                 DB      DEC     MOD 256 ;D ENTRY
0177 91                 DB      END1    MOD 256 ;E ENTRY
0178 8C                 DB      ERROR   MOD 256 ;F ENTRY
0179 DA                 DB      GET     MOD 256 ;G ENTRY
017A 8C                 DB      ERROR   MOD 256 ;H ENTRY
017B D1                 DB      INC     MOD 256 ;I ENTRY
017C 9E                 DB      JUMP    MOD 256 ;J ENTRY
017D 03                 DB      KEEP    MOD 256 ;K ENTRY
017E CC                 DB      LCNTR   MOD 256 ;L ENTRY
017F B4                 DB      MATCH   MOD 256 ;M ENTRY
0180 BE                 DB      TESTN   MOD 256 ;N ENTRY
0181 8C                 DB      ERROR   MOD 256 ;O ENTRY
0182 F9                 DB      CO      MOD 256 ;P ENTRY
0183 8C                 DB      ERROR   MOD 256 ;Q ENTRY
0184 B0                 DB      RETN    MOD 256 ;R ENTRY
0185 98                 DB      SUBR    MOD 256 ;S ENTRY
0186 96                 DB      TYPE    MOD 256 ;T ENTRY
0187 F0                 DB      USER    MOD 256 ;U ENTRY
0188 8C                 DB      ERROR   MOD 256 ;V ENTRY
0189 8C                 DB      ERROR   MOD 256 ;W ENTRY
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018A C8              DB      EXCH    MOD 256 ;X ENTRY
018B 80              DB      TESTY   MOD 256 ;Y ENTRY

                ;END OF LOOK UP TABLE

                ;NOW FOR THE SUBROUTINES CALLED BY EXEC. THESE ARE -
                ;END1,ERROR,EXCH,GET,INC,JUMP,KEEP,LCNTR,MATCH,
                ;RETN,SUBR,TESTN,TESTY AND TYPE.

                ;NOTE THE ORDER OF THESE NEXT THREE SUBROUTINES AS
                ;THEY 'FALL THROUGH' FROM ONE TO ANOTHER.

                ;IF WE ARRIVE AT EITHER ERROR OR END1 WE HAVE FINISHED
                ;EXECUTING THE USER PROGRAM AND MUST GO BACK TO THE
                ;START. IN THIS CASE THE CONTENTS OF D&E ARE NO LONGER
                ;OF ANY IMPORTANCE.

018C 0E3F       ERROR   MVI     C,'?'   ;LOAD A QUESTION MARK
018E CDF901             CALL    CO      ;PRINT IT AS WE HAVE AN ERROR
0191 2B         END1    DCX     H       ;BACK UP TO SHOW THE CHARACTER
                                        ;WHICH HAS CAUSED THE TROUBLE
0192 110001             LXI     D,START ;GET READY TO GO BACK TO START
0195 D5                 PUSH    D       ;START ADDRESS TO TOP OF STACK
0196 1600       TYPE    MVI     D,0     ;SET COM FLAG TO TYPE
0198 C32D01             JMP     COM     ;GO AND PRINT LINE,THE RETURN
                                        ;AT THE END OF COM SENDS US
                                        ;BACK TO EXEC UNLESS WE CAME
                                        ;HERE BY WAY OF ERROR OR END1
                                        ;WHEN IT SENDS US TO START

019B 220002     SUBR    SHLD    RADR    ;SAVE ADDRESS OF THIS MARKER
                                        ;FOR USE LATER AS THE RETURN
                                        ;ADDRESS.AS IT IS A NUMBER
                                        ;EXEC WILL SKIP OVER IT FOR
                                        ;US WHEN WE COME BACK

                ;ONCE THE RETURN ADDRESS HAS BEEN SAVED,THE REST OF THE
                ;SUBROUTINE OPERATION IS IDENTICAL TO A JUMP.
                ;SO "SUBR" 'FALLS THROUGH' TO "JUMP" AT THIS POINT

                ;FIRST WE USE VCOM TO GET THE MARKER NUMBER TO A & TO
                ;CHANGE IT FROM AN ASCII NUMBER TO BINARY AND THEN
                ;TO SUBTRACT ONE -----> THE RESULT FROM ALL THIS
                ;IS THE MARKER COUNTER WHICH VCOM PUTS IN D FOR US
                ;VCOM CHECKS TO SEE THAT THE MARKER NUMBER IS NOT
                ;<1 OR >9 AND GOES TO ERROR IF IT IS.
                ;VCOM DOES MORE THAN THIS AS IT IS ALSO USED BY THE
                ;GET AND KEEP ROUTINES,BUT THE FACT THAT IT CORRUPTS
                ;H&L IS OF NO CONCERN TO US AS WE ARE ABOUT TO RELOAD
                ;THEM ANYWAY

019E CDE101     JUMP:   CALL    VCOM    ;GET THE MARKER COUNTER TO D
01A1 211502             LXI     H,UPROG ;START LOOKING FOR MARKERS FROM
                                        ;BEGINNING OF THE USER PROGRAM
01A4 3E2A               MVI     A,'*'   ;THIS IS WHAT WE ARE LOOKING FOR
01A6 BE         JLOOP:  CMP     M       ;FOUND ONE AT THIS USER ADDRESS?
01A7 23                 INX     H       ;POINT TO NEXT USER ADDRESS
01A8 C2A601             JNZ     JLOOP   ;NO WE HAVEN'T,KEEP LOOKING

                ;AH,WE HAVE FOUND ONE - BUT IS IT THE CORRECT ONE?

01AB 15                 DCR     D       ;IF IT IS,D WILL NOW BE NEGATIVE
01AC F2A601             JP      JLOOP   ;BOTHER,WRONG ONE - KEEP LOOKING
01AF C9                 RET             ;GOT IT,NOW CARRY ON EXECUTION
                                        ;FROM WHERE WE FOUND IT

01B0 2A0002     RETN:   LHLD    RADR    ;WHERE WERE WE IN THE USER'S
                                        ;PROGRAM WHEN WE CAME TO DO THIS
                                        ;SUBROUTINE?
01B3 C9                 RET             ;CARRY ON EXECUTION FROM THERE

01B4 7E         MATCH:  MOV     A,M     ;GET CORRECT ANSWER TO A
01B5 23                 INX     H       ;POINT TO NEXT USER COMMAND
01B6 91                 SUB     C       ;ZERO RESULT IF THEY MATCHED
01B7 06AF               MVI     B,0AFH  ;SET "YES" FLAG IN CASE THEY DID
01B9 C8                 RZ              ;THEY DID - CARRY ON
01BA 0600               MVI     B,0     ;THEY DID NOT - SET "NO" FLAG
01BC C9                 RET             ;AND NOW CARRY ON

01BD 3E         TESTY   DB      3EH     ;IF WE COME IN HERE THIS PLUS
                                        ;THE NEXT BYTE WILL BE READ BY
                                        ;THE PROCESSOR AS A SINGLE
                                        ;INSTRUCTION TO LOAD AF (HEX) TO
                                        ;REGISTER A,I.E. AS MVI A,0AFH
01BE AF         TESTN   XRA     A       ;IF WE COME IN HERE WE JUST
                                        ;CLEAR A TO ZERO
01BF B8                 CMP     B       ;TEST RESULT OF LAST MATCH (IN
                                        ;B) WITH A.IF WE ARE LOOKING FOR
                                        ;"YES" A WILL BE AF IF WE ARE
                                        ;LOOKING FOR "NO" A WILL BE 0
01C0 C8                 RZ              ;0 MEANS TEST PASSED SO CARRY ON
                                        ;WITH THE REST OF THIS USER LINE

                ;IF THE TEST WAS FAILED WE MUST SKIP TO THE END OF THIS
                ;USER LINE AND CARRY ON EXECUTION FROM THERE. WE USE
                ;THE JLOOP ROUTINE TO SEARCH FOR THE CR AT THE END OF
                ;THIS USER LINE AFTER FIRST SETTING UP TO FIND ONLY
                ;ONE CR.

01C1 3E0D       SKIP:   MVI     A,0DH   ;0D IS ASCII FOR CR-WHAT WE WANT
01C3 1600               MVI     D,0     ;SO WE STOP AT THE FIRST ONE
01C5 C3A601             JMP     JLOOP   ;JLOOP DOES THE REST AND WE
                                        ;RETURN FROM THE END OF IT TO
                                        ;EXEC TO CARRY ON

01C8 7B         EXCH:   MOV     A,E     ;PUT E INTO A
01C9 59                 MOV     E,C     ;PUT C INTO E
01CA 4F                 MOV     C,A     ;AND A INTO C
01CB C9                 RET             ;AND CARRY ON

01CC 5E         LCNTR   MOV     E,M     ;LOAD THE COUNTER
01CD 23                 INX     H       ;MOVE OVER THAT CHARACTER
01CE C9                 RET             ;BACK TO EXEC FOR MORE

01CF 1D         DEC:    DCR     E       ;DECREMENT COUNTER
01D0 C9                 RET             ;BACK TO EXEC FOR MORE

01D1 1C         INC     INR     E       ;INCREMENT COUNTER
01D2 C9                 RET             ;AND BACK TO EXEC FOR MORE

01D3 E5         KEEP:   PUSH    H       ;WE NEED SOME ROOM
01D4 CDE101             CALL    VCOM    ;FIND ADDRESS WHERE TO
01D7 71                 MOV     M,C     ;  SAVE C
01D8 E1                 POP     H       ;RESTORE H&L
01D9 C9                 RET             ;AND BACK TO EXEC FOR MORE

01DA E5         GET:    PUSH    H       ;WE NEED SOME ROOM
01DB CDE101             CALL    VCOM    ;FIND ADDRESS WHERE TO
01DE 4E                 MOV     C,M     ;  LOAD C FROM
01DF E1                 POP     H       ;RESTORE H&L
01E0 C9                 RET             ;AND BACK TO EXEC FOR MORE

01E1 7E         VCOM:   MOV     A,M     ;WHICH VARIABLE OR MARKER?

                ;NOTE WE DONT SKIP OVER VARIABLE OR MARKER # AS
                ;EXEC WILL DO IT FOR US. IF WE DID,THE ERROR ROUTINE
                ;WOULD NOT SHOW US THE WHOLE OF THE OFFENDING
                ;STATEMENT!

01E2 D631               SUI     '1'     ;CONVERT TO BINARY-1

                ;IF VARIABLE OR MARKER # WAS <'1' IT WILL NOW BE 256-#
                ;AND THE CHECK IN THE NEXT LINE WILL PICK IT UP TOO

01E4 FE09               CPI     9       ;>9 OR <1?IMPOSSIBLE!
01E6 D28C01             JNC     ERROR   ;SO GO AND COMPLAIN

                ;THE NEXT INSTRUCTION IS ONLY OF USE IF WE ARE
                ;WORKING OUT THE MARKER COUNTER - BUT IT DOES NOT
                ;DO ANY HARM IF WE ARE WORKING OUT A VARIABLE
                ;ADDRESS

01E9 57                 MOV     D,A     ;PUT IT IN D IN CASE

                ;NOW TO WORK OUT THE ADDRESS OF THE PARTICULAR
                ;STORAGE LOCATION IDENTIFIED BY THE BINARY NUMBER IN A
                ;THIS IS OF NO USE (OR HARM) IF WE ARE WORKING OUT
                ;THE MARKER COUNTER!

01EA 210202             LXI     H,VBASE ;POINT TO STORAGE LOCATION 1
01ED 85                 ADD     L       ;ADD THE INDEX FROM A TO THE
                                        ;LEAST SIGNIFICANT BYTE OF THE
                                        ;BASE ADDRESS WHICH IS IN L
01EE 6F                 MOV     L,A     ;AND PUT THE ANSWER INTO L SO
                                        ;H&L NOW POINT TO THE WANTED
                                        ;STORAGE LOCATION
01EF C9                 RET             ;RETURN TO WHOEVER CALLED US

                ;THE NEXT LINE PROVIDES A LINKAGE OUT OF THIS
                ;PAGE FOR THE USER STATEMENT.AT PRESENT IT IS
                ;FLAGGED AS AN ERROR. WHEN YOU USE IT CHANGE THE VALUE
                ;OF THE ADDRESS TO JUMP TO.

01F0 C38C01     USER:   JMP     ERROR   ;'U' IS NOT IMPLIMENTED YET

                ;THE NEXT FEW LINES HANDLE THE SINGLE CHARACTER
                ;INPUT AND OUTPUT. AS WRITTEN HERE THEY USE TWO OF
                ;MY MONITOR'S SUBROUTINES AND SO WILL NEED ALTERING
                ;TO SUIT YOUR SYSTEM. MI GETS A SINGLE CHARACTER
                ;FROM THE TERMINAL TO A,DOES NOT ECHO IT AND
                ;DOES NOT STRIP OFF THE PARITY BIT (BIT 7). MO
                ;PRINTS THE SINGLE CHARACTER IN C ON THE TERMINAL.
                ;YOU WILL PROBABLY HAVE TO REWRITE ALL THE CODE
                ;BETWEEN THE LINES OF DASHES
```

(Refer to page 61 for modified I/O routines).

```
                ;----------------------------------------------------
3803            MI      EQU     3803H   ;ADDRESS OF MY MONITOR INPUT
                                        ;ROUTINE
3809            MO      EQU     3809H   ;ADDRESS OF MY MONITOR OUTPUT
                                        ;ROUTINE

01F3 CD0338     CI      CALL    MI      ;GET A CHARACTER
01F6 E67F               ANI     7FH     ;STRIP OFF PARITY BIT
01F8 4F                 MOV     C,A     ;PUT IN C READY TO ECHO
01F9 CD0938     CO      CALL    MO      ;PRINT CHARACTER IN C
01FC 79                 MOV     A,C     ;COPY IT BACK TO A
01FD C9                 RET             ;AND RETURN TO WHOEVER
                                        ;CALLED US
                ;----------------------------------------------------

                ;END OF THE PROGRAM. EVERYTHING UP TO HERE COULD BE
                ;KEPT IN PROM IF YOU WISH. THERE ARE STILL TWO SPARE
                ;BYTES IN THE 256 BYTE PROGRAM AREA IN CASE YOUR CI
                ;AND CO ROUTINES ARE LONGER THAN MINE

                ;EVERYTHING FROM NOW ON MUST BE IN RAM. RESERVE
                ;SOME SPACE FOR THE USER SUBROUTINE RETURN ADDRESS,
                ;THE NINE SINGLE CHARACTER STORAGE LOCATIONS AND
                ;THE STACK.
                ;SET A NEW ORIGIN SO THAT THESE STORAGE LOCATIONS
                ;AND THE USER PROGRAM SPACE START ON A NEW PAGE

01FE                    ORG     START+100H

0200            RADR    DS      2       ;TWO BYTES FOR USER SUBROUTINE
                                        ;RETURN ADDRESS
0202            VBASE   DS      9       ;NINE BYTES FOR SINGLE
                                        ;CHARACTER STORAGE LOCATIONS
020B                    DS      10      ;TEN BYTES FOR THE STACK
0215            UPROG   EQU     $       ;USER PROGRAM AREA STARTS HERE
0000                    END
SYMBOL TABLE

CI     01F3    CO     01F9    COM    012D    COM1   0130
COM2   014E    DEC    01CF    END1   0191    ERROR  018C
EXCH   01C8    EXEC   015A    EXEC0  015A    GET    01DA
INC    01D1    JLOOP  01A6    JUMP   019E    KEEP   01D3
LCNTR  01CC    MATCH  01B4    MI     3803    MO     3809
NOPAD  013E    PAD    0128    PLF    0153    RADR   0200
RETN   01B0    SKIP   01C1    START  0100    SUBR   019B
TBASE  0173    TESTN  01BE    TESTY  01BD    TLOOP  0104
TYPE   0196    UPROG  0215    USER   01F0    VBASE  0202
VCOM   01E1
```

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Write your modified I/O routines here.

to build a random number generator into Simple, but the form used in this program makes it hard to predict ahead from turn to turn.

The sixth and last example is really a pair of programs, an enciphering program and a deciphering program. For a moment diverting slightly into ciphers, the simplest cipher is one in which every letter in the plain text message is swapped for another. A letter (say e) is always replaced by the same alternative letter (say k). In other words, we always use the same enciphering alphabet. The characteristic features of the language are not altered — for example, in English, 'e' is the most common letter, with a, o, i, t, n, r, s and h also occurring frequently. On the other hand, j, h, q, x and z occur rarely. If a letter follows a vowel four-fifths of the time and only appears before it one-fifth, the letter is probably n. The combination th and he are common, but ht and eh are rare. From these and other characteristic relationships the cipher can quite readily be broken.

In our cipher *we change the enciphering alphabet after every character* — the previous cipher letter guiding us to which of the many possible enciphering alphabets to use next. Our program is an electronic version of a combination of the twin rotating discs described by Leon Battista Alberti in 1466

Program 6. Enciphering and deciphering programs.

```
&    T WHAT IS THE KEY?
&    A,X, C ORIGIONAL KEY TO COUNTER
&    T
&    T START TEXT,TO GET A NEW LINE TYPE A +,
&    T AT END OF TEXT TYPE A FULL STOP.
&    T AFTER EACH CHARACTER YOU ENTER I WILL
&    T GIVE YOU THE ENCIPHERED CHARACTER.
&    T USE AN @ SYMBOL TO REPRESENT THE
&    T SPACE BETWEEN WORDS.
&    C START OF OUTER LOOP
&1*  A, C CHECK FOR A NEW LINE
&    M+,YT
&    YJ1
&    C CHECK FOR END OF TEXT
&    M.,YT
&    YE
&    C CYCLE THE COUNTER
&2*  X,M0,X,D,YLZ
&    C REDUCE THE INPUT CHARACTER 10 0
&    M0,X,D,X,NJ2
&    C PRINT OUTPUT CHARACTER
&    X,P
&    C PRINT A SPACE
&    L ,X,P
&    J1, C GO AND ENCIPHER MORE

&    T WHAT IS THE KEY?
&    A,X, C ORIGIONAL KEY TO COUNTER
&    T
&    T START TEXT,10 GET A NEW LINE TYPE A +
&    T AT END OF TEXT TYPE A FULL STOP
&    T AFTER EACH CHARACTER YOU ENTER I WILL
&    T GIVE YOU THE DECIPHERED CHARACTER.
&    T TO MARK THE SPACE BETWEEN WORDS USE
&    T AN @ SYMBOL.
&    C START OF OUTER LOOP
&1*  A, C CHECK FOR A NEW LINE
&    M+,YT
&    YJ1
&    C CHECK FOR END OF TEXT
&    M.,YT
&    YE
&    C SAVE INPUT CHARACTER FOR NEXT TIME
&    K1
&    C CYCLE THE COUNTER
&2*  X,M0,X,D,YLZ
&    C REDUCE INPUT CHARACTER TO 0
&    M0,X,D,X,NJ2
&    C PRINT OUTPUT CHARACTER
&    X,P,X
&    C PRINT A BLANK
&    L ,X,P
&    C RESTORE LAST CHARACTER INPUT TO COUNTER
&    C AND THEN GO AND DECIPHER MORE
&    G1,X,J1
```

