OCTOBER 1983 $2.35* NZ $2.75

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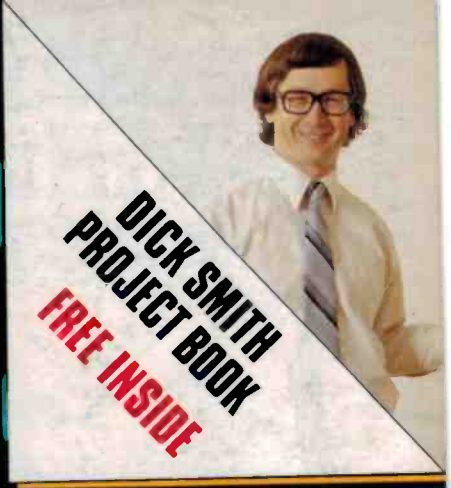
ELECTRONI TODAY INTERNATI



VHF LISTENERS' GUIDE

WIN A SCANNER
Page 135

Table of frequencies and services above 26 MHz

INS AND OUTS OF VIDEO ENHANCERS

SANSUI COMPU-RECEIVER REVIEWED

THE STD BUSS EXPLAINED

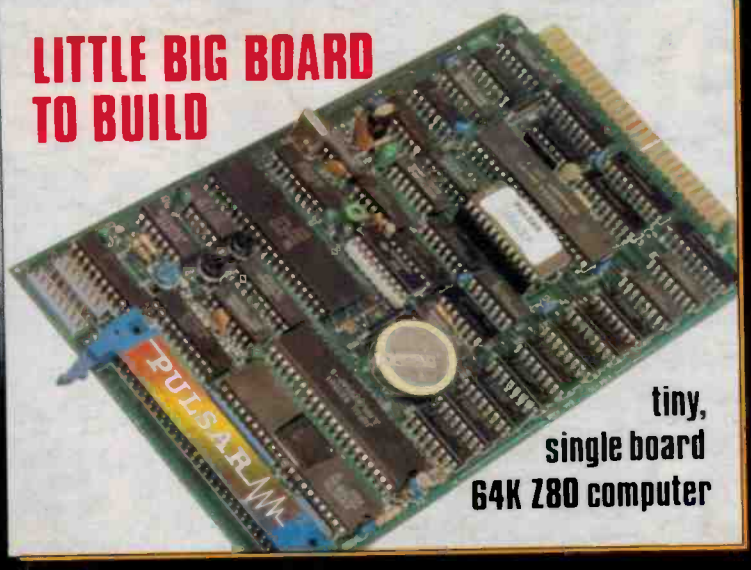
FUNCTION/PULSE GENERATOR

HANDHELD DIGITAL FREQUENCY METER

TWO MICROBEE PRINTER INTERFACES

LED AUDIO PEAK PROGRAMME DISPLAY

LITTLE BIG BOARD TO BUILD



tiny, single board 64K Z80 computer

Sensational sound, dressed to kill... from Sanyo.

Mini & Slim Portable MW/SW_1/SW_2/FM Stereo cassette recorder with 2-way, 6 speaker system

M7740K

6 speakers

to create the right sound for every occasion

6 colours

in today's most fashionable shades, silver, black, red, white, blue and pink

6 ways better value

* sensational sound never looked so good.
* light enough to take with you wherever you go.
* space a problem? The Mini & Slim stacks on its end.
* Automatic Music Select System (AMSS). High-speed scanning to select the songs you want to hear.
* 3-position tape selector automatically adjusts for normal, Cr02 or metal tapes.
* one button record takes the hassle out of recording your own tapes.

SANYO

That's Life!

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FEATURES

SIGHT & SOUND

COMPUTING TODAY

TECHNICAL

COMMUNICATIONS

GENERAL

ROD IRVING ELECTRONICS

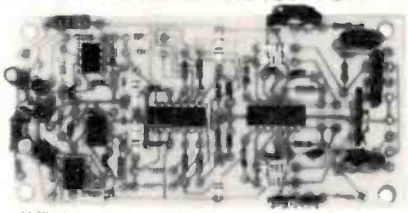
425 HIGH STREET, NORTHCOTE 3070, MELBOURNE, VICTORIA. Ph (03) 489 8131. Telex No. 38897