```
&1 WHAT IS THE KEY?
A
 START TEXT,TO GET A NEW LINE TYPE A +,
 AT END OF TEXT TYPE A FULL STOP.
 AFTER EACH CHARACTER YOU ENTER I WILL
 GIVE YOU THE ENCIPHERED CHARACTER.
 USE AN @ SYMBOL TO REPRESENT THE
 SPACE BETWEEN WORDS
EV L9 EN C: I@ RH DS N4 IE CI S8 @P TX D8 DN A< Y= @W +
I= NI IO E9 RA WM B, IA IR D2 N> AW L: .
E
```

Hex Value	2Ø	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F	3Ø	31	32	33	34	35
ASCII Character		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/	Ø	1	2	3	4	5
Counter Value	-16	-15	-14	-13	-12	-11	-1Ø	-9	-8	-7	-6	-5	-4	-3	-2	-1	Ø	1	2	3	4	5
Simple Usage	√	√	√	T	T	T	T	√	√	√	M	√	√	√	√	√	√	√	√	√	√	√

Hex Value	36	37	38	39	3A	3B	3C	3D	3E	3F	4Ø	41	42	43	44	45	46	47	48	49	4A	4B
ASCII Character	6	7	8	9	:	;	<	=	>	?	@	A	B	C	D	E	F	G	H	I	J	K
Counter Value	6	7	8	9	1Ø	11	12	13	14	15	16	17	18	19	2Ø	21	22	23	24	25	26	27
Simple Usage	√	√	√	√	√	√	√	√	√	√	√	K	I	K	K	K	I	K	I	K	K	K

Hex Value	4C	4D	4E	4F	5Ø	51	52	53	54	55	56	57	58	59	5A
ASCII Character	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Counter Value	28	29	3Ø	31	32	33	34	35	36	37	38	39	4Ø	41	42
Simple Usage	K	K	K	I	K	I	K	K	K	K	I	I	K	K	I

Table 1. The ASCII character set between 2Ø (Hex) and 5A (Hex), equivalent numeric value in the counter and usage in Simple. (√= may be used as a seperator between statements. T = text editor command. K = used key letter. M = marker. I = illegal key letter at present.)

and the auto key proposed by Blaise de Vigenere in 1586. A letter may come out as anything — even itself, but rarely comes out the same way twice. The possible characters (both input and output) are the characters in the ASCII character set, between ϕ and Z inclusive (see table 1). As this does not include a space we use an @ for a space. In order to decipher a message, the initial key (which can be any character from this range) must be known — so it is added as the first character of the enciphered text. As you see the phrase Electronics Today International comes out as the unpronounceable

'AV9N:@HS4E18RX8N<=W=109AM;AR2>W:'.

By using the various Simple statements you can build up bigger and more powerful programs than those shown here. For example, the power that comes from being able to jump (or subroutine) into and out of multiple conditional match statements on a single line has not been explored at all. Try writing a few programs that use a number of logic decisions; you will be surprised how much Simple can do — and remember you can add on extra statements you might want that I have missed out. In the meantime for those of you who enjoy small puzzles you may care to decipher the following message TWA02L7BN8RS38RYCXGX3M3:TϕANX;P.

The answer to this will be given at the end of the article.

Simple

SIMPLE — a small interpreter for microprocessors. Part 2.

Dr. Tim Hendtlass, Applied Physics Department, R.M.I.T.

HAVING DEALT WITH the simple language we now turn to the 8080 machine language program given in listing one which interprets and executes any program given to it in Simple language. No doubt your first reaction is surprise that a source listing which produces a mere 254 bytes of object (machine) code should be so long. The main reason for this is that the listing is very heavily commented. Only those lines which have some numbers at the very left-hand side of the line contain anything other than a comment. A comment is anything on a line to the right of a semi-colon (;), the assembler pays no attention to comments other than to cause them to be faithfully printed out on the final output. You and I are the sole reasons for these comments, they help us find our way through the program and understand how it works. When I first started writing programs I was lazy and did not comment them, or at least not very much. Returning to a Fast Fourier Transform program two years later to adapt it, I discovered a bitter truth — I just could not understand it. An uncommented source listing is as useful as a complete circuit diagram without any component values, wave-forms or labels of any kind.

So, since the design goal for Simple was to produce an interpreter that others could use, understand and especially modify, the source listing is very heavily commented. The listing has one complete instruction per line in general and each line is commented. In addition each block of instructions is also commented. The other items in a line of output from the assembler can be identified by reference to the line almost at the beginning of the listing which has 0100 at the far left-hand side. All lines which contain more than just comments have first of all a four hex digit address printed. This is the address of the first byte of the machine code for the instruction given further across the line. Next to this address are two, four or six hex characters which made up the one, two or three bytes of machine code for the instruction. After them comes an optional entry, a label (in this case START) — this is to allow symbolic references to addresses whose actual value is not known until the assembly is done. A label, if there is one, must end with a colon (:). Next comes the actual instruction, first the key part and then the optional parameters (if any). Finally comes the comment described earlier. With the Simple language description, many readers with a reasonable knowledge of 8080 mnemonics will now be able to work through the source listing with only minor difficulty at one or two places. However, to help those not so familiar with machine code program listings, let us now take a guided tour of the Simple interpreter.

A guided tour of the Simple interpreter

All the addresses below refer to the source listing given in this article which has been assembled to start at location 1ØØ Hex. All addresses and the machine code are given in hex. The Simple interpreter can be separated into two parts, the small text editor used to enter a Simple language program into memory and the actual interpreter which executes a user program once it has been entered.

The text editor

The text editor occupies from 1ØØ to 159 hex inclusive and is complete in itself except for the single character input and output routines CI and CO. The H and L registers are used together as a pointer to some place in the user program storage area. Unless the character entered is one of the five special characters (←, &, %, $, or #), it is put into memory at the current position pointed to by H and L. It replaces what was there and H and L are then incremented to point to the next sequential location in the user program area.

When we first come into Simple no register can be assumed to have any particular value and so first of all (1ØØ, to 1Ø3) H and L and the stack pointer are both loaded with the address of the start of the user programme area. On the 8080 the stack pointer is decremented before an item is placed on the stack so that the stack starts at Ø215 and works down in memory whereas the user program area starts at Ø215 and works up. Note that in 8080 machine code and low byte of an address is sorted before the high byte.

After each character has been processed (except $) we will want to come back to TLOOP for the next character. If we place the address of TLOOP onto the stack just as a subroutine call would have done, we can return to TLOOP by an 8080 RETURN instruction just as if we were returning from a subroutine. This saves valuable space compared to using a JUMP instruction and is the reason for the instructions from 1Ø4 to 1Ø7.

The rest of the text editor is straight forward except for the COM routine and the instruction at 127. These will be covered shortly. Remember though that the character in routine (CI) must also echo the character, I have done this by letting CI 'fall through' to the character out (CO) routine (see 1F3 to 1FD). Note this and the other requirements that CI and CO must meet (given in the listing just after 1FØ) as you will also certainly have to re-write the CI and CO code to suit your system. There are still 2 spare bytes in this page in case your routines are longer than mine.

The Interpreter

The interpreter's main routine starts at EXEC at 15BH and causes the next statement (i.e. the one pointed to by the H and L registers) to be processed. After any statement is processed we must come back to EXEC for the next one, unless we just processed an END statement or found an error. In these latter cases we go back to START and into the test editor again. We use the same technique we used in the text editor to get us easily back to TLOOP in the interpreter, only this time, of course, we put the address of EXEC onto the top of the stack as this is where we want to return to. When we put the EXEC address onto the stack we must not alter any of the 8080's registers, as in the interpreter, unlike the text editor, all of them are used. This takes three instructions and five bytes (15BH to 15FH) compared to the two instructions and four bytes used to get the TLOOP address on the stack.

We then get the key letter of the statement from memory and look to see what kind of statement we have to process, checking to see that it is indeed a legal letter. If the 'letter' comes before 'A' in the ASCII alphabet it may not be an error as it could be a carriage return, marker (*) or a number, all of which are legal, but none of which we want to know about at present. So we skip over it and get the next letter. The fact that EXEC ignores all characters before ASCII 'A' is important and we make considerable use of this later.

Having got an apparently legal key letter (at 16AH) we look up in a table starting at 173H to find the address of the sub-routine which processes this particular kind of statement. Since the whole of SIMPLE fits into one 256 byte page we only have to look up the least significant byte of the address in the table as the most significant byte is the same throughout. The rest of the machine code consists of the subroutines to process the different statements, all of which occur after the address at which the table is stored — a feature that you may find useful if you decide to expand SIMPLE (see later). Some apparently legal key letters are not actually used, the address that all of these send us to is the address of the ERROR subroutine.

The Interpreter's Subroutines

The subroutines called by the interpreter are fairly straight forward except perhaps TESTY and TESTN which will be covered in a moment. Note that VCOM is used by the KEEP, GET, JUMP and SUBROUTINE routines and it does some more error checking to see that the variable or marker number is a digit between 1 and 9 and reports an error if it is not. One possible error that is not checked for is to see that, if you try to jump to the seventh marker (for example), there are seven *'s in your program. If there are less than seven the Simple interpreter will race off through memory looking for the seventh marker and then try to carry on. The result should be so odd that you will know you have made an error! The TYPE sub-routine uses the COM routine of the test editor, but otherwise the interpreter's sub-routines are complete in themselves.

Three Points Of Special Note

Simple uses subroutines that 'fall through' from one to another and an example of this can be seen in the COM routine, which starts at 12DH. Following through this sub-routine you will see that it finally ends at 159H and that the last thing it does is to print a line feed on the terminal. As we wish at one point (127H) to print a line feed, but not to do all the rest of COM, we come in at PLF (153H). In this case there is one difficulty; way up at the start of COM we push the contents of the B and C registers on to the stack and this is normally balanced by the pop just before the final return instruction. One of the subtle bits of coding in SIMPLE concerns how we cope with this POP when we come in at PLF and thus have not done the PUSH. Unelss we take some corrective action we would POP our return address to B and C and immediately get lost. This is why the instruction at 127H (when we go to PLF) *must* be a CALL not a JUMP. Using a call pushes an extra address onto the stack (the address of the RET instruction at Ø12AH) which is really unwanted information. However, this 'unwanted' information is thrown away by the POP B instruction which is itself unwanted when we come in at PLF. So the net result is that everything balances as it should.

Another special point occurs at 1BFH in the interpreter proper. At this point we want to test the state of the YES/NO flag set by the last match statement in Simple. If we are looking for a YES answer we come in at TESTY, if for a NO answer at TESTN. The actual test is carried out at 1C1H, but before this we have to preload A with the desired answer. If we come in at TESTN this is no problem, we exclusive — or the accumulator with itself and thus clear it (NO is represented by zero). However, if we come in at TESTY the processor reads 3EH which is the op-code for MVI A, . . . and so it expects the next byte to be what it is supposed to load into A. Thus now the AFH at 1CØ is taken as data and not as an instruction. The only reasonthat a YES state in the match flag is represented by the rather unusual value of AFH is the fact that Intel chose to use AFH as the machine code for XRA A. Using this way of loading the A register to 'YES' saves several bytes.

The final point of special note again concerns the COM routine. This is used both by the TYPE routine and the PAD routine. In each of these routines it is necessary to take characters one by one from the user program area until a carriage return is found. The only difference is that in one case we type the character and in the other we replace it by a null. We use the D register as a flag to tell us which routine is to be done; this is treated (137H, 138H) in such a way as to set the carry flag if we are to pad and reset it if we are to print. Use is made of the fact that not all instructions alter the state of the carry flag, in particular the 'MVI M,Ø' at 13 CH does not. The carry must have been set at 13CH (otherwise we would have taken the jump at 139H) and is still set when we arrive at 13EH from 13CH. Therefore in this case we do not make the call to print the character at 13EH. Only if the carry was not set at 139H do we make this call at 13EH. Thus we either type or pad depending on the state of the carry flag, but never both. You will see that VCOM at 1E1H is also used by two different types of routines and so has been written in such a way as to do two nearly identical tasks at once. Shared routines have been used as Simple has been written to minimise its size rather than to optimise its speed.

Modifying Simple — Without An Assembler

As stated in the introduction, Simple is designed to allow you to add on statements you would like that I have missed out. There are several ways to do this, the simplest is to use the 'U' or USER statement. To use this the two byte address at 1F1H and IF2H must be altered from the error routine address to the address of the start of your routine. One of the reasons for supplying a version of the Simple interpreter starting at 1ØØH was to leave the memory below 1ØØH as one possible memory area for you to experiment in without any risk of getting tangled up in either the stack or the user program area. As long as normal stack operations are followed in your routine (as many 'pushes' as 'pops' for example) and your routine ends with a return instruction it will correctly take you back to EXEC for the next statement. Only the A register may be altered by your routine although, of course, you may temporarily save other registers on the stack. Your routine may have put up to four extra 16-bit items on the stack at any time without exceeding the space reserved for SIMPLE's stack.

If you want to have more than one extra statement (for example a tape save and a tape load routine) there are also several ways of doing this. One way which does not require you to alter my code is to call your statements U1, U2, etc. Then your routine must check the next character after the 'U' to see which routine is needed and have a way of branching to that one. If you have access to an assembler you have more scope as it is then easy to change the origin of the program.

Modifying Simple — With An Assembler

The only reason for orgainising Simple to start on a page

Simple

boundary are for the ease of the table look up at 16A and for the convenience of anyone wanting to move the whole of SIMPLE to another page by hand as only the most significant byte of each address will need to be changed. If you have an assembler you may use the currently unused key letters (B, F, H, O, Q, V and W) by merely changing the program origin so that TBASE is at the start of a page. Then the same look up procedure will enable you to go anywhere in the page starting at TBASE. (Now you know why all sub-routines referenced from the table occur after the table!) This can be done by setting the original origin to XY00 – 73 where XY is the page you want TBASE on (e.g. to get TBASE at the start of page 2, set the origin to 18D). Now you have 73 bytes of free space on that page you can branch to – of course, you must also change the user program and storage area origin so there is no conflict. If you change the table look up procedure you can have as much space as you like, of course, but this involves modifying my code.

Modifying SIMPLE – With or Without

Naturally you may use any of the subroutines in SIMPLE as part of your new routine, whether you use an assembler or not – another reason for documenting them fairly fully in the listing. The text editor in SIMPLE is hardly the world's greatest and if you have any other text editor available you might care to use it instead – but if you decide to delete the SIMPLE text editor, remember that the interpreter proper uses the COM routine so that must stay. In defense of Simple's text editor it only accounts for 43 bytes (excluding COM). Even if yours is a line oriented text editor (i.e. requires a line number before each line) don't worry, it will work – EXEC skips over numbers at the start of a line, remember?

Simple On Other Microprocessors

If you use an 8085 or Z-80 or microprocessor Simple will run just as it does on an 8080, but if you do use a Z-80 you may use relative jumps instead of absolute (saving one byte a time) and also use the search instructions to do part of what JLOOP is doing. You also have index registers and a second register bank to use. You may even want to use the block move instruction to 'beef up' the text editor to permit inserting extra characters into an existing line.

If you use a 6800, 6502 or 2650 microprocessor you have equivalents to most of the 8080 instructions used here, but I doubt you can do any one – for – one translation. Because of the different instruction sets you may be able to do some things more simply (e.g. the table look up using index registers), but others may take longer. The 8080 instruction set is fairly register oriented, a useful feature when, as here, you can keep most of the 'running' information on the chip. A shortage of internal registers may force you to keep some of this information in extra RAM locations.

If you use a SC/MP the biggest problem you may face is the lack of an obvious external stack. P3 only lets you subroutine one deep, but if you write subroutines to handle an external stack (push, pop, call, return) you should be able to code Simple. Even though you have auto indexing going for you, I doubt you will get it into 256 bytes though.

I would be interested to hear from anyone who writes Simple for another microprocessor – it might become the subject of another article in ETI.

And Finally

Whatever you do with SIMPLE, use it, modify it or just think about it, I wish you fun – after all that is the purpose of a hobby. One last thought; if you do customise it, I suggest you add the word "Revised" to my title of 'Small Interpretive MicroProcessor Language Experiment' – then your version is SIMPLER.

Solution to the enciphering puzzle.

```
#I WHAT IS THE KEY?
I
 START TEXT,TO GET A NEW LINE TYPE A +
 AT END OF TEXT TYPE A FULL STOP
 AFTER EACH CHARACTER YOU ENTER I WILL
 GIVE YOU THE DECIPHERED CHARACTER.
 TO MARK THE SPACE BETWEEN WORDS USE
 AN @ SYMBOL
WW AE QL 2L L@ ZD BO NN 8E R@ SY 3O 8U R@ +
YS LE XE G@ XI 3T M@ 3I -S I@ OS RI NM XP ZL FE .
E
```

PRINTOUT

ETI's COMPUTER SECTION

NEWS

Bidirectional Transceiver

A new 8-bit Tri-State bus transceiver from National Semiconductor provides bi-directional drive for bus-oriented microprocessor systems. Offered in a single 20-pin DIP, the INS8208B device uses low power Schottky technology. The chip has 48 mA drive capability on the B-port (Bus-transceiver) and 16 mA drive capability on the A-port; an additional PNP transistor input on both ports allows reduced input loading.

Typical short-circuit output current is 38 mA for the A-port and 50 mA for the B-port. For 300pf load, the A to B-port propagation delay is 18 nano-seconds for logical "0", and 16 nano-seconds for logical "1" transition.

Each receiver section requires a minimum of 2 volts at only 0.1 μA (typical) for a logical "1" signal; logical "0" requires 70uA. The INS8208B has lower power supply requirements than most other available bus transceivers. The power supply requirement will not exceed 130 mA.

For simplified system interconnections, the INS8208B transmitter and receivers, connected as reversed pairs in parallel, are applied to two sets of eight I/0 ports. Only two control signals are required – a transmit/receive signal to enable the transceivers and a chip disable signal which places both sets of ports in a TRI-STATE condition.

The INS8208B is priced at $4.35 each in 100-unit quantities. Delivery is stock to two weeks.

Applied Technology on the Move

Applied Technology has moved to new, larger premises. As from 2 January the company will operate from:

Applied Technology Building
1A Pappison Avenue
Waitara NSW 2077

Announcing the expansion, Owen Hill, Managing Director of Applied Technology, explained the move was necessary to cope with the enormous growth in business in all areas especially wholesale and mail order divisions. The new complex is equipped with telex and automatic phone facilities and also features a seminar room for microprocessor training.

Applied Technology has developed several exciting products in the microprocessor field applicable to small business systems, educational systems, hobby systems, industrial control and these will be announced over the next few weeks.

Fairchild 'Channel F'

Dick Smith announces that his company will be marketing the Fairchild Video Entertainment Computer. The video computer, known as the Fairchild "Channel F", is all the rage in the US and Europe.

The refined system II version, now available from Dick Smith stores, Grace Bros. outlets and dealers, is, in fact, a very powerful computer with the equivalent of over 20,000 transistors in it. Rather than a game, the 'Chanel F' is an ever-expanding library of video fun, challenge, entertainment and education.

The educational potential for the machine is staggering. Already the machine will teach children to add, subtract, divide and multiply in a fun-packed way. More educational programs are in the pipeline.

Three components make up the 'Channel F' system: your TV set, the Game Console and the plug-in cartridges. The "Videocarts" as they are called, plug into the console like cassettes to change the game. (Some Videocarts have up to 200 game variations in them, not to mention variable options such as variable game speed, elapsed time, etc.) Participants compete via joystick-like individual eight-way hand controllers to get amongst the on-screen action.

Despite its sophistication, it simply

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. 356 6176.

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.

plugs into the aerial socket of your TV set and a 240V outlet with the adaptor provided.

Cost of the 'Channel F' console complete with two resident games, one Videocart, two hand controllers, all leads, 240V adaptor in presentation gift box is only $259.00.

Over seventeen Videocarts are available with over 1,000 game combinations including: Tenpin bowling; Checkers; Casino Blackjack (pontoon); Spitfire ("Curse you, Red Baron!"); How to divide and multiply; How to add and subtract; Backgammon; Baseball, War-games – naval, land and outer space; Rotot wars; Noughts and Crosses; Hangman; Drag race and many others.

All Videocarts only $24.50 each.

For a free demonstration of the fantastic Video Entertainment Computer, call in to any Dick Smith store, Grace Bros. store (except Top Ryde) or participating dealer.

Superboard II

Ohio Scientific, Inc., has just introduced Superboard II, a complete personal computer system contained entirely on only one board. Superboard II was designed specifically with low price and the first-time user in mind. It promises to be the most dramatic price and performance breakthrough to date in the microcomputer industry. Ohio Scientific, with worldwide headquarters in Aurora, Ohio, is one of the top manufacturers of complete micor-computer systems for everyone from the beginning computer hobbyist right up to business and OEM applications.

Superboard II's unique single-board construction and custom LSI micro circuits result in large cost savings without sacrificing system capabilities or performance. In fact, it has more features and higher performance than some home or personal computers that are selling today for up to $2,000. It's more powerful than computer systems that cost over $20,000 in the early 1970's.

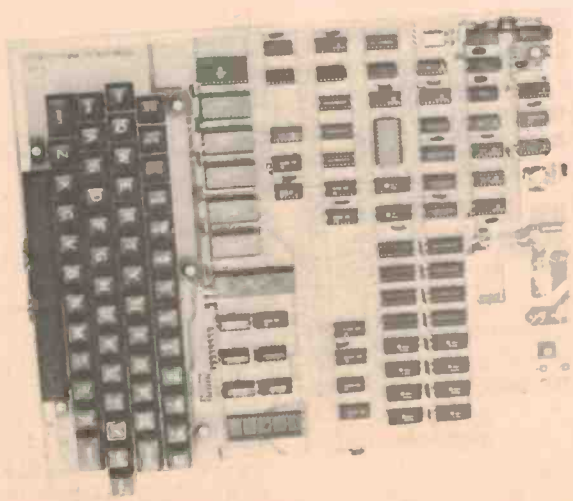
The broad range of Superboard II features includes 8K of BASIC-in-ROM, up to 8K of static RAM, an ultra-fast 6502 microprocessor, a full 53-key computer keyboard with upper/lower case and user programmability, a video display interface with graphics, and a Kansas City standard audio cassette interface, plus full machine code monitor and I/O utilities in ROM. The BASIC-in-ROM is full-feature BASIC that runs faster than currently available personal computers and all 8080-based business computers. The video display is direct access with 1K of dedicated memory in addition to user memory. This display has upper case, lower case, graphics, and gaming characters for an effective screen resolution of up to 256 x 256 points. Normal TV's with overscan display about 24 rows of 24 characters, without overscan up to 30 x 30 characters.

Available options include an expander board that features 24K of additonal static RAM, dual mini-floppy interface port adapter for printer and modem, and an Ohio Scientific 48 line expansion interface. Also available is an assembler/editor and extended machine code monitor, as well as a complete software library.

Ohio Scientific's Superboard II was designed for the first-time hobbyist, student, or serious computer user so it comes without a power supply or case. Any + 5 volt DC 3 amp supply powers it up. The superboard II packs in a lot of personal computing for an extremely low retail price of $279 in the US.

Superboard II is also available as the Challenger 1P complete with power supply (on the same board) and case for only $349. (Export prices for either model are slightly higher.)

For details on where to buy Superboard II or Challenger 1P, or for complete information on other Ohio Scientific microcomputer systems write: Systems Automation Pty Ltd, 26 Clark Street, St Leonards, NSW 2065.



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8k-250 ns	279	4k expansion kit 450 ns)	93

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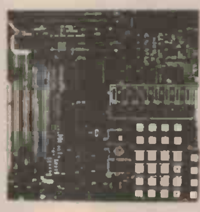

The ideal choice for the beginner, this is a complete Z80 system on a board. Includes 1k static RAM with sockets for another 1k, powerful 2k ZBUG monitor, extra PROM socket PLUS on-board PROM programmer. There's also a Kansas City standard cassette interface, hex keyboard and six digit display, twelve command keys, four counter/timer channels, two eight-bit parallel I/O ports, and room for you to expand: a generous 2½" x 8" wire-wrap area for custom circuitry AND S-100 INTERFACE WITH POSITIONS FOR TWO S-100 EDGE CONNECTORS ON BOARD.

Comprehensive documentation including full operating and programming guides. Power requirements: +5v at 1A, +25v at 30 ma. (for PROM programming).
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THE BEST VALUE IN FLOPPY DISC CONTROLLERS $159
assembled and tested 239

SHUGART FLOPPY DISC DRIVES

SA-400 5" minifloppy	$379	SA-400 cable	35
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assembled and tested 189

EXPANDORAM — High density dynamic RAM, compatible with SD Systems Z80 CPU boards and the Versafloppy controller. Designed to work with 8080 and 8085 CPUs as well, these boards come in 32k and 64k models, which can be purchased partly populated for later expansion if needed.

32k model (uses 4115 RAM)			64k model (uses 4116 RAM)		
Size	Kit	A&T	Size	Kit	A&T
8k	$199	$379	16k	$499	$595
16k	299	449	32k	689	849
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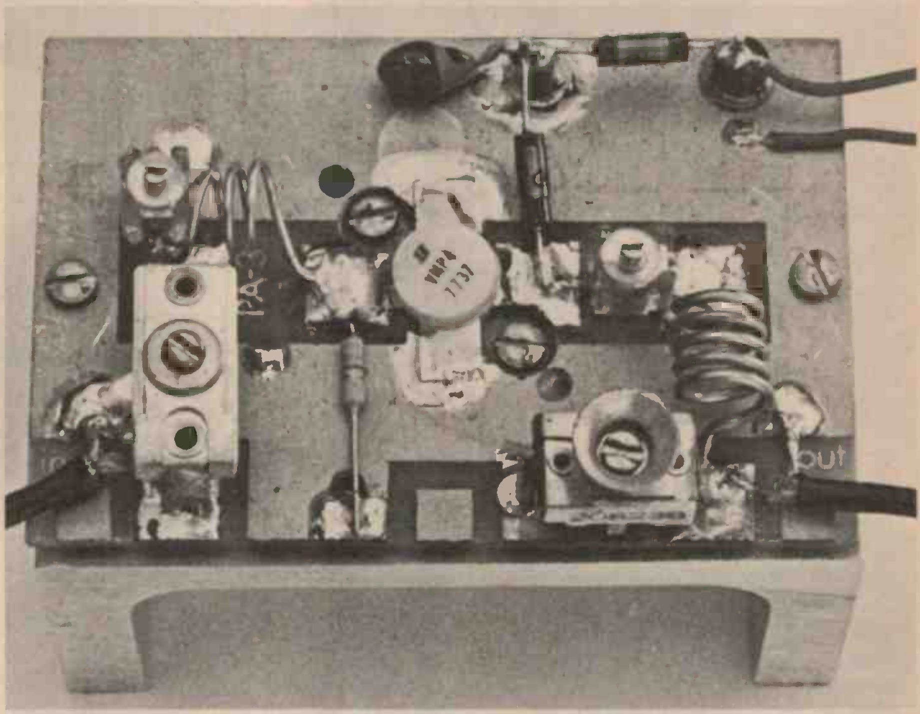
Project 720

144 MHz VMOS Power Amplifier

This first practical project design for a VMOS RF PA, by Roger Harrison VK2ZTB and Phil Wait VK2ZZQ, shows these devices have a number of advantages over bipolar amplifiers.

THE LATEST DEVELOPMENT to emerge from the semiconductor research establishments is the VMOS FET. This device seems set to rapidly revolutionise many areas of solid-state technology, particularly fast switching/high current applications such as line drivers, optical data transmission, memory drivers, DC/DC converters and so on. However, VMOS devices also have unique advantages in communications circuitry. These are:

1. They can be used in any class of operation (A to D) due to the advantages of enhancement-mode operation.
2. They have excellent linear transfer characteristics. Fifth order intermodulation distortion figures are typically eight to ten dB better than bipolars.
3. The drain temperature coefficient has a negative characteristic which prevents thermal runaway. VMOS devices may be easily paralleled and will current share automatically.
4. VMOS devices have no minority carrier storage time thus allowing efficient class D operation as switching times are up to 200 times faster than bipolar devices and there are no switching transients.
5. They are, by virtue of their construction, protected against infinite VSWR problems.
6. They have a high source-drain breakdown voltage.
7. They have low gate-drain feedback capacitance. This characteristic particularly suits VHF/UHF operation.
8. Low noise figure: 2.5 dB is typical. A power amplifier can be used as a low-level amp as well.



Specification – ETI 720

Saturated output power:	V_d of 24 volts – 16 watts (13.5 watts specified)
	V_d of 36 volts – 22 watts (21 watts specified)
Power Gain:	V_d of 24 volts – 11.2 dB at 10 watts output (10 dB @ 200 MHz specified)
	V_d of 36 volts – 11 dB at 18 watts output.
Efficiency:	53%
Input VSWR:	less than 1.5:1.

The prototype was unconditionally stable without neutralisation.

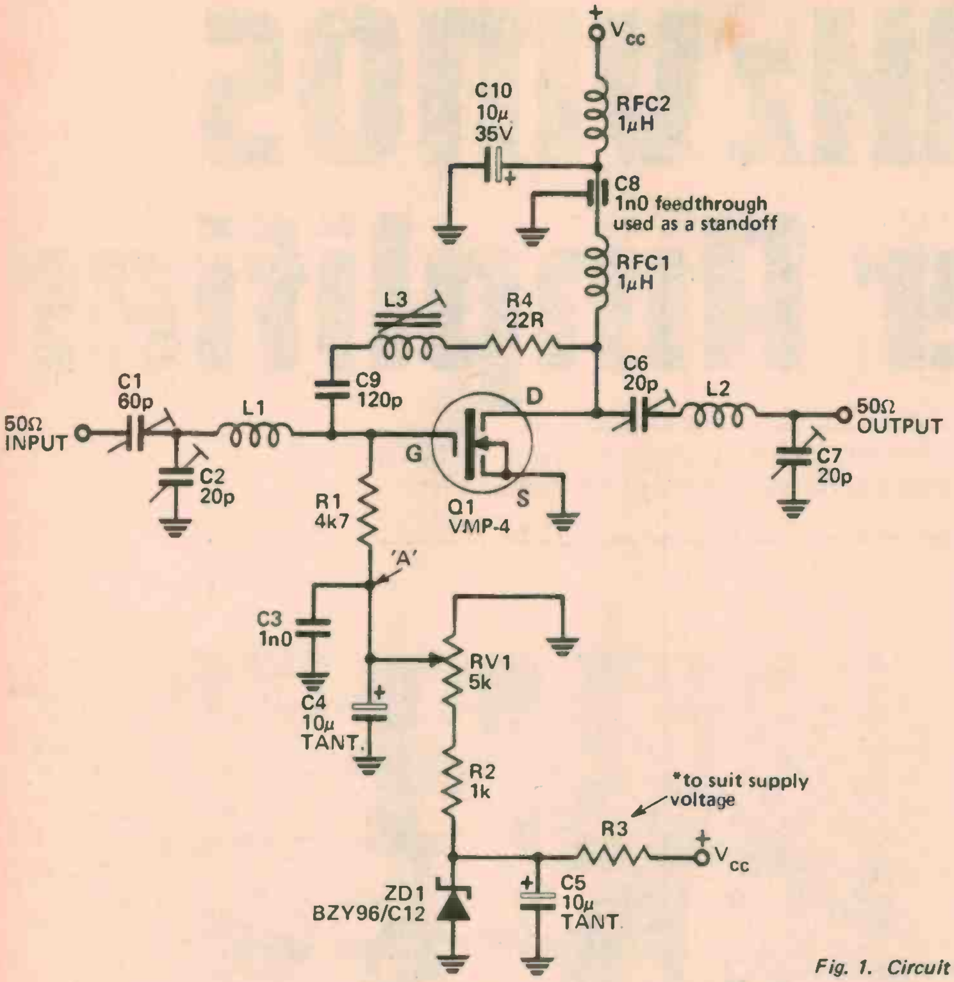


Fig. 1. Circuit diagram of the VMOS Power Amplifier.

9. Wide bandwidth and uniformity of characteristics across frequency range.
10. Higher gain than bipolars of equivalent power dissipation rating.
11. Input and output impedances generally higher than equivalent bipolar devices making matching easier.

High power MOS devices were pioneered in the mid-1960's by RCA laboratories who managed to produce an amplifier that delivered up to 14 watts at 10 MHz. The Russians next achieved 1 watt at frequencies up to 100 MHz.

Recently DMOS (double-diffused MOS) was developed in Japan and commercially produced by Signetics.

The performance of these early types of MOS technology has been surpassed by VMOS which can offer higher power levels by virtue of its inherent improved thermal transfer in the chip construction.

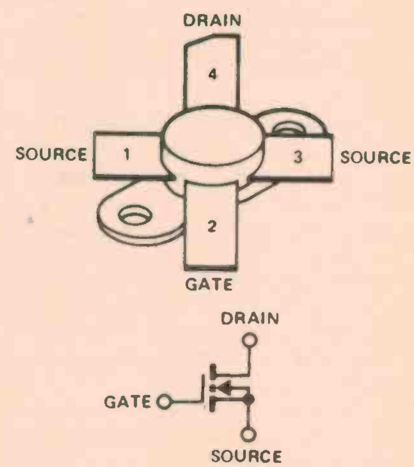
Several companies have developed VMOS devices for communications applications. These are; Westinghouse, Siliconix and the Communications Transistor Corporation. Other companies, such as Fairchild, have confined their interests to fast switching devices.

The Project

The amplifier described here will produce 10 watts output on the amateur two-metre band from a drive of less than one watt, using a 24 volt dc power supply. It can be operated in either class AB or C modes for SSB or FM applications. At a supply voltage of 36 volts (recommended maximum) the prototype delivered 22 watts of RF power driven by around two watts.

The amplifier was unconditionally stable and required no neutralisation, although the manufacturer recommended it. Typical efficiency should be greater than 50%, comparable to bipolar designs for this power level.

The device used is a Siliconix VMP-4, obtained through the Sydney agents, IRH Components, with some considerable delay between order and delivery.



NOTE: The bias and neutralisation components are not shown on the overlay. Neutralisation was not found to be necessary on the prototype.

If bias is required for linear operation R1 should be fed to the bias supply and this point by-passed through C3.

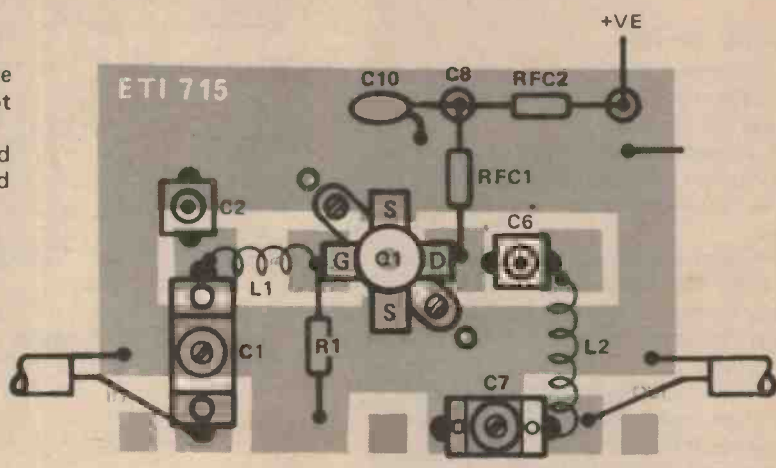


Fig. 2. Component Overlay.

PARTS LIST – ETI 720

Resistors all ¼W, 5% unless stated

R1 . . . . . 4k7
R2 . . . . . 1k
R3 . . . . . to suit supply voltage
R4 . . . . . 22R

Potentiometer

RV1 . . . . 5k lin

Capacitors

C1. . . . . . 60p Elmenco mica compression trimmer, or miniature film trimmer
C2. . . . . . 20p Philips miniature film trimmer
C3. . . . . . 1n0 ceramic
C4, 5 . . . . 10μ tantalum
C6, 7 . . . . 20p mica compression trimmer or miniature film trimmer
C8. . . . . . 1n0 feedthrough, used as standoff
C9. . . . . . 120p ceramic

Semiconductor

Q1 . . . . . VMP-4 (Siliconix)

Miscellaneous

RFC1, 2 . . 1μ miniature moulded RF chokes
pc board . . ETI 715
heatsink . . to dissipate 20W
nuts, bolts, wire, etc.

We hope this article contributes to a considerable shortening of the delay in future. The VMP-4 costs around $20, although this may fluctuate due to exchange rate variations and price movements.

The circuit is shown in Figure 1. Conventional matching was employed with values calculated from data given in reference 1. Input and output impedances of the VMP-4, S_{11} and S_{22} respectively, were taken from the manufacturer's data sheet.

The neutralisation circuit, as recommended by Siliconix, shown in the circuit, was found to be unnecessary on the prototype and could probably be left out in many cases. If your amplifer proves to be unstable it may be added after construction and testing as it is quite a simple matter.