50V 5A LABORATORY POWER SUPPLY

New switchmode supply can deliver anywhere from three to 50V DC and currents of 5A at 35V or lower. Highly efficient design.
EA May, June 1983

$140.00

OVERLOAD INDICATOR



Will detect even slight overload conditions and is not affected by load impedance or varying supply voltages. **E.A. JUNE '83**

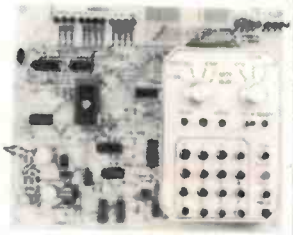
EFFECTS UNIT

$75.00

An "Effects Unit" that can create phasing, flanging, echo, reverb and vibrato effects. **E.A. JUNE '83**

EPROM PROGRAMMER

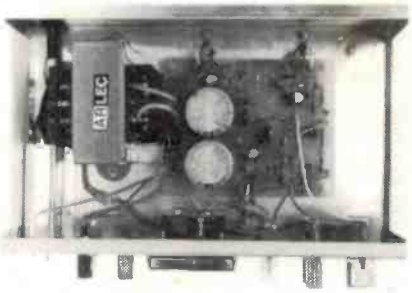
$43.00



No need for a Micro with EA's great Eprom Programmer suitable for 2716/2758 Eproms.

With Textool Sockets $55.00
EA January 82

DUAL TRACKING POWER SUPPLY $83.50



Built around positive and negative 3-Terminal Regulators, this versatile dual tracking Power Supply can provide voltages from ±1.3V to ±22V at currents up to 2A. In addition, the Supply features a fixed +5V 0.9A output and is completely protected against short circuits, overloads and thermal runaway. **EA March 82**

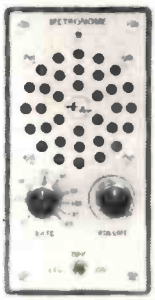
SOUND TRIGGERED FLASH $26.50

This easy to build sound or light operated flash trigger has many feature.

Catch those spectacular and humorous moments like that time your mother-in-law slipped on the moss covered patio and broke her neck. **ETI 568 October 80**

ELECTRONIC METRONOME

$18.90



Great new Metronome Circuit with low current drain (less than one milliamp) drives a Loudspeaker and a Led Indicator. **EA January 82**

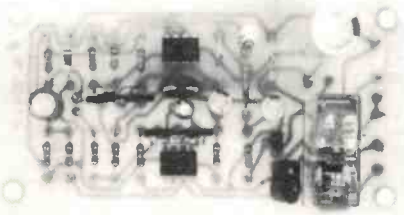
"LE GONG"

$14.95

The "Le Gong" Doorbell with those unmistakable chimes generated by the LSI. A must for the man who has everything! **EA February 81**

VOICE OPERATED RELAY

$14.95



EA's great new Voice Operated Relay can be used to control a tape recorder, as a VOX circuit for a transmitter, or to control a slide projector. **EA April 82**

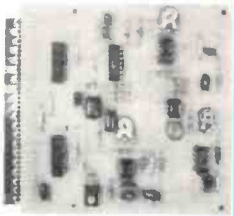
3½ DIGIT LCD CAPACITANCE METER

Handy pocket size Digital Capacitance Meter, runs off a 9V battery and measure 1pF to 19.99uF in just three ranges.
EA March 82

$79.00

LED LEVEL METER

$27.00



Build a Led level Meter with simultaneous peak and average display plus 60dB dynamic range. This kit is ideal for any application requiring a wide dynamic range level display. **ETI 458 June 81**

FUNCTION GENERATOR $79.50

This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 160kHz with low distortion and good envelope stability. It has an inbuilt four-digit frequency counter for ease and accuracy of frequency setting. **EA April 82**

DIGITAL THERMOMETER: 3½ DIGIT LCD

$79.00

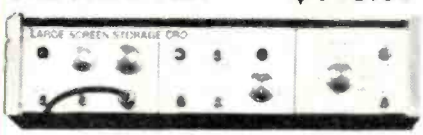
Measure temperatures from below freezing point to around boiling point. **EA February 82**

LOTTO/POOL'S SELECTOR

$22.50

You have to be in it to win it . . . Take the chance out of winning the Pools as well as Lotto, and build the great new Pools/Lotto Number Selector. **EA July 81**