For class AB operation, bias is applied from a simple zener regulator through a pot. and resistor to the base (no messy base chokes!).

In class C operation, the 4k7 base resistor is simply earthed. RF Chokes RFC1-RFC2 are 1 uH miniature moulded chokes.

The VMP-4 is an SOE (stripline-opposed-emitter) package device with flange, rather than stud, mounting.

Construction

The amplifier is constructed on an ETI-715 printed circuit board. All components are mounted on the *copper* side of the board. Commence construction by drilling two holes diagonally opposite the transistor mounting hole, as shown in figure 2 and the photograph, to clear the mounting bolts for the transistor flange. A small file should be used to elongate the holes.

Drill two holes in the heatsink to accommodate the transistor flange securing bolts.

Next, carefully solder the VMP-4 to the copper side of the pc board taking care that the orientation is correct: gate to the input side, drain to the output side.

All the minor components may then be soldered to the board. Wind and mount the two coils L1 and L2 last.

Take care when mounting the pc board assembly to the heatsink. Secure the VFET flange-mounting bolts first. These could be tapped into the heatsink (as we did with the prototype) or secured by nuts through the other side of the heatsink.

The pc board should be secured, and at the same time grounded to, the heatsink by two bolts. These were placed at each end of the pc board, simply for convenience, and a suitable number of washers placed between the pc board and the heatsink so that the pc board was firmly secured without placing strain on the VFET leads.

Input and output switching, if required, may be effected by diode switching (as detailed in reference 4), or a carrier-operated-relay circuit (see reference 5).

Tune Up and Test

Once construction is completed, and you have checked that all is correct, testing can commence.

A variable supply with a current limiting facility is suggested for initial test and tune up. Bias is not necessary at this stage.

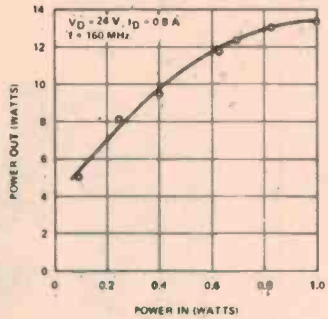
Connect the output to a dummy load and some RF power measuring device. Apply supply voltage and then drive power. Tune for maximum RF output! This should correspond with a peak in drain current. If 'funny' things happen here then suspect positive feedback and install neutralisation.

It's dead simple. However, take care not to grossly overdrive the device — VFETS do not take kindly to this sort of abuse. Becoming the owner of a four-legged stripline fuse can be a chastening experience!

For class AB linear operation, bias should be set to provide about 100 mA quiescent drain current, subsequently adjusted for best performance.

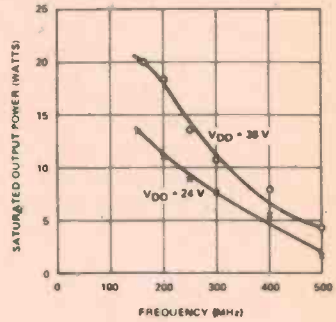
Some adjustment of the input network was required on the prototype suggesting that the input impedance, S_{11}, of the particular VMP-4 was lower than indicated on the data sheet.

Output Power vs Input Power*



*Conjugate input/output match

Saturated Output Power vs Frequency*
P_{IN} = 1 Watt, I_{DRAIN} = 0.8 A



*Conjugate input/output match

	Characteristic	Min	Typ	Max	Unit
BV_{DSS}	Drain-Source Breakdown	60			V
$I_{D(on)}$	ON-State Drain Current	400	600		mA
g_{fs}	Forward Transconductance	170	240		m℧
C_{oss}	Common-Source Output Capacitance		34	37	pF
C_{iss}	Common-Source Input Capacitance		32	35	
C_{rss}	Reverse Transfer Capacitance		4.8	6.5	
G_{ps}	Common-Source Power Gain	10			dB
NF	Small Signal Spot Noise Figure		2.5		

Conclusion

This project proved exceptionally easy to build and its performance very impressive. Other VMOS devices should be available soon from CTC who are marketing a range with output powers from 10 W to 100 W (see ETI, March 1978, page 92).

One obvious application of a VMOS amplifier takes advantage of its excellent small- and large-signal characteristics. One could construct a unilateral mast-head amplifier with the supply voltage fed up the centre-conductor of the feedline coax. With a bit of cunning PIN-diode switching the device would serve as a power amplifier on transmit and a low-noise preamp on receive. A hand-held low power transceiver such as a Ken KP202, or a low power (home-brew) transverter/transceiver would then combine to make quite a powerful base station. Less expensive coax, having a higher loss than could normally be tolerated (like RG58), could be used at a saving approaching the cost of the amplifier in many cases.

This project is but a starting point.

Coil Winding Details - ETI 720

L1. . . . . 5 turns 18 B+S (19 SWG) tinned copper wire 6mm inside dia. 10mm long.

L2. . . . . 3 turns 18 B+S (19 SWG) tinned copper wire 6mm inside dia. 6mm long.

L3. . . . . 4 turns 26 B+S (27 SWG) enamelled wire wound on Neoside LJ010 former with F29 slug.

References

1. "VFETS for Everyone", by Wally Parsons, ETI January 1978, pp. 37-41; and February 1978, pp. 53-58.

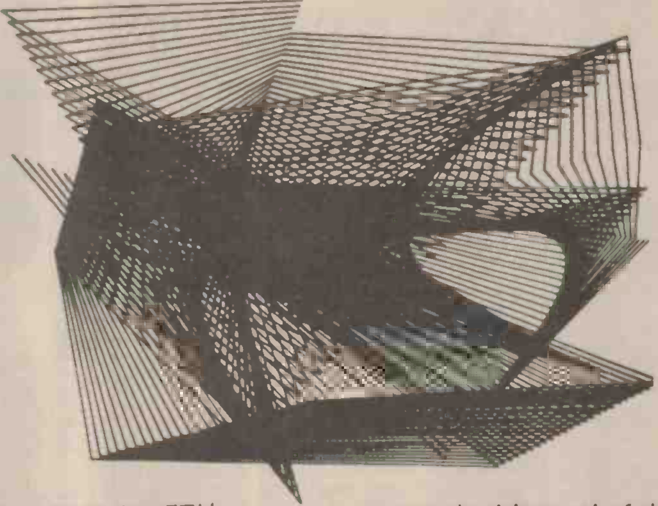
2. "Matching Network Designs with Computer Solutions", by Frank Davis, Motorola Applications Note AN-267.

3. "Solid State RF Power Amplifiers", by Roger Harrison VK2ZTB and Phil Wait VK2ZZQ, from Proceeding of the Symposium of Future Amateur Communications Techniques (FACT), May 20-21, 1978.

4. "VHF Power Amplifiers", by Roger Harrison VK2ZTB and Phil Wait VK2ZZQ, ETI November 1977 (part 1).

5. "VHF Power Amplifiers", by Roger Harrison VK2ZTB and Phil Wait VK2ZZQ, ETI February 1978 (part 3).

eti/computerland software contest



Last minute exhortation! We launched the ETI/ Computerland Software Contest back in April, and since then it seems to have stimulated considerable interest but, frankly, not as many entries as we'd hoped. For this reason, we have decided to set back the closing date of the contest to the 19th of January 1979, and encourage readers to send in their recent software efforts. They don't have to be very complex; quite short programs could well 'scoop the pool'.

We really aren't looking for professional-style brilliance, just software that works and can be used by people to *do* something with their computers.

The type of applications software we're seeking can be anything from a spelling or arithmetic demonstration program or a mortgage repayment program to the kind of sophisticated software we list here:

* *Mailing list processor.*
* *Address/telephone file.*
* *Point of sale terminal.*
* *Recipe file.*
* *Inventory control.*
* *Circuit analysis.*
* *Music synthesis.*
* *Calendar/clock/reminder list.*
* *Chequebook balancing program.*
* *Applications to help the handicapped.*
* *Small business accounting package.*
* *Computer communications set.*
* *Amateur radio station control.*
* *Burglar alarm with police notification.*

The idea is to get your computer doing something that is in some way useful. The only stipulation we'd like to make is that software must be written either in BASIC or in the form of a well-annotated assembly language listing for one of the popular microprocessors such as Z-80, 8080, 6800, 6502 and 2650. This means that we stand some chance of running your software to check it out. For the same reason, specialised hardware should be kept to an absolute minimum.

The criteria the judges will use to decide upon the winning entries will be: the value of the software to the user; its complexity, i.e. the size of the program; the 'elegance' of the software; the degree of 'human engineering' in the design of software features; and the quality, amount and presentation of the documentation supplied. It is likely that other factors will also influence the judges to some extent, as different criteria will apply in varying degree to different programs. The judges will be Dr R Graham, of NSW Institute of Technology, Rudi Hoess, of Computerland, and Collyn Rivers and Les Bell of ETI.

The prizes? Overall first prize is a Cromemco ZPU Z-80 CPU card while the second prize winner will receive a Vector Graphics 8K RAM kit. Third prize is a Vector Graphics 260 x 260 graphic display generator and fourth prize is a PROM/RAM card from Vector Graphics. In addition, each of the prizewinners will receive a two year airmail subscription to the US computer magazine of their choice and a two year subscription to ETI.

There will also be three special prize categories — the awards for 'Best Documentation' and 'Most Original Application' will each be a two year subscription package, while the 'Most Marketable Software' winner will, subject to agreement, be marketed on a royalty basis. In addition, the winning entries will be published in ETI, and payment for this will be made at our usual (excellent!) rates.

With the promise of all these super prizes, fame, and fortune, it's well worth while tidying up some of the software you've written recently, writing it up and sending it in. You've got nothing to lose and a whole lot to gain!

The closing date for the contest is now Friday, 19th January 1979, which should give plenty time to 'polish up' existing programs. The winners will be announced in the March or April 1979 issue of ETI, but if (as we hope) there is a lot of entries to be checked this may be delayed.

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7" x 1200ft	20/20 + Mastering Tape	$10.00	T.B.A.
7" x 1800ft	20/20 + Mastering Tape	$12.50	T.B.A.
10" x 3600ft	20/20 + Mastering Tape	$29.00	T.B.A.
45 min.	Cartridge Tape	$3.80	$70.00
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T.V.I. High Pass Filter .... $1.30 ea. or $11 for 10
T.V.I. Low Pass Filter .... $4.50 ea. or $40 for 10
CB Lock Mount .... $4. ea. or $30 for 10
CB Base Station Antenna .... $20 ea. or $90 for 5
Power Supply Chassis Only .... $15 ea. or $50 for 4

*Please add 10 percent to above prices to cover packaging and postage for all orders under $100 and 5 percent for orders over $100.

CLEARANCE SALE ON GARRARD TURNTABLES
BY MAIL ORDER

CC-10: Rim Drive Chassis Only w/Ceramic Cart. $15
6200: Rim Drive Chassis Only No Cartridge...... $20
65B: Rim Drive Chassis Only No Cartridge....... $35
GT-55: Full Auto Belt Drive w/Shure 756S Cart. $260
DD-75: Direct Drive w/Shure 756S Cart. $250
N.B. GT-55 and DD-75 come complete in base and lid fully imported.
Please add $2 for freight on CC-10, 6200 and 65B and $5 freight on GT-55 and DD-75.

L & D HIGH FIDELITY LOUDSPEAKER BY MAIL-ORDER

N.B.: All speaker systems sold by mail subject to customer being satisfied with product within 7 days of delivery. Full refund guaranteed if not satisfied.

10" 3-way	30 watt R.M.S.	H.610	W.360	D.270	$225 pr
12" 3-way	40 watt R.M.S.	H.685	W.360	D.270	$270 pr
12" 4-way	50 watt R.M.S.	H.685	W.390	D.340	$250 pr
15" 3-way	60 watt R.M.S.	H.795	W.510	D.360	$615 pr

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COMPONENTS SPECIALS —
ALL BRAND NEW

Valve Tuners Black/White ...... $2.50 ea
Transistor Tuners B1/Wh....... $5.00 ea
11" Picture Tubes B1/Wh. .... $12 ea
Yoke for above....................... $5 ea
3 x 4 T.V. Speaker.............. $1.50 ea
Dual Base and Lid .... $18 ea
Garrard Base and Lid.......... $18.00 ea
B.S.R. Base and Lid.............. $18 ea.
C6MR 6" Midrange Speaker...... $8. ea
8" Goodmans Speaker........... $10 ea.
6" Goodmans Speaker .... $6. ea
DT3 Goodmans Dome Tweeter... $9 ea.
5" Philips Midrange................ $9 ea.

N.B. All above freight free anywhere in Australia.

Project 813

Race Track Game

We're not really taking a gamble with this game — we know you'll like the project!

THE DESIRE TO place bets upon almost any event, from the outcome of the Melbourne Cup to the likelihood of life on other planets, is a deep seated one in many Australians. That old joke about the guy who bet his friend a couple of quid that he can give up gambling for a week would not be amusing but for the fact that it were so near the truth.

Three Way Bet

Bets fall into a number of different categories. They may be made on disagreements of fact ('I bet mine's bigger than yours'), about events capable of being modified by skill or lack of it ('I bet I can get mine further than yours'), or bets made upon random events (the mind boggles!).

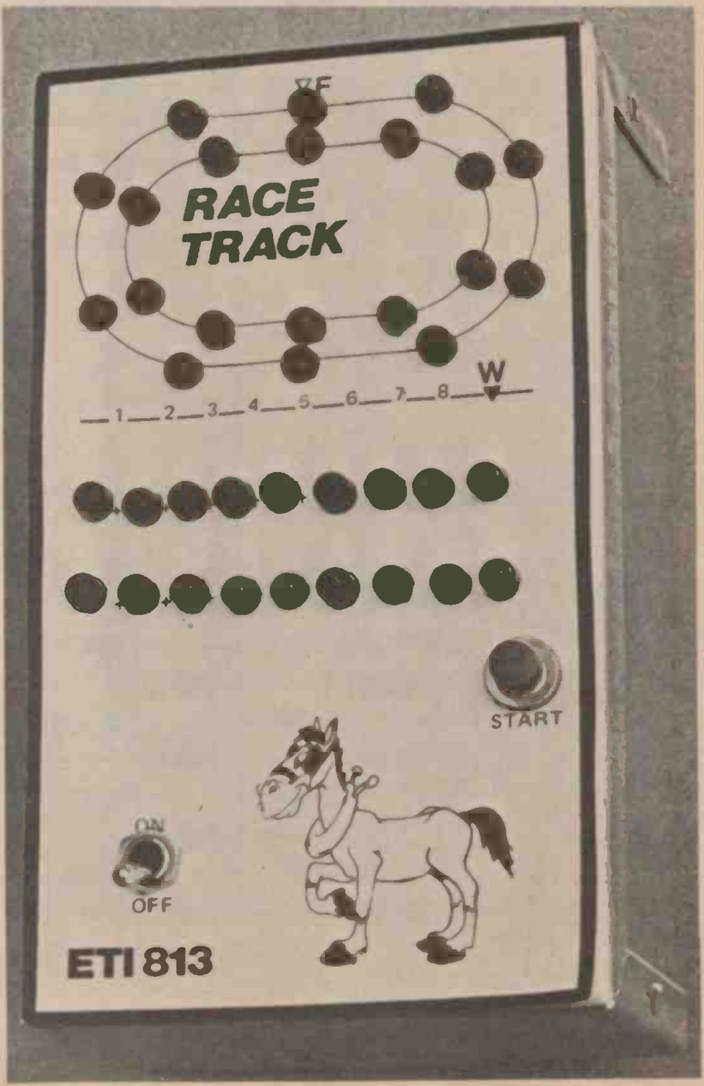
It is this latter type of bet, the toss of a coin, cut of a card or spin of a roulette wheel, that is probably the most popular form of gambling amongst groups of people our race track game provides an exciting means of indulging in this type of activity.

The game is really a development of the well known 'heads or tails' type of game, but whereas most games of this sort are visually unexciting, the race track game more than makes up for any shortcomings in this area!

They're In The LED

When the game's reset button is pressed all the LEDs are off and the 'horses' line up at the starting post. Now is the time to choose a horse and place bets if you wish.

Releasing the button starts the action



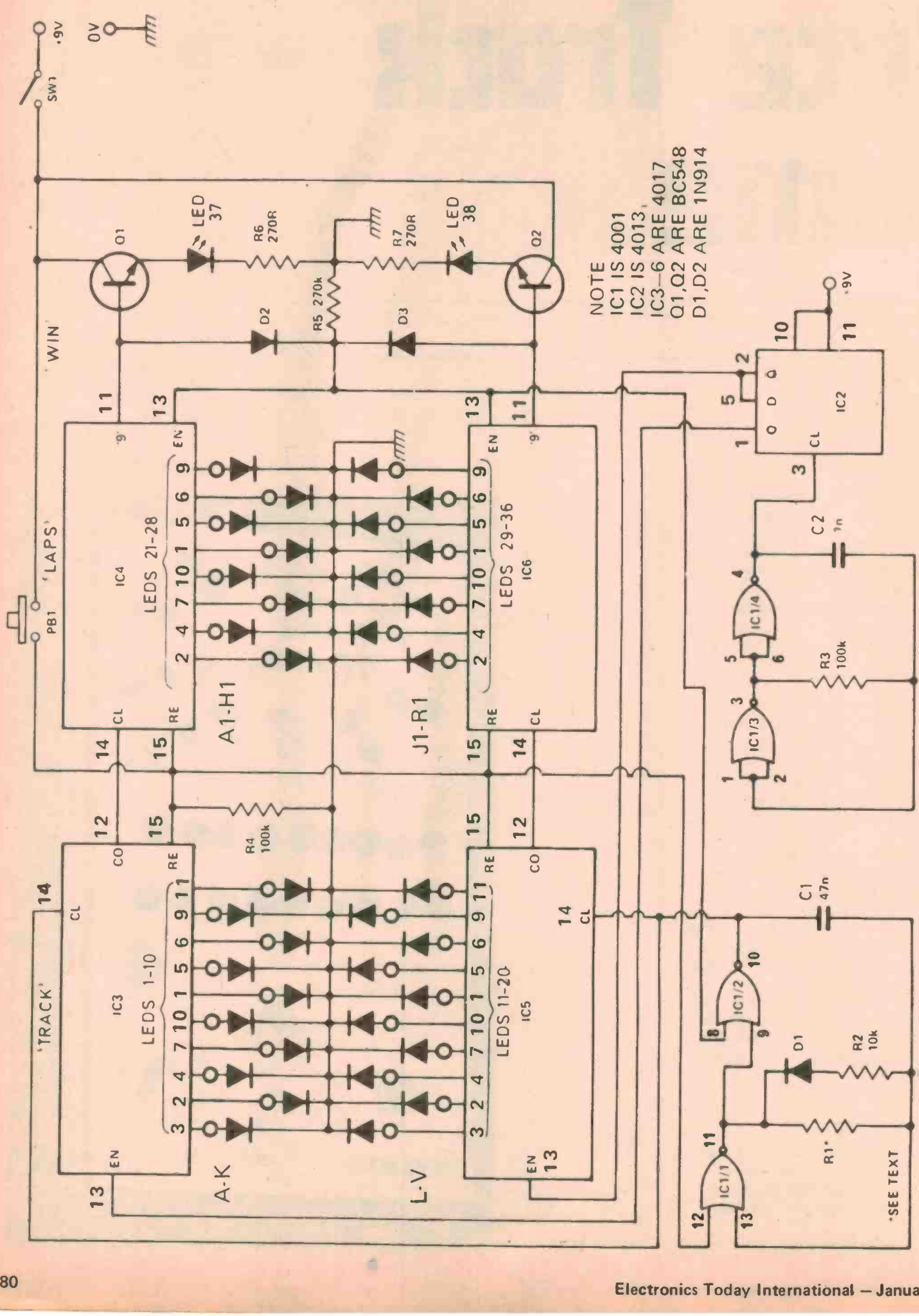


Fig. 1. Circuit of the race track game.

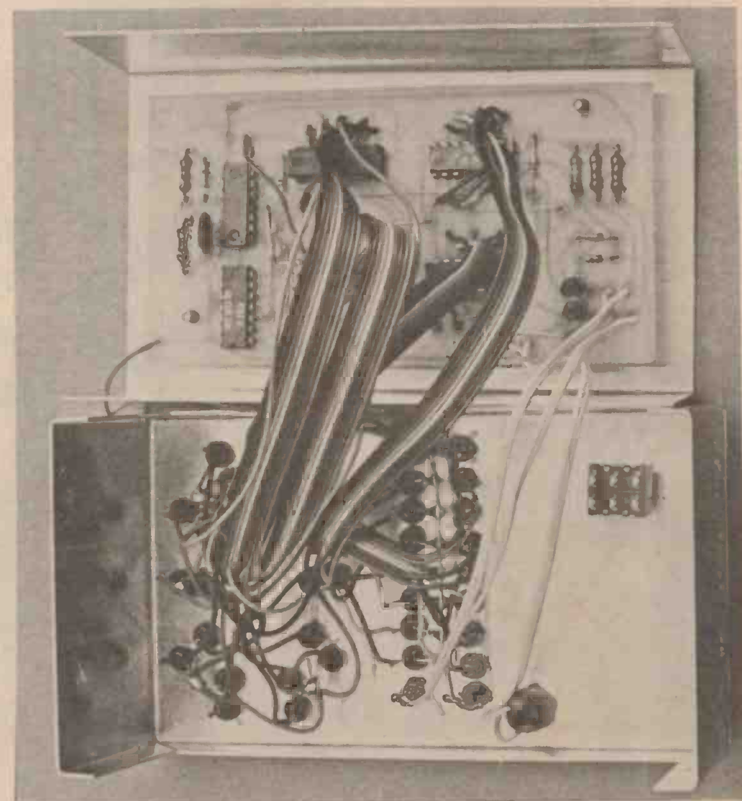
with the circles or LEDs representing the 'horses' starting to flash as first one horse then the other takes the lead. As each horse completes a lap the appropriate lap LED lights. The first horse to cross the finish line lights his 'win' LED and halts the racing horses. If lady luck did not smile on you this time, pressing the reset button gives her, and you another chance.

Construction

Mount all the components on the PCB as indicated in our overlay diagram. We recommend that sockets are used for ICs 1–6 as these are CMOS devices and should not be placed in circuit until all constructional work is complete. The LEDs are hard wired to the PCB and the interconnection information is given in Tables 1 and 2. Note that LEDs 37 and 38 have their cathodes taken to 0 V via R6 and R7 and not directly to ground as the rest.

The value of R1 should be selected to give the best display on the race track. A value somewhere between 4M7 and 10M should suit.

Now is the time to turn on, place your bets and probably lose your shirt.



The completed unit showing the interconnecting wiring between the pcb and the front panel.

HOW IT WORKS – ETI 813

The circuit uses two oscillators each based on two of the NOR gates in the 4001 quad NOR CMOS package. One of these (IC1/3 and IC1/4) runs at a high frequency and its output is fed to the input of one half of a 4013 Dual D type flip-flop. The device divides the output of the high speed oscillator by two and provides two signals that are 180° out of phase at its Q and Q outputs. These signals enable either IC3 or IC5, the ICs being enabled if their enable input is held low.

The second oscillator based on IC1/1 and IC1/2 runs at a lower speed and is arranged to provide a non-unity mark space ratio, in fact a very short "high" output followed by a much lower "low". This non-unity mark space ratio is achieved by the inclusion of D1 in the oscillator's timing network. This second oscillator can be gated on and off by signals to be described below.