LARGE SCREEN TV STORAGE CRO ADAPTER $119.00



For a low cost Storage CRO with Synchronised Display, Electronic Graticule, One-Shot Triggering and Optional Storage of up to four Screen Displays it can't be beaten. **EA February 82**

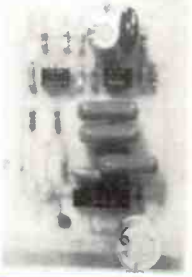
LOW OHMS METER

$34.50

How many times have you cursed your Multimeter when you had to measure a low-value resistance. Well alas, with the "Low Ohms Meter" you can solve those old problems and in fact measure resistance from 100 Ohms down to 0.005 Ohms. **ETI 158 November 81**

SOUNDBENDER

$29.00



Have great fun creating your own recording effects with music and voice. The Sound Bender can receive from Electric Guitar, Microphones, etc. **ETI February 82**

ADVERTISERS' INDEX

COMMENT

IT IS with distinctly mixed feelings that I bring you the news that this will be the last issue our talented project designer and Technical Editor, David Tilbrook, will have worked on. I knew it was inevitable that, one day, a man of such talent and rare creative genius would have to move on to greater things.

David has accepted a position in research at the Physics School of a major university, working on laser development, a field in which that university is at the forefront of current research. David has been doing a part time course in physics for the past three years and will complete his B.A. (Physics) degree later this year.

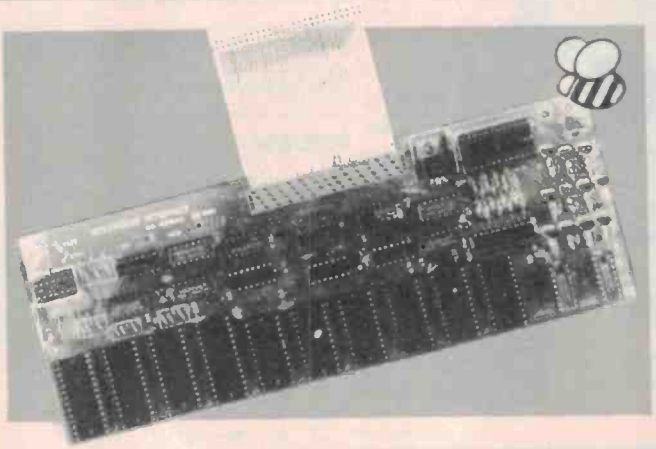
Since joining the magazine early in 1979, David's ability soon made its presence felt in projects such as the Series 4000 Moving-Coil Preamp, the Electromyogram, the Series 4000 four-way and three-way loudspeakers and latterly, the Series 5000 equipment.

To allay anyone's fears that the Series 5000 gear will halt, let me affirm that David will be continuing his association with the magazine, contributing articles and developing projects for us on a freelance basis.

David, your calm, logical, methodical approach to everything, and your tenacity in tackling problems that daunted lesser mortals has been a remarkably steadying influence in the freneticism that is publishing. From all of us here at ETI, and from those who have worked with you in the past, we sincerely wish you "all the best", confident that you will make as great an impression in your new field as you have in this one.

Roger Harrison
Editor

NEXT MONTH



MICROBEE MULTIPROM INTERFACE

This project allows you to extend the Microbee's ROM capacity. It is a board that just plugs into the 'Bee's 50-way expansion buss and can either be fitted inside the 'Bee or externally. The board takes the EDASM and NET PROMs normally residing in the 'Bee and allows several different PROM sets to be fitted and used at will. You can mix 2532s and 2764s, even. The board also has an I/O scheme giving 11 open-collector outputs and eight buffered inputs. Turn your Microbee into a much more versatile machine.

SOLID-STATE RELAYS

Two solid-state switches for remote control of mains-operated devices or appliances are featured next month. These allows you to safely interface a computer or electronic controller to mains equipment as opto-isolators are used. Two types are described: a zero-crossing switch and a non-zero-crossing type.

SURFACE ACOUSTIC WAVE DEVICES

Surface acoustic wave (SAW) devices have been used for the last decade in professional and military equipment and are now beginning to be found in consumer electronic products. This article explains the basic physics of SAW devices and some important current applications of the technology are examined.