Circuit action is as follows. PB1 is closed and this resets all the counters to zero as well as inhibiting the slow running oscillator. Upon releasing PB1, IC3 or IC5 will be clocked as the first positive pulse is generated by IC1/1 and IC1/2. Which counter is incremented will depend upon the state of IC2's outputs.

In general as the two oscillators are out of phase the counters will appear to be clocked in a random manner. A further random element is introduced because while a 4017 is normally clocked with positive going pulses at the clock input with enable held low, it is possible for it to be clocked with a negative going pulse at enable while clock is high. Thus occasionally IC2 will act as a clock.

At the end of a lap a pulse is generated from the carry out (CO) output of either IC3 or IC5 and is used to advance the lap counters (IC4 and IC6).

The game ends on the ninth lap when the '9' output of either lap counter goes high. This turns on either Q1 or Q2 and in turn lights the appropriate win LED. The signal from either '9' output is ORed by diodes and this signal used to halt the game by disabling the slow running oscillator.

PARTS LIST — ETI 813

Resistors all ¼W, 5%
R1 . . . . see text
R2 . . . . 10k
R3, 4 . . . . 100k
R5 . . . . 270k
R6, 7 . . . . 270R

Capacitors
C1. . . . . 47 n greencap
C2. . . . . 1n0 greencap

Semiconductors
IC1 4001
IC2 4013
IC3–IC6 4017

D1–D3. . . . . 1N914

Q1, 2 . . . . BC548

LED1–LED38 . . Red LEDs

Miscellaneous
pcb . . . . ETI 813
miniature pushbutton
spst miniature switch
suitable box
9V battery and holder

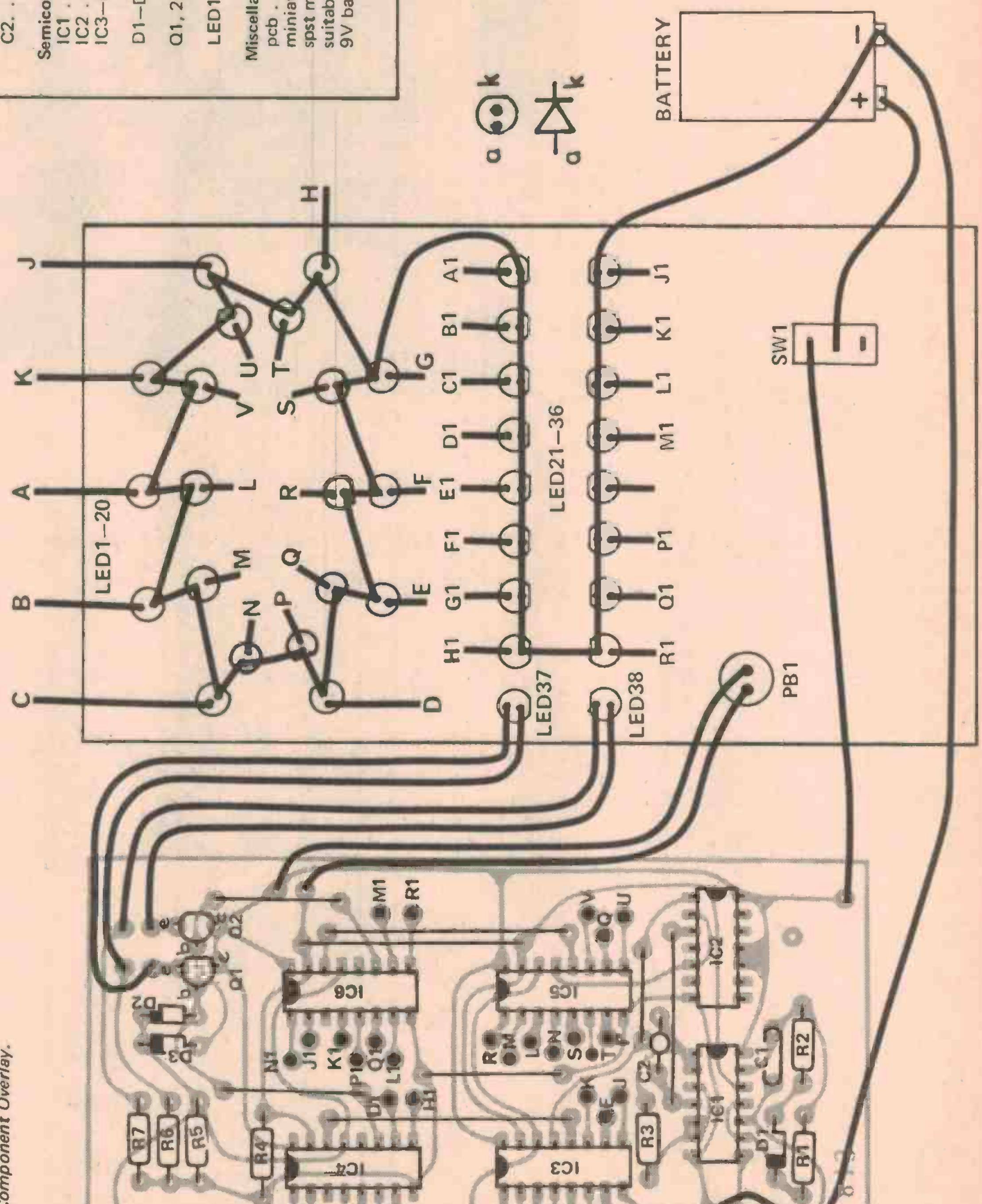


Fig. 2. Component Overlay.

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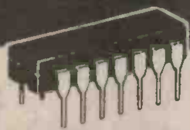
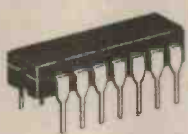
74LS



74LS00	.30	74LS92	1.20
74LS01	.30	74LS93	1.20
74LS02	.30	74LS95	1.50
74LS03	.30	74LS109	.50
74LS05	.35	74LS113	.55
74LS08	.30	74LS114	.55
74LS09	.30	74LS138	1.20
74LS10	.30	74LS151	1.20
74LS11	.30	74LS154	1.60
74LS12	.30	74LS157	.90
74LS14	1.20	74LS163	1.20
74LS20	.30	74LS164	1.30
74LS21	.30	74LS174	1.00
74LS27	.30	74LS175	1.00
74LS28	.40	74LS191	1.20
74LS30	.30	74LS192	1.20
74LS32	.33	74LS193	1.20
74LS37	.45	74LS194	1.20
74LS38	.45	74LS195	1.20
74LS40	.40	74LS196	1.20
74LS42	1.20	74LS221	1.20
74LS73	1.20	74LS253	1.85
74LS74	.50	74LS279	.65
74LS75	.70	74LS365	.80
74LS78	.50	74LS367	.80
74LS85	1.50	74LS368	.80
74LS86	.50		
74LS90	1.20		

TTL



7400	.28		
7401	.28		
7402	.28		
7403	.28		
7404	.37		
7405	.37		
7406	.50		
7407	.50		
7408	.34	7476	.45
7409	.34	7480	1.25
7410	.30	7483	1.25
7411	.37	7485	1.45
7413	.54	7486	.65
7414	1.03	7489	1.20
7416	.60	7490	.75
7417	.60	7491	1.00
7420	.30	7492	.75
7422	.30	7493	.75
7426	.45	7494	1.10
7427	.45	7495	.95
7430	.30	74100	2.45
7432	.43	74107	.65
7437	.50	74121	.60
7438	.50	74123	1.10
7440	.30	74132	1.25
7441	1.50	74150	1.80
7442	.70	74151	1.10
7447	1.25	74153	1.10
7448	1.25	74154	1.70
7450	.35	74157	1.10
7451	.35	74160	1.55
7453	.35	74164	1.55
7454	.30	74165	1.55
7460	.35	74173	2.75
7470	.65	74175	1.65
7472	.45	74180	1.35
7473	.60	74192	1.40
7474	.65	74193	1.40
7475	.65	74221	1.50

CMOS

4000	.25		
4001	.25	4043	1.50
4002	.25	4044	1.50
4006	1.40	4046	1.95
4007	.25	4049	.60
4008	1.25	4050	.60
4011	.25	4051	1.20
4012	.25	4052	1.20
4013	.55	4053	1.20
4014	1.35	4060	2.65
4015	1.20	4066	1.00
4016	.50	4068	.40
4017	1.40	4069	.35
4018	1.40	4070	.40
4019	.75	4071	.40
4020	1.60	4072	.40
4021	1.40	4073	.40
4022	1.60	4074	.40
4023	.25	4076	1.85
4024	.90	4077	.40
4025	.40	4078	.40
4027	.80	4081	.40
4028	1.25	4082	.40
4029	1.90	4510	1.50
4030	.40	4511	1.50
4040	1.30	4518	1.50
4041	1.25	4520	1.45
4042	1.25	4528	1.20

MICROPROCESSOR CHIPS

All devices supplied complete with data.

Z80 2MC/S	$29.95
PIO for Z80	$15.95
CTC for Z80	$15.95
2650A	$19.75
260 PIPBUG	$17.25
SC/MP 11	$12.75
8080A	$12.75
6800	$22.50

OPTOELECTRONICS

FND500 .5" C/C	$1.25
FND 507 .5" C/A.	$1.50
FND 357 .3" C/C.	$1.30
RED LED. .2". 5 for	$1.00
GREEN LED	.35
YELLOW LED	.35

MEMORY IC'S

2101 256 x 4 STATIC RAM.	$3.75
2102-4 1K STATIC.	$1.45
2114 4K STATIC	2 for $19.95
4116 250NS DYNAMIC.	$22.00

CRYSTALS

(± .005% @ 25°C)

		5.000Mhz	7.95
		6.000Mhz	7.95
1.000Mhz	7.95	10.000Mhz.	7.95
1.843Mhz	7.95	12.000Mhz.	7.95
2.000Mhz	7.95	18.000Mhz.	7.95
4.000Mhz	7.95	20.000Mhz.	7.95

LINEAR

		386	1.95
301	.40	555	.35
307	.65	556	.85
308	1.35	565	1.95
311	.85	566	.85
324	1.35	567	2.65
339	.90	709	.75
349	2.25	723 (VR).	.55
356	1.65	741	.35
380	2.00	747	1.25
381	2.00	3900	.90
382	2.00	3909	1.25

CAPACITORS

Ceramic disc:

10pf 50V	.10
47pf 50V	.10
100pf 50V	.10
220pf 50V	.10
330pf 50V	.10
470pf 50V	.10
.001mfd 50V	.10
.0047mfd 50V	.10
.01mfd 50V	.10
.022mfd 50V	.10
.047mfd 50V	.10
.1mfd 50V	.10

Polyester:

.001 100V	.15
.0015mfd 100V	.15
.0022mfd 100V	.15
.0047mfd 100V	.15
.01mfd 100V	.15
.022mfd 100V	.15
.047mfd 100V	.15
.1mfd 100V	.20
.15mfd 100V	.25
.22mfd 100V	.25

Electrolytic:

1mfd 50V	.10
4.7mfd 50V	.10
10mfd 50V	.10
22nfd 25V	.15
47mfd 25V	.15
100mfd 25V	.20
220mfd 25V	.30
470mfd 25V	.45
1000mfd 25V	.55
2200mfd 16V	.85

Tantalum:

.1mfd 35V	.35
.22mfd 35V	.35
.33mfd 35V	.35
.47mfd 35V	.35
.68mfd 35V	.35
1mfd 35V	.35
1.5mfd 35V	.35
2.2mfd 25V	.35
3.3mfd 25V	.35
4.7mfd 25V	.35
6.8mfd 25V	.35
10mfd 25V	.40
22mfd 25V	.45
33mfd 16V	.50

¼W RESISTORS

Full E12 range from 1OHM to 10MEG .04

Each decade includes: 1.0, 1.2, 1.5, 1.8, 2.2, 2.7, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2

SWITCHES

SPST min tog	1.20
ADDT min tog	1.45
SPDT mon push.	1.75
DIPSWITCH 16pin	2.50

PLEASE ALLOW $2.00 postage and handling on all orders.

ETI data sheet

MCM6810A MOTOROLA

128 X 8-BIT STATIC RANDOM ACCESS MEMORY

The MCM6810A is a byte-organized memory designed for use in bus-organized systems. It is fabricated with N-channel silicon-gate technology. For ease of use, the device operates from a single power supply, has compatibility with TTL and DTL, and needs no clocks or refreshing because of static operation.

The memory is compatible with the M6800 Microcomputer Family, providing random storage in byte increments. Memory expansion is provided through multiple Chip Select inputs.

- Organized as 128 Bytes of 8 Bits
- Static Operation
- Bi-Directional Three-State Data Input/Output
- Six Chip Select Inputs (Four Active Low, Two Active High)
- Single 5-Volt Power Supply
- TTL Compatible
- Maximum Access Time = 350 ns – MCM6810AL1
  450 ns – MCM6810AL

NOTE 1: Permanent device damage may occur if ABSOLUTE MAXIMUM RATINGS are exceeded. Functional operation should be restricted to RECOMENDED OPERATION CONDITIONS. Exposure to higher than recomended voltages for extended periods of time could affect device reliability.

ABSOLUTE MAXIMUM RATINGS (See Note 1)

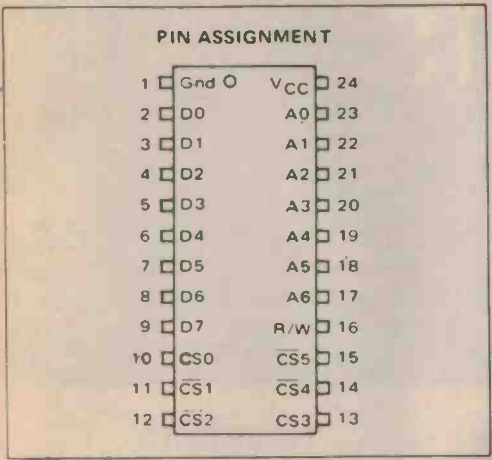
Rating	Symbol	Value	Unit
Supply Voltage	V_{CC}	-0.3 to +7.0	Vdc
Input Voltage	V_{in}	-0.3 to +7.0	Vdc
Operating Temperature Range	T_A	0 to +70	^oC
Storage Temperature Range	T_{stg}	-65 to +150	^oC

RECOMMENDED DC OPERATING CONDITIONS

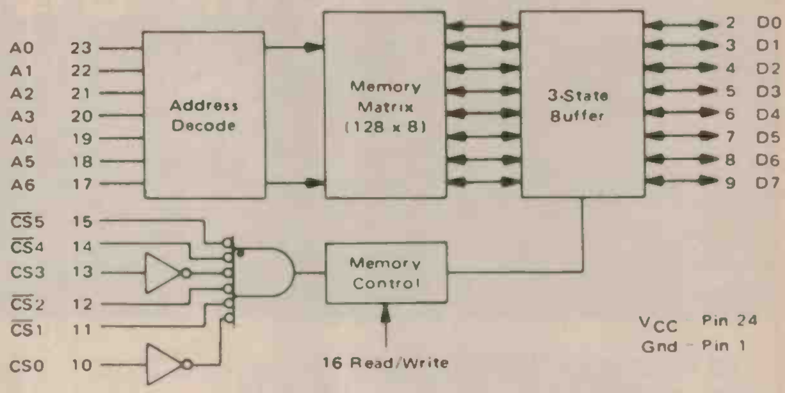
Parameter	Symbol	Min	Nom	Max	Unit
Supply Voltage	V_{CC}	4.75	5.0	5.25	Vdc
Input High Voltage	V_{IH}	2.0	–	5.25	Vdc
Input Low Voltage	V_{IL}	-0.3	–	0.8	Vdc

DC CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Input Current (A_n, R/W, CS_n, $\overline{CS}_n$) (V_{in} = 0 to 5.25 V)	I_{in}	–	–	2.5	μAdc
Output High Voltage (I_{OH} = –205 μA)	V_{OH}	2.4	–	–	Vdc
Output Low Voltage (I_{OL} = 1.6 mA)	V_{OL}	–	–	0.4	Vdc
Output Leakage Current (Three-State) (CS = 0.8 V or $\overline{CS}$ = 2.0 V, V_{out} = 0.4 V to 2.4 V)	I_{LO}	–	–	10	μAdc
Supply Current (V_{CC} = 5.25 V, all other pins grounded, T_A = 0°C)	I_{CC}				mAdc
MCM6810AL		–	–	70	
MCM6810AL1		–	–	80	



BLOCK DIAGRAM



CAPACITANCE (f = 1.0 MHz, T_A = 25°C, periodically sampled rather than 100% tested.)

Characteristic	Symbol	Max	Unit
Input Capacitance	C_{in}	7.5	pF
Output Capacitance	C_{out}	12.5	pF

This device contains circuitry to protect the inputs against damage due to static voltages or electric fields; however, it is advisable that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high-impedance circuit.

READ CYCLE

Characteristic	Symbol	MCM6810AL		MCM6810AL1		Unit
		Min	Max	Min	Max	
Read Cycle Time	$t_{cyc(R)}$	450	–	350	–	ns
Access Time	t_{acc}	–	450	–	350	ns
Address Setup Time	t_{AS}	20	–	20	–	ns
Address Hold Time	t_{AH}	0	–	0	–	ns
Data Delay Time (Read)	t_{DDR}	–	230	–	180	ns
Read to Select Delay Time	t_{RCS}	0	–	0	–	ns
Data Hold from Address	t_{DHA}	10	–	10	–	ns
Output Hold Time	t_H	10	–	10	–	ns
Data Hold from Write	t_{DHW}	10	80	10	60	ns

WRITE CYCLE

Characteristic	Symbol	MCM6810AL		MCM6810AL1		Unit
		Min	Max	Min	Max	
Write Cycle Time	$t_{cyc(W)}$	450	–	350	–	ns
Address Setup Time	t_{AS}	20	–	20	–	ns
Address Hold Time	t_{AH}	0	–	0	–	ns
Chip Select Pulse Width	t_{CS}	300	–	250	–	ns
Write to Chip Select Delay Time	t_{WCS}	0	–	0	–	ns
Data Setup Time (Write)	t_{DSW}	190	–	150	–	ns
Input Hold Time	t_H	10	–	10	–	ns

KITS FOR ETI PROJECTS

WE GET MANY enquiries from readers wanting to know where they can get kits for the projects we publish.

We have only listed the projects published in the last two years, with their dates of publication, so this page can also be used as an index, even though kits are not available for some of them (as far as we know). We will repeat a complete list every 6-12 months depending on space limitations. Any companies not included in this list should phone Jan Collins on 33 4282.

Key To Companies

A Applied Technology Pty Ltd, 109 Hunter Street, Hornsby NSW 2077
C J R Components, PO Box 128, Eastwood NSW 2122
D Dick Smith Electronics P/L, PO Box 747, Crows Nest NSW 2065
E All Electronic Components, 118 Lonsdale Street, Melbourne Vic 3000
J Jaycar Pty Ltd, PO Box K39, Haymarket, NSW 2000
K S M Electronics, 10 Stafford Court, Doncaster East, Vic 3109
M Mode Electronics, PO Box 365, Mascot NSW 2020
N Nebula Electronics Pty Ltd, 15 Boundary Street, Rushcutters Bay NSW 2011
O Orbit Electronics, PO Box 7176, Auckland, New Zealand
P Pre-Pac Electronics, 718 Parramatta Road, Croydon NSW 2132
R Rod Irving, PO Box 135, Northcote Vic 3070
T Townsville Electronic Centre, 281E Charters Towers Road, Rising Sun Arcade, Townsville Qld 4812
V Silicon Valley, 23 Chandos Street, St Leonards NSW 2065

Project Electronics

041. . . . .Continuity Tester . . . . .T, D
042. . . . .Soil Moisture Indicator. . . . . .T, D
043. . . . .Heads or Tails Circuit . . . .Oct 76. . .T, D, E, A
044. . . . .Two Tone Door Bell . . . . .Oct 76. . .T, D, E, O, A
045. . . . .500 Second Timer. . . . . .T, D, O, A
047. . . . .Morse Practice Set. . . . . .T, D, O, A
048. . . . .Buzz Board . . . . .T, D, A
061. . . . .Simple Amplifier. . . . . . . .Oct 76. . .T, D, O, A
062. . . . .Simple AM Tuner . . . . . . .Mar 77 . .D, E
063. . . . .Electronic Bongos . . . . .D, A
064. . . . .Simple Intercom . . . . .Nov 76 . .T, O, A
065. . . . .Electronic Siren . . . . .D, O, A
066. . . . .Temperature Alarm . . . . . .Dec 76 . .T, D, E, A
067. . . . .Singing Moisture Meter. . . . . .D
068. . . . .LED Dice Circuit. . . . . . . .Oct 76. . .T, D, E, A
070. . . . .Electronic Tie Breaker . . . .Jan 77
071. . . . .Tape Noise Limiter . . . . . .Jan 78. . .E
072. . . . .Two-Octave Organ. . . . . . .Jun 78. . .D
081. . . . .Tachometer . . . . .Mar 77 . .T, E, O
082/528 .Intruder Alarm . . . . .T, E, A
083. . . . .Train Controller
084. . . . .Car Arm .D, A
085. . . . .Over-rev Alarm
086. . . . .FM Antenna
087. . . . .Over-LED
088. . . . .Hi-Fi Speaker

Test Equipment

132. . . . .Experimenter's Power Supply . . . . .Feb 77 . .E
133. . . . .Phase Meter . . . . .Apr 77 . .E
134. . . . .Ture RMS Voltmeter . . . . .Aug 77 . .E
135. . . . .Digital Panel Meter . . . . . .Oct 77. . .E
136. . . . .Linear Scale Capacitance Meter . . . . .Mar 78 . .E
137. . . . .Audio Oscillator . . . . .May 78 . .E
138. . . . .Audio Wattmeter. . . . . . . .Nov 78
139. . . . .SWR/Power Meter . . . . . . .May 78
140. . . . .1 GHz Frequency Meter-Timer . . . . .Mar 78 . .C

Simple Projects

243. . . . .Bip Beacon. . . . . .Apr 77
244. . . . .Alarm Alarm . . . . .Feb 77
245. . . . .White Line Follower . . . . .Nov 77
246. . . . .Rain Alarm . . . . .Apr 78
248. . . . .Simple 12V to 22V Converter. . . . . .Jul 78

Motorists' Projects

316. . . . .Transistor Assisted Ignition . . . . .May 77 . .K, O, E
317. . . . .Rev Monitor Counter . . . . .Jul 77 . . .E
318. . . . .Digital Car Tacho . . . . . . .Jul 78 . . .K, E
319. . . . .Variwiper MK II . . . . .Sep 78. . .E

Audio Projects

448. . . . .Disco Mixer . . . . .Nov 76
449. . . . .Balanced Microphone Amp . . . . .Nov 76 . .J, E
450. . . . .Bucket Brigade Audio Delay Line . . . . .Dec 77 . .J
480. . . . .50-100 Watt Amp Modules. . . . . .Dec 76 . .J,E,D,O,R,A
481. . . . .12 V 100 Watt Audio Amp . . . . .May 77 . .E
481. . . . .High Power PA/ Guitar Amp . . . . .Jun 77. . .O
482. . . . .Stereo Amp . . . . .Jan 77. . .O, E
482. . . . .Stereo Amp Part 2. . . . . . .Feb 77 . .O, E
483. . . . .Sound Level Meter. . . . . . .Feb 78 . .E
484. . . . .Simple Compressor Expander. . . . . .Jul 77 . . .E, A
485. . . . .Graphic Equalizer . . . . . . .Jun 77. . .J, E
486. . . . .Howl-round Stabilizer . . . .Nov 77 . .J
487. . . . .Audio Spectrum Analyser . . . . .Feb 78 . .E
489. . . . .Audio Spectrum Analyser 2 . . . . .Apr 78 . .J, E
495. . . . .Transmission Line Speakers . . . . .Aug 77

Miscellaneous

546. . . . .GSR Monitor . . . . .Mar 77 . .E
547. . . . .Telephone Bell Extender . . . . .Jun 77. . .E
548. . . . .Photographic Strobe . . . . .May 77 . .E
549. . . . .Induction Balance Metal Detector . . . . .May 77 . .E
550. . . . .Digital Dial. . . . . .Aug 78 . .E
551. . . . .Light Chaser. . . . . .Sep 78. . .E
552. . . . .LED Pendant . . . . .Sep 78. . .A
553. . . . .Tape/Slide Synchroniser . . .Oct 78. . .E
581. . . . .Dual Power Supply . . . . . .Jan 77. . .E
582. . . . .House Alarm . . . . .Jul 77 . . .T, O, E, A
House Alarm — Installation Instructions . .Aug 77
583. . . . .Marine Gas Alarm . . . . . . .Aug 77 . .M, E
585. . . . .Ultrasonic Switch . . . . . . .Sep 77. . .R, O, E, T
586. . . . .Shutter Speed Timer . . . . .Oct 77. . .E
587. . . . .UFO Detector. . . . . .May 78
588. . . . .Theatrical Lighting Controller . . . . .Nov & Dec 77, Jan & Mar 78 . .N
589. . . . .Digital Temperature Meter (PCB135) . . . . . . .Dec 77 . .E
590. . . . .LCD Stopwatch . . . . .Oct 78. . .N
591. . . . .Up/DownPresettable Counter. . . . . .Jul 78 . . .E
592. . . . .Light Show Controller . . . .Aug 78 . .E

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602. . . . .Mini Organ. . . . . .Aug 76 . .O, E, D, A
603. . . . .Sequencer . . . . .Aug 77
604. . . . .Accentuated Beat Metronome. . . . . .Sep 77. . .E
605. . . . .Temp Stabilized Log-exponential Converter . . .Sep 78