PERREAUX HI-FI SYSTEM

A review of the New Zealand manufactured Perreaux SM2 preamp and PMF1150B power amp shows just what can be done with some innovative 'nature technology'.

SERVICES

TECHNICAL INQUIRIES: We can only answer readers' technical inquiries by telephone after 4.30pm Mondays to Thursdays. The technical inquiry number is (02) 662-4267. Technical inquiries by mail must be accompanied by a stamped, self-addressed envelope. There is no charge. We can only answer queries relating to projects and articles as published. We cannot advise on modifications, other than errata or addenda. We try to answer letters as soon as possible. Difficult questions may take some time to answer.

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YOUR DOLLAR BUYS MORE AT JAYCAR/ ELECTRONIC AGENCIES

FANTASTIC Multimeter

ONLY $17.95

- FUSE/DIODE PROTECTED!
- 4mm BANANA SOCKET PROBES!
- BIFURCATED SELECTOR SWITCH CONTACTS!
- ABS IMPACT–RESISTANT CASE!
- LARGE! MEASURES 90(w) x 135(h) x 45(d)mm

SPECIFICATIONS:

DC	AC
0 – 0.25	0 – 10
0 – 10	0 – 50
0 – 50	0 – 250
0 – 250	0 – 1000
0 – 1000	AT 9,000 ohms/volt
AT 20,000 ohms/volt	

RESISTANCE	DC CURRENT
0 – 5K	0 – 0.05
0 – 50K	0 – 25
0 – 500K	0 – 250mA

dB: 20 to +22dB
BATTERY CHECK FACILITY: AA, C & D CELLS
ACCURACY: DC +/–3% F.S. AC +/–4% F.S.
OHMS +/–3%
BANANA PLUG PROBES AND BATTERY INCLUDED
This is an unbelievable meter bargain. Normally this unit would sell for around $25. Japanese made quality
Cat. QM-1005 $17.95

115V COMPUTER FANS

GREAT VALUE!

$14.95

We have made a scoop purchase of computer grade Box Fans. They measure a standard 80 x 80 x 40mm. But there's a catch! They are only available in 115V!
Great if you are making equipment for export to the USA – or use 2 in series! No problem!
Cat. YX-2508 ONLY $14.95
STAGGERING VALUE

MICROCHARTS BACK!
NEW LOWER PRICES!
NEW CHARTS!

ALGORITHMS – Cat. BM-8504 ONLY $9.95
This 215 x 280 (A4) virtually indestructible plastic card contains a set of algorithms expressed in the BASIC language. Most are easy to implement even with assembly language for small machines. You will be surprised at the amount of information this card contains.

7400 SERIES TTL REFERENCE CARD
Cat. BM-8503 ONLY $9.95
This card gives complete pin out and description details on 54/74 series devices from 7400 (74LS00) thru 74962! OVER 350 devices in all!!
(All micro charts are the same size)

OTHER POPULAR MICROCHARTS

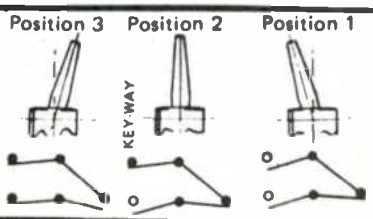
Z80 CPU MICROCHART
ALL the info on the Z80 series CPU
Cat. BM-8500 ONLY $9.95

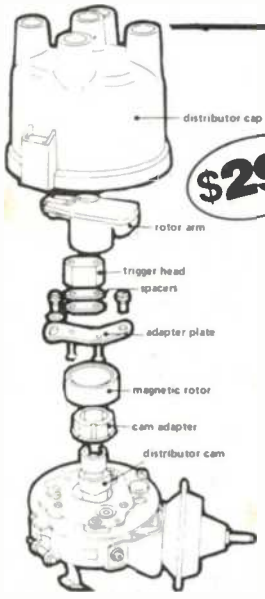
6502 (65XX) MICROCHART
ALL the info on ORIGINAL micros and their newer cousins
Cat. BM-8501 $9.95

6502/65XX MICROCHART
As above, for the 6502 etc
Cat. BM-8502 $9.95

Incredible TOGGLE SWITCH

Check the schematic! Ideal for Headlight Parking switch. Dependable 10 AMP contacts conservatively rated. A special shorting strap on the rear of the switch enables you to customise your own configuration!
Cat. SE-0658 $1.50





$29.95

IT HAD TO HAPPEN

* * * *

PLEASE NOTE
this system must be used in conjunction with an electronic ignition. The Hall Effect device will not switch enough current to replace the contact breaker points on their own!

A professionally engineered electronic I 'breakerless" I contact breaker system
Yes only Jaycar has a complete Hall effect triggerhead assembly designed to adapt to an extensive number of cars. Each kit contains the following
- HALL EFFECT TRIGGER HEAD
- MAGNETIC ROTORS FOR BOTH 4 & 6 CYLINDER CARS
- OVER 6 CAM LOBE ADAPTORS
- OVER A DOZEN DIFFERENT ADAPTOR PLATES FOR YOUR PARTICULAR DISTRIBUTOR
- OTHER HARDWARE (i.e. SCREWS etc.)
- YOU CAN REMOVE THIS SYSTEM AND RE-EQUIP YOUR CAR WITH THE ORIGINAL BREAKER POINTS WHEN YOU SELL THE CAR!
- AS EASY TO INSTALL AS A SET OF POINTS!
- INSTRUCTIONS (SIMPLE TO FOLLOW) INCLUDED!

This set is designed to fit most European and Japanese cars. In fact it will also fit many Australian cars fitted with Lucas, Bosch, Motorcraft, AC Delco or Autolite electrics. If you wish to check first, please send SAE for car distributor list.
Because we have no way of knowing, you get the fitting set for ALL of the distributors available. Basically you end up with a jar full of parts that you don't need to use! (Perhaps for your next car?)
Quite frankly, we are amazed that we can supply such a comprehensive kit for this price. To produce a kit that will adapt to the dozens of different distributors around is amazing!
Remember, once you have installed a breakerless system it will never wear out and that part of your system will remain in tune FOR EVER.
We expect this kit to sell well. To ensure that you receive one, check with us early!
Cat. KJ6655

FERGUSON TRANSFORMERS

MF-1000	PL9/5VA	PCB	$7.90
MF-1002	PL12/5VA	PCB	$7.90
MF-1004	PL15/5VA	PCB	$7.90
MF-1006	PL18/5VA	PCB	$7.90
MF-1009	PL24/5VA	PCB	$7.90
MF-1012	PL30/5VA	PCB	$7.90
MF-1015	PL40/5VA	PCB	$7.90
MF-1018	PL18/12VA	PCB	$8.95
MF-1021	PL24/12VA	PCB	$8.95
MF-1024	PL30/12VA	PCB	$8.95
MF-1027	PL1.5-18/20VA	LP	$17.95
MF-1030	PL12/20VA	LP	$14.50
MF-1033	PL15/20VA	LP	$14.50
MF-1036	PL18/20VA	LP	$14.50
MF 1039	PL24/20VA	LP	$14.50
MF-1042	PL30/20VA	LP	$14.50
MF-1045	PL40/20VA	LP	$14.50
MF-1048	PL12/40VA	LP	$17.95
MF-1051	PL15/40VA	LP	$17.95
MF-1054	PL18/40VA	LP	$17.95
MF-1057	PL24/40VA	LP	$17.95
MF-1060	PL30/40VA	LP	$17.95
MF-1063	PL40/40VA	LP	$17.95
MF-1066	PL30-9/60VA	LP	$20.95
MF-1069	PL12/60VA	LP	$20.95
MF-1072	PL15/60VA	LP	$20.95
MF-1075	PL18/60VA	LP	$20.95
MF-1078	PL24/60VA	LP	$20.95
MF-1081	PL30/60VA	LP	$20.05
MF-1082	PL40/60VA	LP	$20.95
MF-1087	PPB8/1000 Bell transformer		$13.95
MF-1092	TS115/125B 115V STEPDOWN		$79.50
MF-1095	PF3577/JT144 56VCT 2 amp		$34.50
MF-1098	OP590 Line output transformer		$45.00
MM-2015	PF4361		$39.50
MM 2016	PF4362		$49.50
MM-2017	PF4363		$49.50

VIDEO SENSATION AT LAST
A Video Enhancer/ Distribution Amplifier designed EXCLUSIVELY for AUSTRALIA

VALUE **$49.50**

Jaycar has had designed a high quality, high performance Video Enhancer which is specifically for the Australian 625 line 50 frame PAL-D system.
As far as we know it is the ONLY Australian designed, Australian built unit available!!
But, guess what? The Jaycar AV6501 Enhancer is CHEAPER than its inferior imported Asian counterparts!!
This unit is professionally designed and University tested! It works and it works well.