Computer Projects

630. . . . .Hex Display . . . . .Dec 76 . .E, A
631. . . . .ASCII Keyboard . . . . .Dec 76 . .O, E, A
631. . . . .Keyboard Encoder. . . . . . .Apr 77 . .O, E, A
632. . . . .Video Display Unit . . . . . .Jan- Mar 77 . . . .O, A
633. . . . .TV Sync Generator . . . . . .Jan 77. . .E, A
634. . . . .8080 Educational/ Prototyping Interface . . . .Jul, Aug 78
635. . . . .Microcomputer Power Supply. . . . . .Sep 77
637. . . . .Cuts Cassette Interface . . . . .Jan 78. . .V, O, E, A
638. . . . .Eprom Porgrammer . . . . . .Jul 78 . . .E, A
639. . . . .Computerised Musical Doorbell . . . . .Mar 78 . .A
640. . . . .S100 VDU. . . . . .Apr- Jun 78 . . . .V, O, A
641. . . . .S100 Printer. . . . . .Sep 78
650. . . . .STAC Timer. . . . . .Nov 78 . .A

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712. . . . .CB Power Supply . . . . . . .Jun 77. . .O, E
713. . . . .Add-on FM Tuner . . . . . . .Sep 77
714. . . . .VHF-Log-Periodic Antenna. . . . . .Feb 78 Mar 78
715. . . . .VHF Power Amplifiers. . . .Nov 77
716. . . . .VHF Power Amplifiers . . . .Jan 78 Feb 78
717. . . . .Crosshatch Generator. . . . .May 78 . .E, A
718. . . . .SW Radio. . . . . .Oct 78. . .E
719. . . . .RF Field Strength Indicator . . . . .Nov 78

Electronic Games

804. . . . .Selectagame . . . . .Nov 76 . .O
804. . . . .Selectagame (Rifle Project) . . . . .Mar 77 . .O
805. . . . .Puzzle fo the Drunken Sailor . . . . .Oct 77
806. . . . .Skeet . . . . .Jan 78
810. . . . .Stunt Cycle TV Game . . . .Jun 78. . .O, D
811. . . . .TV Tank Game . . . . .Oct 78. . .O, E, D

Utility Dxing

Steve Thurlow of the ARDXC, fills in those gaps in the dial.

LISTENERS WHO TUNE beyond the confines of the international HF broadcasting bands will discover a fascinating world of AM, SSB, morse code and radioteletype signals transmitted by government and commercial utilities or agencies. A *Utility* is any station other than those concerned with Broadcasting, Amateur or CB activities.

Thousands of these stations transmit voice signals so it is not essential to have a knowledge of the morse code to participate in or enjoy Ute DXing, although it could help when hunting the rarer stations. The major requirement to become 'active' is the possession of a full coverage communications receiver that is equipped with a BFO to resolve SSB and CW signals.

As you may well know, a large majority of the broadcasting stations will verify correct reports; however when dealing with Utilities we have a different picture altogether. There is no far flung audience scattered around the globe for these stations to satisfy, so they would not be unduly worried if they did not receive reports; but fortunately for us many are happy to oblige us with an attractive QSL card, including our own OTC and VNG. Others may answer by letter, and others still verify by completing the relevant details on a prepared card forwarded to the station by the DXer.

When sending reports to Utility stations it is of paramount importance that the law is implicitly obeyed at all times; not to do so could bring a penalty in the courts or even confiscation of equipment. In general the regulations state "you must not in any manner whatsoever make use of, or divulge to another person, the contents or any portion of the text of a message". The time, date, frequency and callsigns heard are ample for checking purposes by the station receiving a verification request.

There are three categories of Utility station; these are *Fixed* or point-to-point stations operating radio links between two permanent locations on land, *Aeronautical* stations which are the airports and aircraft in flight, and *Maritime* stations which are the coast stations and ships at sea.

Fixed Stations

Among the most common of these stations are the world wide networks operated by such major companies as American Telephone and Telegraph Company, Cable and Wireless, France Cable and Radio, ITT and RCA. Australia's international communications are the responsibility of OTC, which may often be heard transmitting from its Doonside station to the ANARE Antarctic bases and our near neighbours in the South Pacific. All these stations can be easily identified by a preliminary transmission which may sound something like "This is a test transmission from a station of . . . located in . . . ," which more often than not will be on SSB; this is known as a "voice mirror" (VM). Others still will transmit a short melody called a "melody mirror" (MM). In practice fixed stations operate duplex, that is, two stations of a link use different frequencies; and if secrecy is desired for "live" traffic this is effected by the use of a scrambling device known as condition "A".

The major HF Fixed bands where these stations will be heard are:

4000 – 4063	5060 – 5250
5730 – 5950	6765 – 7000
7300 – 8195	9040 – 9500
9775 – 9995	10100 – 11175
11400 – 11700	11975 – 12330
13360 – 14000	14350 – 14990
15450 – 16460	17360 – 17700
18030 – 19990	20010 – 21000
21750 – 21850	22720 – 23200

In addition fixed stations will also be found in other bands where they operate on a shared basis with additional services.

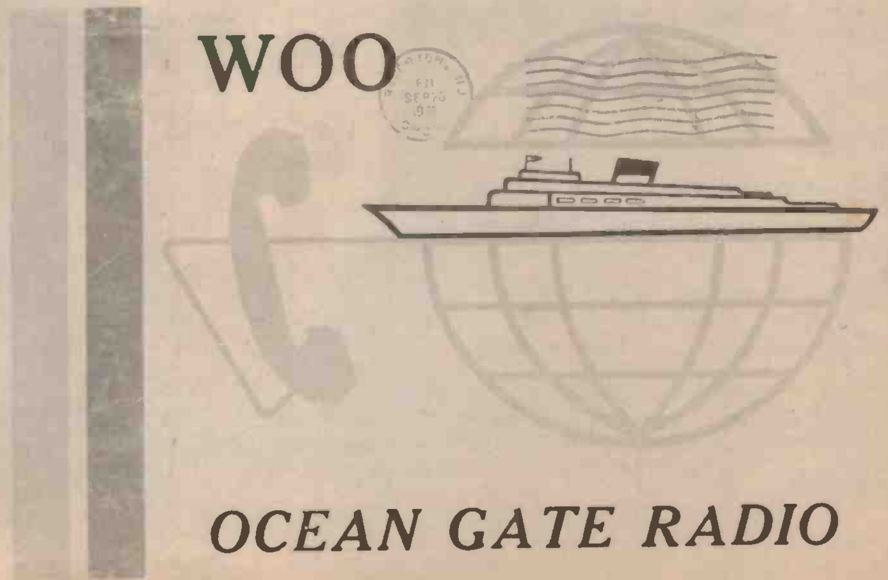
The novice Ute DXer is fortunate that here in Australia we have, in the Outpost Radiocommunications Service, what is perhaps the world's largest HF network; this is a facility enabling isolated people in the remote interior to maintain contact with civilisation. These outposts are controlled by base stations of the Royal Flying Doctor Service, OTC and Telecom Australia. All stations operate on SSB, and in addition the evening frequency of 2021.5 kHz they are sometimes audible during the day on the following networks:

Royal Flying Doctor Service

VJB Derby	5301.5	6926.5
VJC Broken Hill	4056.5	6921.5
VJD Alice Springs	5371.5	6951.5
VJI Mount Isa	5111.5	6966.5
VJJ Charleville	4046.5	6846.5
VJJ Cairns	5866.5	7466.5
VJQ Kalgoorlie	5361.5	6826.5
VJT Carnarvon	4046.5	6891.5
VKF Wyndham	5301.5	6946.5
VKJ Meekatharra	5261.5	6881.5
VKL Port Hedland	4031.5	6961.5
VNZ Port Augusta	5146.5	6891.5

OTC

VIE Esperance	3394.5	6771.5
VIH Hobart	5356.5	



Utility Dxing

Department of Commerce
NATIONAL BUREAU OF STANDARDS
RADIO STATION WWVH
KAUAI, HAWAII

2.5 MHz—21° 59′ 31″ N, 159° 46′ 04″ W   10.0 MHz—21° 59′ 29″ N, 159° 46′ 02″ W
5.0 MHz—21° 59′ 21″ N, 159° 45′ 56″ W   15.0 MHz—21° 59′ 26″ N, 159° 46′ 00″ W
20.0 MHz—21° 59′ 24″ N, 159° 45′ 58″ W

This is to confirm your reception report of WWVH

on 5 & 10 MHz. (Frequencies)   July 1, 1971 (Date)

Serial # 39   C. L. Trembath (Engineer-in-Charge)

Complete description of Services of NBS Radio Stations given in Special Publication 236 Available from Government Printing Office—25c

VIN Geraldton	4441.5
VIO Broome	4981.5
VIR Rockhampton	5766.5
VIT Townsville	5021.5

TELECOM AUSTRALIA

VJY Darwin	6841.5	6976.5

Another familiar signal is the "feeder" program beamed by international broadcasters such as the BBC and VOA to distant stations for subsequent relay to the intended audience. Radio Australia has such a service to its Carnarvon station for retransmission to Asian listeners, and has during recent times been monitored on 6865, 9210, 9450, 12190, 12290, 15870, 16220, 18215 and 18760 kHz.

Aeronautical Stations

Of all the bands reserved for aeronautical communications you will find the most active are the 5, 6 and 8 MHz bands, so this is where to start listening if you want to hear the ground-air-ground transmissions of airports and aircraft in flight. The full complement of HF frequency bands allocated to this service are:

2850 – 3025	3400 – 3500
5480 – 5730	6525 – 6765
8815 – 9040	10005 – 10100
11175 – 11400	13200 – 13360
15010 – 15100	17900 – 18060

You will not hear any landings or take-offs because these communications are conducted in the VHF range; however you will be able to pick up domestic and international aircraft when they are flying enroute between destinations. Domestic aircraft use frequencies assigned to their area of operations as follows:

Northeastern area (QLD)
3460 6533 6575 8896
Southeastern area (NSW, VIC)
3008 5498 6575 8938
Western area (NT, SA, WA)
3418 6610 8952 8938

In addition, airports close to boundaries are equipped with adjacent area frequencies, and may also be heard working each other for liaison purposes. International flights use route frequencies, and on a single channel you can hear stations thousands of miles apart working the one aircraft.

Aircraft arriving at Sydney from the Pacific can be heard on 2945, 5638, and 8847. These frequencies are also held by Auckland, Nandi and Honolulu. Darwin and Perth arrivals use 2987, 5673 and 8868, as do also Djakarta and Singapore

The Overseas Telecommunications Commission (Australia) has pleasure in confirming your reception of the following transmission :—

SERVICE: SHIP/SHORE ON DEMAND.

CALL SIGN: VIS9

EMMISSION: A3h.

TRANSMITTER POWER: 10KW

AERIAL TYPE: OMNI DIRECTIONAL

AERIAL BEARING:

FREQUENCY: 8757.6 KHz

O.T.C., the Australian national body responsible for telecommunications services between Australia and other countries, and between Australia's external territories and shipping, thanks you for your report on its transmission and conveys best wishes.

.... Signed for O.T.C.

for aircraft from or traversing Asia. Indian Ocean flights arriving at Perth use 3481 and 6561; early morning listeners will find these channels are shared with Bombay, Nairobi, Salisbury and Johannesburg.

Domestic aircraft may be recognised by the use of the last three letters of their registration as their callsign. An aircraft with the registration VH-BMD will identify as Bravo Mike Delta. Overseas carriers invariably use flight numbers and a name associated with the airline, such as Qantas 4 and Speedbird 888 (British Airways).

Other aeronautical signals regularly heard are the VOLMET broadcasts by major airports detailing weather conditions at selected landing sites in their immediate area. Transmissions are on a rotating basis with other regional stations in AM. Australia's only VOLMET station at Kingsford Smith Airport identifies as Sydney VOLMET, and transmits on the hour and half-hour on 3432, 6680 and 10017 kHz. On the same frequencies at five minute intervals you may also hear Calcutta, Bangkok, Karachi and Singapore. In the Pacific area coverage is provided by Oakland, Tokyo, Hong Kong, Honolulu and Anchorage who broadcast in that order on 2980, 5519 and 8913 kHz.

Maritime Stations

These are the coast stations and all ships afloat from the tiny radio-equipped craft in inland waters to liners and huge tankers on the high seas.

The 2 MHz band where AM is used is primarily for the use of vessels in coastal waters, while ships further afield operate on 4 MHz and above where SSB is the only voice communication permitted. The full range of HF maritime frequency bands are:

2065 – 2107	2170 – 2300
4063 – 4438	6200 – 6525
8195 – 8815	12330 – 13200
16460 – 17360	22000 – 22720

Just like the 'fixed' services, maritime stations operate duplex, but here the similarity ends. After contact has been initially established on a common calling frequency, communications are then conducted on a system of 'paired' working frequencies where both are permanently linked together. An exception to this is the 2 MHz band where 2201 kHz is used simplex for all traffic. OTC's coast stations transmit routine broadcasts and traffic for ships from 7-9 am, 12-2pm and 4-7pm local time on the following frequencies:

AUSTRALIAN RADIO DX CLUB

QSL From VLKZ

RECEPTION REPORT RECEIVED CHECKED AND VERIFIED

FREQUENCY 512 khz POWER Joe. WOTTS ?

DATE 22-10-67 TIME 0857 AEST

REMARKS TAMBUA advising VIS of ETS at

S.S. TAMBUA 171243 SYDNEY

Official Stamp — Signed

Common Calling frequency	Coast Station Working frequency	Ship Station Working frequency
2182	2201	2201
4125	4428.7	4134.3
6215.5	6512.6	6206.2

Ocean forecasts by Oakland and Miami are usually well received, as are also signals from the few coast stations transmitting voice mirrors at Athens, Goteborg, Rome and St. Lys.

Standard Frequency and Time Signal Stations

These stations are perhaps the most well-known of the Utilities to the shortwave listener, and will readily verify correct reports by QSL card. Telecom Australia's VNG station at Lyndhurst may be heard on any two of its 4500, 7500 and 12000 kHz transmissions around the clock with voice announcements each quarter hour. The US stations WWV at Fort Collins and WWVH at Kauai broadcast each minute, and their comprehensive program provides information on sunspot activity and propagation conditions.

For further information write to: The Australian Radio DX Club, P.O. Box 227, Box Hill, Victoria 3128.

REFERENCES

Telecom Australia's "Australian Table of Frequency Allocations".

Telecom Australia's "Outpost Radiocommunications Stations".

Dept of Air Tpt "En Route Charts".

OTC's "Small Ships Service" sheet.

Aeronautical Radio Incorporated (ARINC) Route Charts.

ZME

Raoul Island **Kermadec Group** **South Pacific Ocean**

Confirming your Reception Report dated 10th March that this Station, on a frequency of 5225/4600 Mhz k/cs was working with Station ZLZ51 at the time stated in your report.

Transmitter Collins

Power .25 kw

Antenna 2 Wire FD

Signed F R Knewstubb.

Station Radio Technician.

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JOSTYKIT's engineers, technicians and educational experts are continuously developing new advanced and reliable electronic kits which can be constructed without any great technical know-how. Even large and intricate projects can be constructed with JOSTYKIT, all kits are supplied with instruction booklets which include a small course on assembling and soldering - a great help for beginners.

The instruction booklets are divided in such a way that the simplest components are assembled first. Every single component, construction and assembly examples are shown on drawings easily understood by everyone. For those with special technical interests each instruction booklet ends up by describing function and diagram. You'll always learn something when you construct a kit from JOSTYKIT. JOSTYKIT's one-year guarantee is an extra safeguard for you.

RECEIVERS
AMPLIFIERS
PWR. SUPPLIES
TRANSMITTERS
&
Many others !

AT465 3 CHANNEL LIGHT SHOW
Turn your music into light! Simply connect to the audio output terminals of your amplifier and this quality kit does the rest for you. Have your own DISCO!

Kit AT465 . . . . $64.00
Chassis kit and Knobs B6065 . . . . $25.00

AT468 4 CHANNEL LIGHT SHOW
This superb kit drives 4 lights up to 400w each from the audio amplifier output.

Kit AT468 . . . . $75.00
Complete Chassis Kit and Knobs B3265 . . . . $48.00

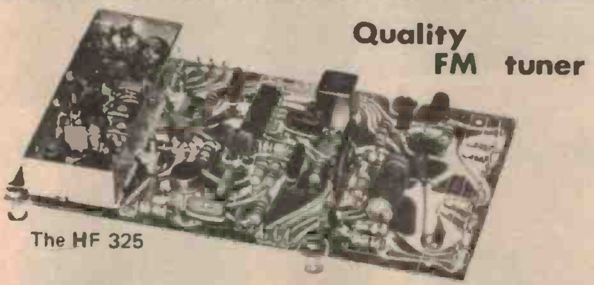
AT365 3 CHANNEL LIGHT SHOW