Cat. AV6501

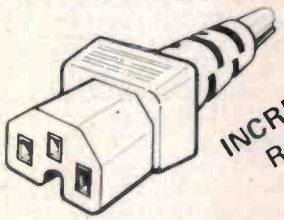
12 Volt AC Adaptor only $12.95

NOT A KIT BUILT, TESTED AND GUARANTEED KIT VERSION ONLY $39.50

SPECIFICATIONS
- 1 Maximum enhancement, not less than +8.3dB @ 2MHz
- 2 Enhance disabled (Bypass) response, DC to 5MHz, −0.5+1.0dB.
- 3 Colour Subcarrier 0dB notch frequency, tunable to 4.43 MHz, −/+ 0.5dB, all settings
- 4 Amplifier group delay, less than 0.075uS
- 5 Signal handling capability not less than 1.35 volts p-p. (Sync. is clipped first.
- 6 Power 12V AC @ 100mA
- 7 Controls, ON/OFF, ENHANCE, ENHANCE/BYPASS SWITCH, CORE/GAMMA CONTROL
- 8 Input connector, RCA socket
- 9 Output connector, RCA socket x 3

DESIGN FEATURES
- 1 A unity gain notch at the colour subcarrier frequency, whose purpose is to prevent chrominance to luminance errors at high enhance levels.
- 2 A closed loop configuration with lead lag compensation to achieve stable, well defined gain
- 3 DC coupling, eliminating large capacitors in series with the video signal and achieving DC response for applications requiring it.
- 4 Low output impedance prior to termination resistors, enabling up to three outputs to exist and be used or left unterminated.
- 5 A level dependant closed loop response or Gamma control ("Core")
- 6 Clip on negative going signals at −67 volts into 75 ohms to prevent sync errors owing to overshoot.

IEC Cable Connectors



INCREASED RANGE

Most imported equipment these days now uses IEC-320 style AC power inlet connectors. Indeed, the electronics mags will soon be specifying these connectors on many of their mains-powered projects to simplify (and therefore make safer) mains wiring. Jaycar now stocks a range of ELECTRICITY AUTHORITY APPROVED mains line cords. We have them in straight entry, left and right entry with and without standard 240V mains moulded plug. Each cord is a generous 2 metres long and is rated at 7.5 amp continuous.

Cat. No	Description	Price
PS4302	LINE CORD STRAIGHT ENTRY 2M	$3.95
PS4304	LINE CORD R/HAND ENTRY - 2M	$3.95
PS4305	LINE CORD L/HAND - 2M	$3.95
PS4306	LINE CORD STRAIGHT ENTRY WITH 240V PLUG - 2M	$4.95
PP2302	IEC 320 CHASSIS PLUG	$2.95
WM4530	2 PIN 240V PLUG MOULDED TO 2M FIG. 8 7.5 AMP CORD - BLACK IN COLOUR (Note: the first 5 items are grey in colour)	$2.95

TWIN SCREENED AUDIO CABLE

Twin screened round audio cable. (Two screened conductors - NOT fig. '8')
This cable normally sells for $0.48/metre or $42.00/roll.

Cat. WB-1504 $20.00/roll

SAVE OVER 50%... PER ROLL **$20.00**

OCTOBER ONLY

HORWOOD CASES

HE-1452	84/6V	$18.50
HE-1454	84/8V	$20.00
HE-1457	84/10V	$21.50
HE-1458	84/12V	$23.00
HE-1459	84/17V	$28.00
HE-1461	93/6V	$16.50
HE-1462	93/8V	$18.00
HE-1463	93/10V	$19.50
HE-1467	93/12V	$22.00
HE-1469	93/17V	$25.50

Quartz Crystal Clock move ment

Cat. XC6000

NEW **$14.95**

- Very compact and reliable
- Self-starting one-second stepping motor has strong torque
- Powered by 1.5V AA battery that lasts for a year
- Supplied with two sets of hands, one short and one long
- ±15 second/month accuracy
- 56mm square, 15mm deep

Complete with data sheet, instructions and wall hanger bracket.