This quality kit uses microphone input instead of connection to the audio output of the amplifier. Singing, clapping will all effect the light show! 1500w max.

Kit AT365 . . . . $69.00
Complete Chassis Kit and Knobs B3265 . . . . $48.00

HF325-2 QUALITY FM TUNER MODULE
High quality kit with good sensitivity and low distortion. With this kit all coil-winding is already done for you.

Kit HF325-2 . . . . $79.00
Stereo decoder HF330 . . . . $24.00

Quality FM tuner



The HF 325

HF310 FM RECEIVER
Popular FM tuner 87.5 – 108 MHz with 60dB signal to noise ratio and low harmonic distortion.

Kit HF310 . . . . $49.00
Stereo decoder HF310 . . . . $24.00

HF330 STEREO DECODER
Gives 40 – 45 dB channel separation, just add to a good quality FM receiver.

Kit HF330 . . . . $24.00

HF65 FM TRANSMITTER 60-148 MHz
Will run 5w output with heat sink. Ideal for signal testing or for a miniature transmitter which could be received on a standard FM receiver.

Kit HF65 . . . . $9.00

NT415 LAB POWER SUPPLY 0 – 30V
1 amp well-regulated supply for professional use. Complete with box and transformer.

Kit NT415 . . . . $128.00

AT347 ELECTRONIC ROULETTE
Roulette Kit with 10 light diodes. It slowly unrolls and stops at a random digit. Complete with box and attractive panel display.

Kit AT347 . . . . $54.00

HF61 MEDIUM WAVE RECEIVER
540-1600 KHz receiver complete with ferrite coil antenna.

Kit HF61 . . . . $19.00

AF300 AUDIO AMPLIFIER – 3 WATTS
A real work-horse, this universal power amp. has a wide range of applications such as car radio, record players and small receivers. Due to its well designed electronic circuit the AF300 can be used over wide voltage ranges without deterioration of the specification parameters.

Kit AF300 . . . . $25.00

AF340 40 WATT AUDIO AMPLIFIER MODULE
High quality 20-20,000 Hz, 37w RMS with low distortion.

Kit AF340 . . . . $35.00
AF380 . . . . $18.00

HF395 RF PREAMPLIFIER
Gain 30dB to 20 MHz, 10dB to 100 MHz and 5dB to 225 MHz. Ideal to boost reception on short-wave receivers.

Kit HF395 . . . . $6.00

HF385 VHF/UHF ANTENNA PREAMP
Superb quality with two aerial inputs and one down lead which simultaneously supplied current from the power supply. Freq. range 40-250 MHz and 400 – 820 MHz, gain 9 – 18dB depending on frequency.

Kit 385 . . . . $30.00
Box B850 . . . . $6.00
Optional Power Supply NT410 . . . . $20.00

NT300 LABORATORY POWER SUPPLY 2 – 30V
High quality supply, regulated 2 – 30V dc at 2 amps with overload protection. Complete with box and transformer.

Kit NT300 . . . . $110.00

HF305 AMATEUR BAND 2m CONVERTER
Converts 2m FM down to the FM band 88 – 108 MHz.

Kit HF305 . . . . $28.00
Optional Squelch Unit $25.00

AT320 ALL ROUND AC/DC REGULATOR
This kit is a control unit with almost incredible possibilities. Use it as a touch control, burgler alarm, timer, heat/cold regulation. Power supply is built in.

Kit 320 . . . . $54.00

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JK01	GENERAL PURPOSE AMP 0.5w	$18.00
JK02	MICROPHONE AMPLIFIER	$19.00
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JK04	FM TUNER 88-108 MHz	$30.00
JK05	27 MHz RECEIVER	$33.00
JK06	27 MHz TRANSMITTER	$29.00
JK07	DUAL TONE DECODER FOR R/C MODELS	$43.00
JK08	240vac LIGHT OPERATED RELAY	$20.00
JK09	SIREN KIT incl. SPEAKER	$19.00
JK10	PHOTOGRAPHIC TIMER 240vac	$23.00
JK101	BURGLAR ALARM KIT	$55.00

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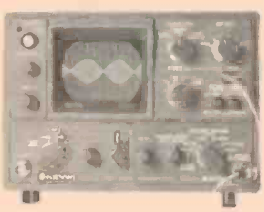
WHENEVER YOU WANT TO MOVE UP — KENWOOD HAS THE WAY

TL-922
HF LINEAR AMPLIFIER
160-10 METER
2kW PEP INPUT

AT-200
ANTENNA TUNER



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TS-520S
THE NEW HF TRANSCEIVER

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Amateur News

Kenwood's TS120V Surprises Dealers

At a recent dealer release conducted by Melbourne firm Vicom, the gathering was amazed by the superb technical performance of the TS120V. Many of those present were technically well-qualified to give the transceiver a critical appraisal. Biggest surprise was the rig's performance in the sensitivity and selectivity areas.

The transceiver was still able to 'hear' a signal generator at 0.075 μV (about -130 dBm) across all bands 3.5 to 30 MHz! Coupled with this a 7mV signal 4 kHz off frequency could not be heard on the receive frequency — that's a rejection ratio of almost 100 dB!

From the enthusiasm shown by the dealers, the TS120V looks set to become a real winner.

Technical Standards for Amateur Equipment

The Australian Government, through the Postal and Telecommunications Department, is considering introducing a minimum standard for spurious and harmonic radiations for amateur radio equipment.

The standard is included in a draft Amateur Radio Handbook which has been distributed to the Wireless Institute of Australia for comment. The proposed specification calls for out-of-band radiations to be at least 45 dB down from the fundamental radiation for both commercial and home-constructed equipment.

Melbourne amateur equipment importer/dealers, have made a submission to the Postal and Telecommunications Department suggesting that the standard should be set at -40 dB otherwise "Australian amateurs will be deprived of any commercial equipment"

Vicom, whilst agreeing in principle with the establishment of standards, urged P & T to base their specifications for high frequency equipment on the American ~~Fcc~~ standard, when this is implemented. A spokesman for Vicom said that "Practically all ham equipment is specifically designed for the USA market and manufacturers would probably not bother with the smaller Australian market if unreasonable parameters were set.

"The 45 dB standard is even tougher than some P & T commercial specifications such as the Flying Doctor and maritime services."

However, Vicom felt that manufacturers and importers had a responsibility to ensure that their equipment met the manufacturer's specification which generally was -40 dB.

Looking at the major transceivers available on the Australian amateur market, the manufacturer's specifications indicate that *none* would meet the proposed P & T standard. Have a look at this list:

	Spurious	Harmonics
TS120V	-40 dB	–
TS520S	-40 dB	–
TS820S	-60 dB	-40 dB
FT101E	-40 dB	–
FT301	-40 dB	–
FT901DM	-40 dB	–
FT-7	-40 dB	–
ATLAS210/215	-40 dB	–
IC701	-60 dB	-40 dB

Now, most manufacturer's specifications do preface their figures with "better than" or "less than", indicating that figures quoted in the specification are *minimum* with some margin for parameter spread. In the light of this, a specification of -45 dB for spurious emissions (including harmonics) may not really be all that draconian. However, looking at figures obtained from tests conducted for ETI, on some popular amateur transceivers, many would easily meet the proposed specifications . . . but others would not. For example, the same FT-7 transceiver submitted for review measured -52 dB down on the second harmonic while the FT901DM tested measured only -42 dB on the first harmonic.

It seems not unreasonable then, that when setting a specification in this area, some four to six dB of margin should be allowed.

Is the proposed -45 dB specification on spurious emissions too drastic? Perhaps a range of tests and some debate on the issue would spread considerable light on the question and any possible answer.

(Note: The Drake TR-7 specification for harmonic emissions quotes "better than 45 dB down" and would appear to be the only current transceiver to meet the proposed spec. However, it is not 'generally available' in Australia at present).

WIA Auction

The Auction Sale conducted for the Institute by the NSW Division on Saturday 28th October was very successful both in terms of the value of goods for sale and the money raised. Despite the poor weather conditions an estimated 600 plus attended.

All the items for the auction had been donated by the Dick Smith Group. Items included a wide range of shop soiled lines, samples etc, all of which were sold on the day.

$3500 was raised and goes to the Institute to be used nationally in assisting the education of future members of the Amateur Radio Service.

Tim, VK2ZTM thanks the many helpers who assisted on the day and also Terry, VK2TQ. an excellent Auctioneer.

Geelong Radio and Electronics Society

The Geelong Radio and Electronics Society, VK3ANR, has recently been livened up by the formation of two groups, an RF group and an AF group. The Society has ordered a scope, a signal generator, a GDO and some general tools for the use of members.

A printed circuit board workshop is now operating using presensitised board and excellent results are being achieved. AOCP, LAOCP and NAOCP classes are held free of charge to members on Mondays at 7.30 pm and Syllabus meetings are held on Thursdays at 8.00 pm. Visitors are welcome at the Rooms on the Breakwater Road, Belmont Common, Geelong.

All correspondence should be addressed to *Geelong Radio and Electronics Society, PO Box 962, Geelong, 3220.*

SWL News

Compiled by Peter Bunn, on behalf of the Australian Radio DX Club (ARDXC).

All times are in Greenwich Mean Time (GMT), add 11 hours for Australian Eastern Summer Time. All frequencies are given in kiloHertz (kHz).

Broadcasters Switch to 11 Metres

The increasing sunspot count during 1978 has resulted in a number of international stations deciding to introduce new frequencies in the little-used 11 metre band. The present sunspot cycle is expected to peak during 1980, when high frequency reception should be at its best.

For the "D"-78 transmission period which will be in force until March, the Voice of America has introduced three frequencies on 11 metres. 25990 is used by VOA from Delano for broadcasts in English to the Far East each day between 2200 and 0100. 26095 carries English programmes for Oceania between 2200 and 0000, via a transmitter at Dixon, California.

The third outlet is 26040, used for English to Africa 1600-2000 daily from Greenville, North Carolina. This frequency may also be used for broadcasts from the United Nations during these hours, for relay of General Assembly or Security Council proceedings.

Radio France International is another station returning to 11 metres as the ionosphere feels the effects of increasing sunspot activity. Recently, Paris added 25620 which is currently audible between 1100 and sign-off at 1400, carrying the French program.

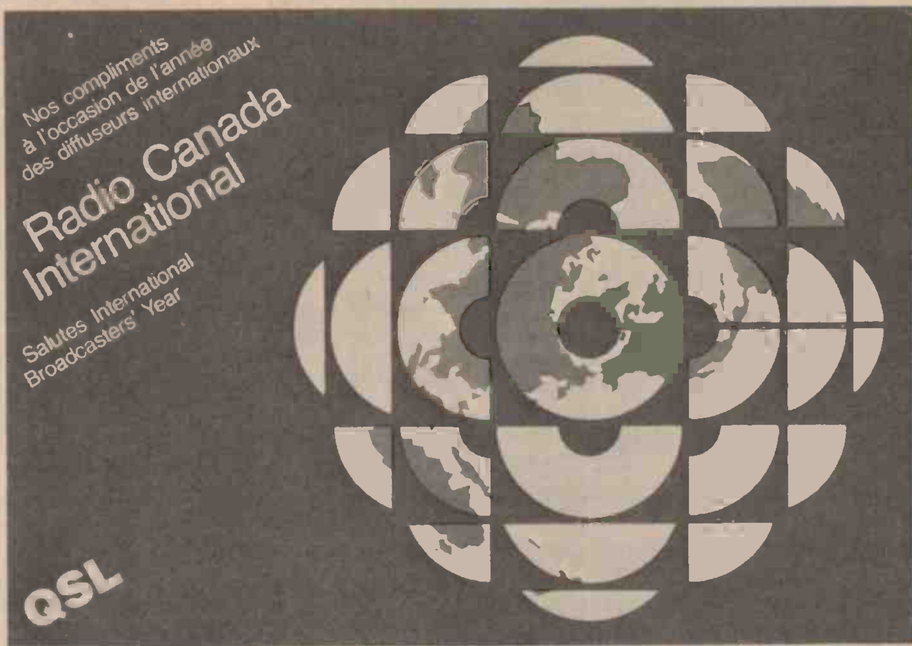
The Israel Broadcasting Authority at Jerusalem also uses 11 metres, with the English service 1200-1230 followed by French until 1300 on 25605.

Radio Liberty has been one of the few stations to use the 11 metre band consistently in the last year, and programs in Russian via a 10 kilowatt transmitter located at Gloria in Portugal continue to be aired from sign-on at 0800, the frequency being 25690.

There is no doubt that more international broadcasters will switch to the 11 metre band in the near future. This may be seen in March, as the northern hemisphere winter season approaches and the sunspot count continues to rise, further enhancing conditions for high frequency broadcasting.

Canada Introduces New Service

The winter schedule of Radio Canada International shows a new service to Europe in English, Monday to Friday between 2200 and 2300. The new segment is called "The World at Six As It Happens" (as it is timed for six o'clock in the evening in Montreal) and is listed for transmission on 11855, 9575, and 5995.



Other RCI transmissions to Europe include English programs 2000-2030 daily on 17820, 15325, 11945, 11905 and 5995. The English service to the Middle East is broadcast 0615-0630, and again from 0645-0700 Monday to Friday on 17860 and 15265.

A highlight of Radio Canada International programs is DX Digest, heard every Sunday, in two editions. The African service features DX Digest in the service 1800-1830 on 17760 and 15260.

DX Digest edition 1 is included in the European service at 1900-1930 each Sunday with the second edition heard in the 2000-2030 program block. Featured every week is Glenn Hauser's DX News Report, and other regular features on DX Digest are the technical mailbag, presenting interviews and items on communications. DX Digest also includes a monthly report on the activities of the Handicapped Aid Program (HAP), a volunteer organization devoted to introducing the hobby of shortwave listening to handicapped people, and giving them any assistance needed to carry on the hobby.

Malta

Malta Calling, the program presented by Maltese Radio over the shortwave relay station at Cyclops, has returned to 5980 after briefly using 6010 for weekly programs in both English and German. The English program is broadcast each Saturday 2045-2115, with the German program aired at the same time on Tuesdays.

Italy

Radio-televisione Italiana (RAI) currently broadcasts daily in English for Japan 2200-2225, using 11905, 9710 and 5990. Evening broadcasts in Italian for Australia may be heard 0830-0930 on 21690, 17780, 15340, 11810 and 9580. The morning program for Australian listeners is on the air 2050-2130 in Italian on 11800, 9575 and 7290.

Sweden

Relays of the Radio Sweden home service programs on single sideband (SSB) via a transmitter at Varberg continue during period "D"-'78. The programs, all in Swedish, may be heard on LSB (lower sideband) as follows:

0500-0830 on 17777.5;
0930-1600 on 21557.5;
1600-1800 on 17787.5;
1800-2000 on 15192.5
and from 2000-2130 on 11952.5

Correct reception reports of these broadcasts will earn the listener a special verification card. Reports are wanted by the Swedish Telecommunications Administration (STA), S-123, 86 Farsta, Sweden.

Compiled by the Australian Radio DX Club (ARDXC). For further information regarding shortwave radio and ARDXC's activities, write to either PO Box 67 Highett, Vic. 3190, or to PO Box 79, Narrabeen, NSW 2101, with a 30c stamp.

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HAMS, see the TM 13 Amateur UHF Beam Antenna ONLY $28.75

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.018	6c	.18	14c
.022	6c	.22	15c
.027	6c	.27	16c
.033	7c	.33	18c
.039	7c	.39	19c
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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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8A 400V C122D	—	$1.05	DIAC ST2	— 35	1N4148	— 5c, $4/C, $30/K
8A 500V C122E	—	$1.20	Chart to identify leads			
25A 400V C37D	—	$2.50	Plus trigger info.	— 10c		

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CB News

New UHF Antenna

Melbourne firm, KT Electronics, are marketing a locally-made UHF CB antenna. Designated the KT500, it is described as a gain antenna and provides omnidirectional radiation, vertically polarised. It requires no tuning and has a low SWR across the whole 40 UHF channels.

The antenna may be mounted as a base or mobile antenna and comes complete with 15 metres of high quality RG8 coax cable. A special Belling-Lee compatible connector is provided on the end of the coax to suit the Philips FM320 antenna connector.

For further information, contact *KT Electronics, 16 Railway Cr., Broadmeadows, Vic.*, phone (03) 309-4549. Trade enquiries welcome.

JD Frequency Monitor

One of the handiest things for an enthusiast or a technician to have around the shack or workshop is a digital frequency meter. The JD-5050 is an economically-priced, high performance digital frequency counter that will measure frequencies between 10 kHz and 50 MHz. It has good sensitivity as it will measure signals as low as 100 mW in a coaxial line, yet will stand up to 50 W of RF power.

The meter is designed to operate in the 'through-line' mode, connected in a coaxial transmission line, but may also be used in the usual fashion and a coax lead with clip connectors is provided for this purpose.

The JD-5050 features a five-digit LED display and is powered from a nominal 12 Vdc source (8-14 V range). Power consumption is a mere 250 mA.

The JD-5050 frequency monitor is imported and marketed in Australia by *IFTA, 1 Greville Street, Randwick (P.O. Box 21 Bondi Beach 2026)*; phone (02) 665-8211.

Heavy Duty Power Supply

The Transwest heavy duty power supply is distributed by IFTA in most states and is intended for applications involving mains operation of any dc-operated equipment requiring a nominal 13.8 V dc supply – CB rigs, cassette recorders etc.

The supply has a fully-regulated output at 13.8 volts and is rated to deliver 4 amps at 50 percent duty cycle, 7 amps on peaks. It is electricity authority approved (approval number W/2014) and has dc output terminals located on the rear panel. This is convenient when using a mobile rig as a base station as their dc power leads are always led out from the rear. Having the dc power leads run behind the equipment helps maintain a tidy installation.

For further information, there is a review in the December issue of CB Australia. You could also contact IFTA at *1 Greville Street, Randwick, NSW 2031*; phone (02) 665-8211 or through *PO Box 21 Bondi Beach 2026.*

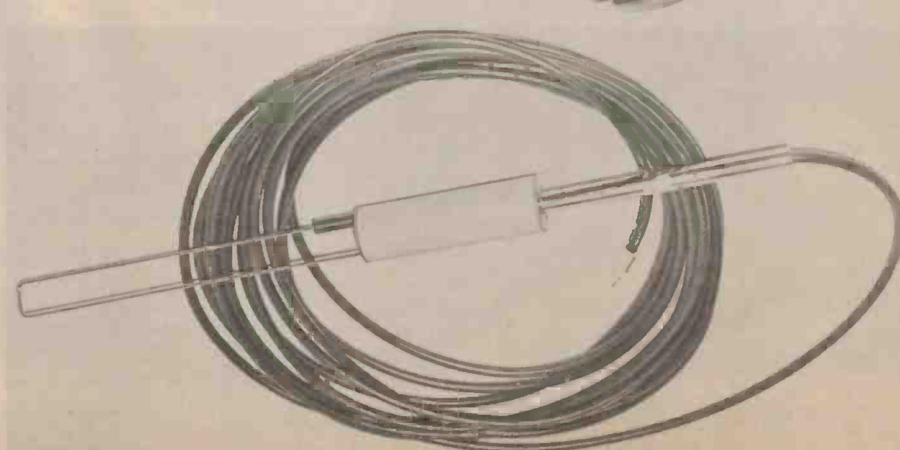
Turner Mic

Turner's M+2/U mobile mic features a preamp with a gain of 15 dB, adjustable, powered by a 7-volt mercury battery. Housed in an attractive blue and grey Cycolac plastic case, this rugged mic comes complete with a matching blue curly-cord.

The M+2/U is designed to deliver stable performance in high temperature and humidity situations. The mic cartridge is a ceramic type and the unit provides a frequency response of 300 to 3000 Hz covering the voice frequency range. Battery drain of the preamp is just under 1 mA and battery life expected is around six months.

For further information on the M+2/U, contact *the John Barry Group, 105 Reserve Rd, Artarmon, NSW 2064* phone (02) 439-6955 or through *PO Box 199, Artarmon 2064.*

Top: The JD frequency meter.
Right: Transwest's 7 A power supply.
Bottom: The omnidirectional vertically polarised UHF antenna from KT Elctronics.



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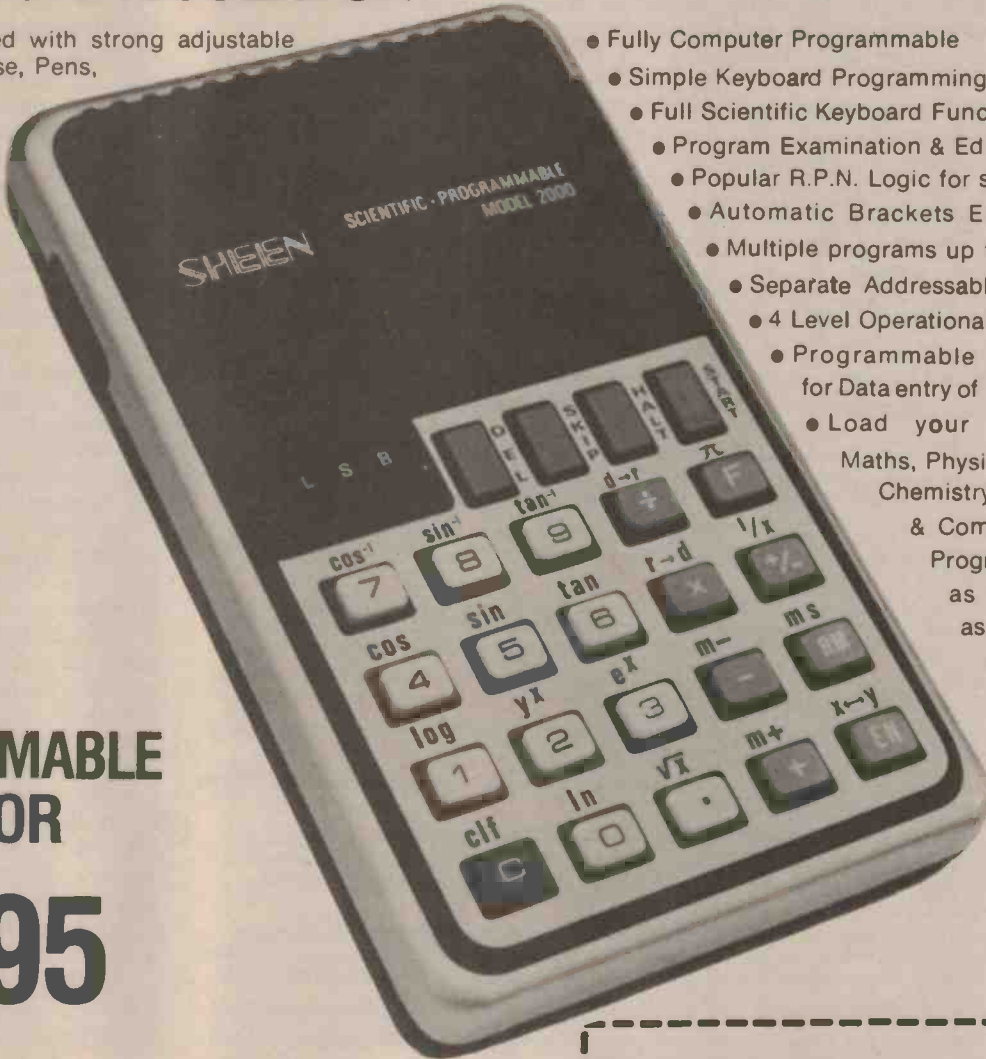

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ETI

predictions

The Ionospheric Prediction Service have kindly developed propagation predictions for us, in the form of a computer printout, which we can reproduce directly. These predictions are known as GRAFEX and contain a lot more information than those we published previously.

The left hand vertical column of each printout lists the frequency, in MHz, for each horizontal row of characters. Each vertical column of characters represents one hour, commencing at 00 UT on the left-most column going to 23 UT on the extreme right column.

Each printout is for a particular path, named at the bottom. The month to which the predictions apply, the mean path distance and the great circle bearing are also listed beneath each printout.

A variety of up to ten characters may appear on the printout and their meanings are listed in the table reproduced here.

The form of the GRAFEX predictions allows the indication of several 'modes' of propagation. The *first* mode is that requiring the least number of 'hops'. This will mean *two* hops on paths of length 4000 to 6000 km or so, *three* hops on paths around 7000 to 10,000 km in length, and so on. The *second* mode for a path will be the next integral number of hops that may be required to propagate a signal over the path.

Thus, the second mode for paths around 4000 to 6000 km in length will involve *three* hops and for paths 7000 to 10,000 km long will involve *four* hops, and so forth.

Mixed modes may also be indicated (symbols M, S and X). That is, a combination of hops involving both first and second modes perhaps (this indicates that considerable fading may be experienced on signals); a mixture of hops involving both the E and F layers of the ionosphere, etc. (See "Propagation, a Closer Look", the July 1978 issue of ETI, pages 112 to 114.).

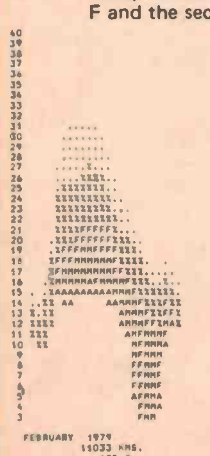
For ultra-reliable predictions follow the times and frequencies indicated by the F characters on the printouts. For a bit of adrenalin in your operating, use the % symbols area of the printouts. But, for a real 'buzz' look to the dot symbols area and hang around during the month of the predictions for those magic days when the higher frequency DX starts pouring through!

Six metre band amateur enthusiasts should scan the printouts for those that have characters extending into the 40 MHz region and operate accordingly.

Co-ordinated Universal Time (UT) is used on all predictions. For most people's purposes that's equivalent to the well-known GMT. Thus, times for Eastern Australia will be 10 hours ahead (Eastern Australian Standard Time or E.A.S.T.); for central Australia, 9½ hours ahead and for Western Australia, 8 hours ahead. Don't forget to take into account Daylight Saving Time where and when it applies. Oh, heck, save yourself all the hassle and run a clock in the shack set to Universal Time!

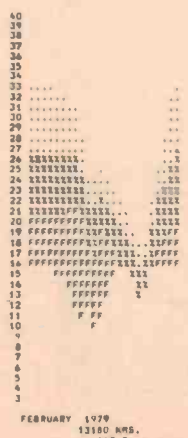
For information on the areas served by the prediction charts, see ETI July 1978, page 113.

' '	A blank means no propagation is possible by a normal first or second mode.
'.'	A dot indicates that propagation is possible but probably on less than 50% of the days of the month. This normally applies for the first F mode but under some circumstances the first mode may not be propagated because the layer is too low (usually for hops greater than 3000 kilometres) in which case the symbol applies to the second mode.
'%'	Propagation is possible between 50% and 90% of the days of the month. It should be noted that the median F MUF for each hour lies between the lowest '.' and the highest '%' for that hour.
'F'	Propagation is possible by the first F mode on at least 90% of the days of the month unless there is a severe ionospheric disturbance. For frequencies on the highest 'F' for the hour the probability is 90% but this will increase slightly on lower frequencies.
'E'	Propagation is possible by the first E mode and on less than 50% of days by the first F mode. This symbol overrides '.' if present.
'P'	Propagation is possible by the first E mode and between 50% and 90% of days by the first F modes. This symbol overrides '%'.
'B'	Propagation is possible by the first E mode and by the first F mode on more than 90% of the days. This symbol overrides 'F'.
'M'	Propagation is possible by both the first and second F modes. The strongest mode is normally the first mode but the vertical aerial pattern may influence the mode received. It should be noted that the second F mode MUF is just about the highest frequency showing 'M'.
'S'	Propagation is not possible by the first mode but it is possible by the second mode. It should be remembered that propagation may be possible by other modes, e.g.: the third F or mixed E and F modes at these frequencies. This symbol does not occur very often.
'A'	High absorption i.e.: above the ALF but probably too close to it for good communication.
'X'	Complex mixture of modes including the second E mode (the vertical angles of the first F and the second E modes are often very close).



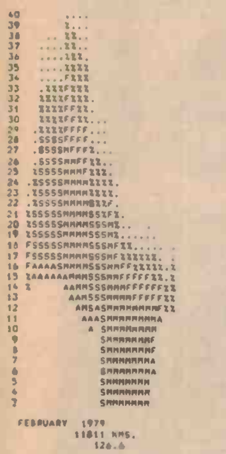
East Coast — South Africa (also serves South Central)

East Coast — North Africa (also serves South Central)

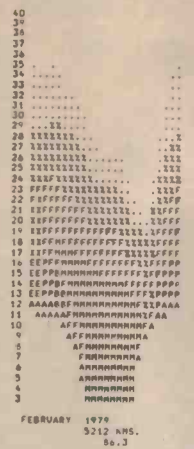


East Coast — South America (also serves South Central)

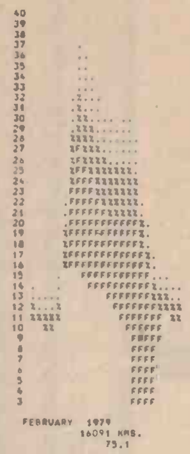
East Coast — North America (also NE and South Central)



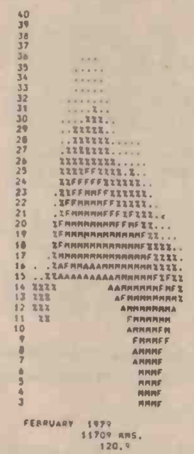
East Coast — Japan (also serves NE and South Central)



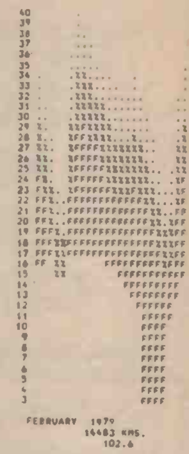
East Coast — South Pacific



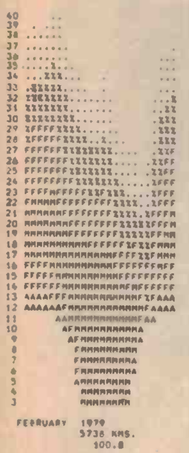
East Coast — Europe (Short Path)



North East — South Africa

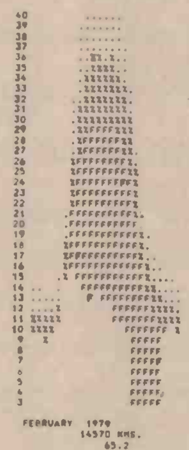


North East — North Africa

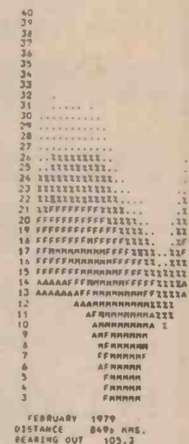


North East — South Pacific (also serves South Central)

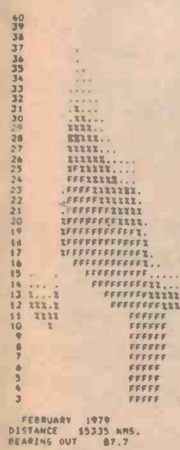
SWL and AMATEUR COMMUNICATIONS



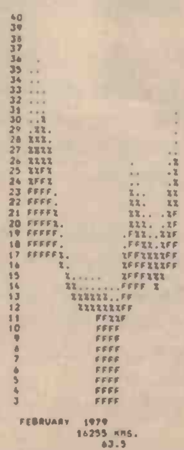
North East — Europe (Short Path)



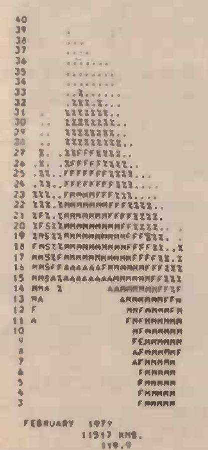
West Coast — Japan



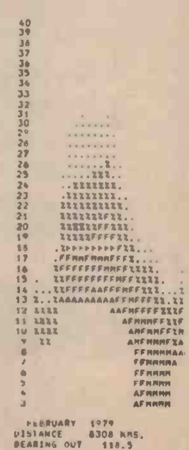
South Central — Europe (Short Path) (also West Coast)



West Coast — North America



West Coast — North Africa



West Coast — South Africa

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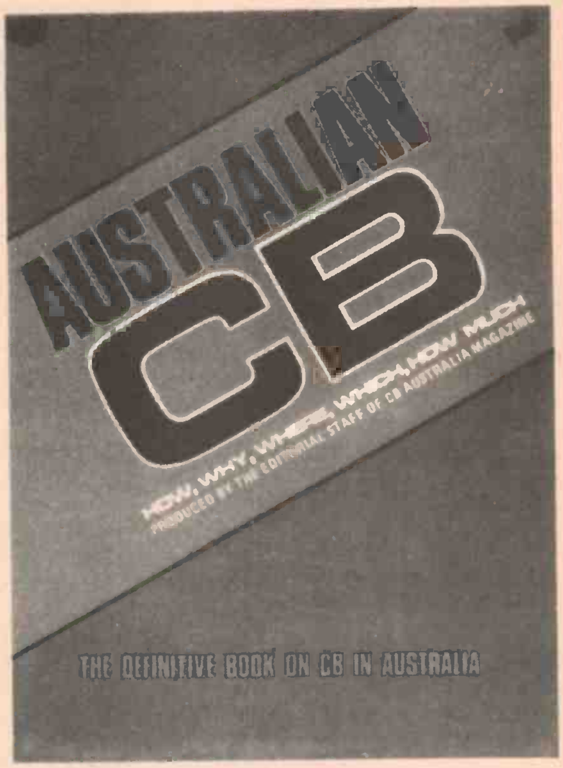

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Ideas for experimenters

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.

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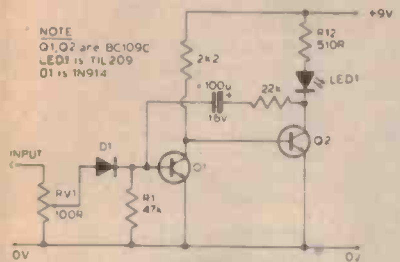
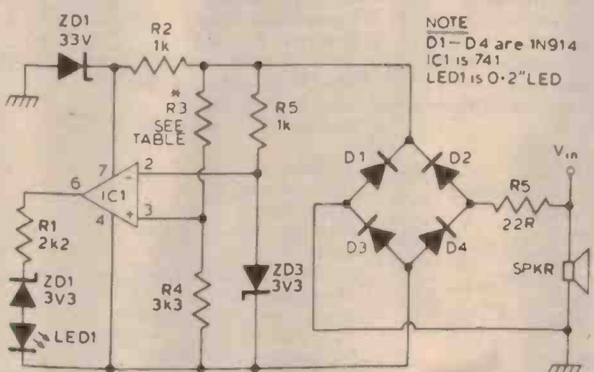


Peak Level Indicator

The diagram shows a simple monstable multivibrator with a LED which is normally lit, but will be briefly extinguished if the input exceeds a preset (by RV1) level. A possible application is to monitor the output voltage across a loudspeaker, when the LED will flicker with large signals.



V	5	10	15	20	25	30	35
R3 kΩ	5·6k	9·1k	12k	15k	16k	18k	22k

Speaker Power Indicator

This circuit will indicate the peak level of an input signal applied to a speaker. It is primarily intended as a fail safe device when connected to an amplifier of higher power rating than the speaker.

The circuit is unique in that no separate DC power supply is required since the circuitry operates from the input voltage to the speaker.

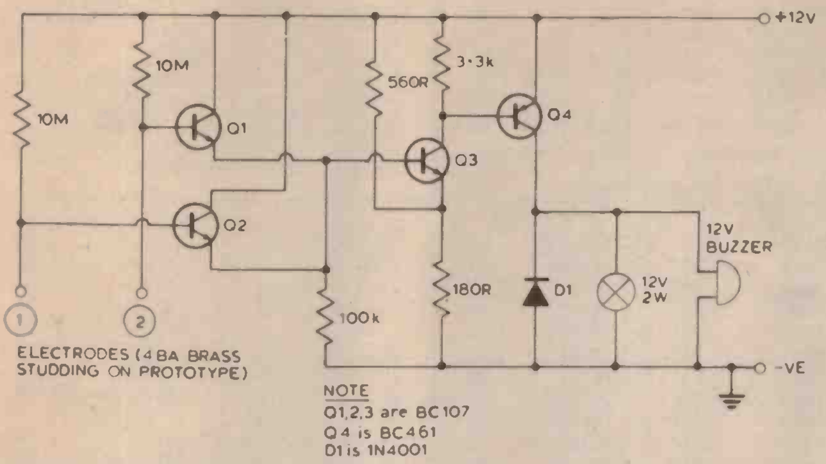
R5 isolates the amplifier's output stage from possible fault conditions in the circuit. D1 to D4 full wave rectify the input signal and the resulting DC is used to supply the op amp.

The 741 is used as a comparator a reference voltage being obtained from across ZD3 and fed into the inverting input of the op-amp. The non inverting input samples the rectified input signal. When a peak is fed into the circuit the IC's output goes high and the led flashes. ZD1 prevents the LED turning on when the output of IC1 is low due to the output being unable to go less than 1.5V above earth under these circumstances. ZD2 defines the upper limit of the op amp's supply voltage in the presence of large transients whilst R2 is the current limit resistor. It should be obvious that the level at which the led lights is dependent upon the value of R3. The accompanying table shows the value required for the component for different input powers across an 8 ohm load. If different load values are to be used for the speaker the value of R3 can be determined from the equation,

$$R3 = {}_{1.4}\sqrt{PR} - 3.3\,k\Omega$$

P = Pout
R = load in Ω

Ideas for experimenters



Brake Fluid Indicator

This circuit indicates by means of a warning light and a buzzer when the fluid in the tank of a braking system is getting low.

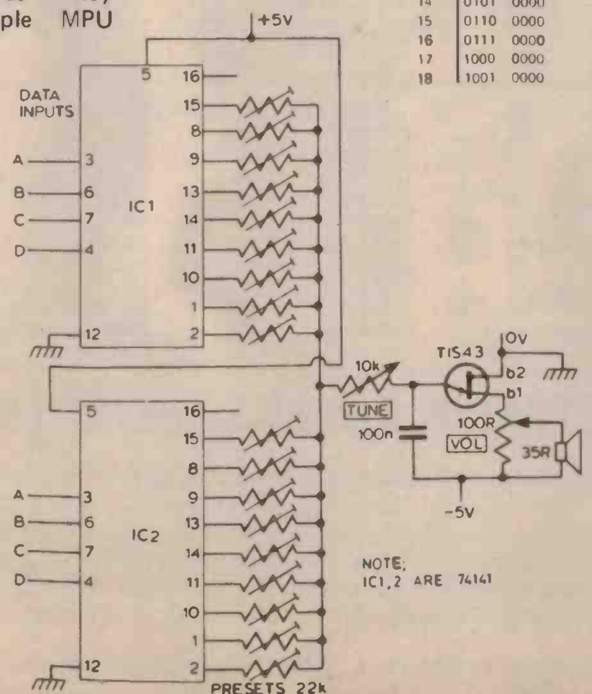
Normally both electrodes are immersed in the brake fluid, and the bases of Q1 and Q2 are at ground potential (the fluid makes a connection between the electrodes and the brake cylinder which is connected to the car chassis). If the fluid level should fall, and either of the electrodes becomes dry, Q1 and Q2 will turn on which will turn on Q3 and Q4 and the alarm will be energised.

BCD Tone Generator

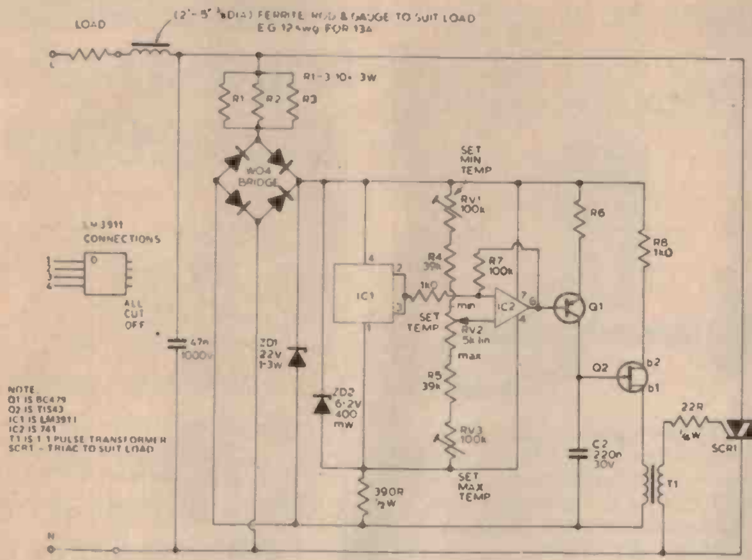
When one of the binary codes in the table is set up on the data inputs, a corresponding preset connected to IC1 and 2 will be grounded, and the uni-junction will start to oscillate. The frequency of oscillation depending on which output of the ICs is grounded.

If the 18 presets are tuned to form a chromatic scale and the inputs interfaced to your MPU data bus — hey presto you have a simple MPU controlled organ!

NOTE No	CODE (BINARY) HGFE	DCBA
1	0000	0001
2	0000	0010
3	0000	0011
4	0000	0100
5	0000	0101
6	0000	0110
7	0000	0111
8	0000	1000
9	0000	1001
10	0001	0000
11	0010	0000
12	0011	0000
13	0100	0000
14	0101	0000
15	0110	0000
16	0111	0000
17	1000	0000
18	1001	0000



Ideas for experimenters

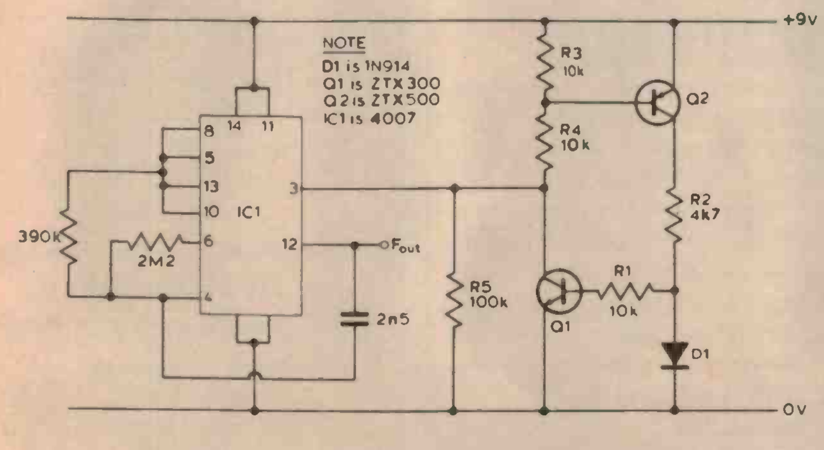


Temperature Control

This circuit provides full phase proportion control of a heater, infrared lamp etc, uses no expensive transformers for its own power, and is extremely sensitive.

The LM3911 sensor is connected to the circuit via a 3 core cable, and enclosed in a rubber sleeve to enable it to be used as a probe. The output of the LM3911 varies by 10 mV/ C and the minute change is amplified by the 741. Any increase in temperature will increase the output of the 741 which will lower the base current through Q1 and so reducing the constant charge current with temperature will alter the time taken for the UJT to fire, changing the phase angle of the power to the load.

The 5k lin pot is set to the temperature required and is linear over its entire range. The upper and lower limits of this control can be changed by adjusting the 100k presets.



Temperature to Frequency Converter

This circuit uses the fact that when fed from a constant current source, the forward voltage of a silicon diode varies with temperature, in a reasonable linear way.

Diode D1, and resistor R2 form a potential divider, fed from the constant current source. As the temperature rises the forward voltage of D1 falls tending to turn Q1 off. The output voltage from Q1 will thus rise, and this is used as the control voltage for the CMOS VCO. With the values shown, the device gave an increase of just under $3\ HzC^{-1}$ (between 0 C and 60 C) giving a frequency of 470 Hz at 0 C.

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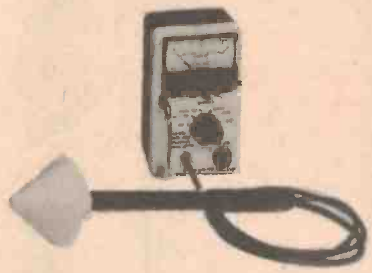

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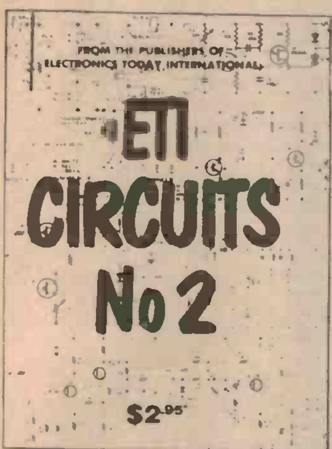

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