UV GLOBES

The ideal globe for parties. Works in standard light socket (240V AC). This UV light will not erase EPROMs.
Cat. SL-2680 100watt $3.95

TRANSISTOR BARGAIN

3 amp high speed TO-5 power transistor type 2SC 799. Normally $1.95 ea. Now 75 cents each OR $5 for 10!! Has exclusive slide-on flange to convert to chassis mount for greater power dissipation!
Cat. ZT-2600

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JAYCAR BUYS ELECTRONIC AGENCIES

In a shock move that had Sydney's "Silicon Alley" — York Street — all a buzz, Jaycar purchased the entire operations of Electronic Agencies on September 1. Electronic Agencies currently has two stores, one in Concord, the other in York Street, City.

Electronic Agencies will continue to trade at Concord and in York Street, but will now be selling all Jaycar products as well. Jaycar's York Street store will close at the end of October and operations will be transferred to the Electronic Agencies store at 117 York Street. All Electronic Agencies' products will be available in the established Jaycar stores, including the new Hurstville outlet.

The cost of the takeover was not disclosed and Gary Johnston, the proprietor of Jaycar, would not confirm or deny that the 'ballpark' figure was between $349 999 and $350 000, or thereabouts.

Bill Edge. Pleased with himself.

Bill Edge, the former Managing Director of Electronic Agencies, was unavailable for comment as he had awarded himself a long weekend and gone fishing. We understand Bill Edge will not be part of the amalgamation. However, he will not be leaving the industry and is expected to remain available in a consultative capacity, according to Jaycar.

Bill Edge took over the Concord store from Pre-Pak late in 1978 and set about changing the business to concentrate on kits and components. He specialised in a number of areas not addressed by other electronics retailers at the time, particularly speaker drivers and loudspeaker kits. Electronic Agencies became a major supplier of the ETI Series 4000 three-way and four-way kits.

Recently, the firm became a Microbee supplier and has done very well with that product plus associated software and hardware. Bill Edge opened a store in York Street in March 1982, where Avtek is now located, moving 'downstairs' to the present location later in the year.

Gary Johnston purchased Jaycar in March 1981. The business was then located at 380 Sussex Street, down near Chinatown, but moved to York Street also in March 1982. Jaycar's great strength was always audio gear and Gary Johnston continued with this, expanding the range of kits in this line — particularly with the now-famous ETI Series 5000. He also concentrated on mail order and direct importing of components to rapidly expand the business, opening another store at Carlingford late in 1982. A line of robotics products was recently added to the range of Jaycar products.

Gary Johnston. Double the worries.

Gary Johnston claims that nothing but good will come from the amalgamation: "Jaycar and Electronic Agencies have a very similar product range but each with some unique great products. Now, all of these products will be available in all stores.

"We also expect to be able to direct-import a greater range of products and pass on great savings," he said.

All outlets will now be known as 'Jaycar Electronics incorporating Electronic Agencies'. From November, there will be four outlets in the Sydney metropolitan area: York Street, Carlingford, Concord and Hurstville.

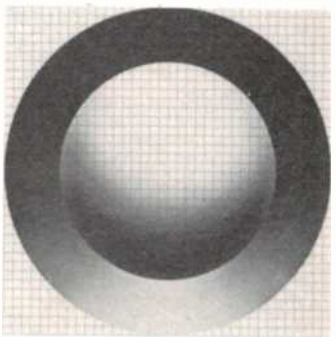
CHANNEL 0 TO GO

The Federal Minister for Communications, Mr Michael Duffy, has indicated in a letter to the chairman of the Special Broadcasting Service, Sir Nicholas Shehadie, that Channel 0 transmissions will cease over the next 18 months, the service then transferring totally to UHF Channel 28.

"It must be clearly understood that the use of VHF Channel 0 has been on the basis that it was an interim measure," the Minister said.

"I am confident that the Multicultural Television Service, in advising its audience of the cessation of Channel 0 transmission over the next 18 months, will play an important role in educating the public with regard to future receiver requirements."

This decision only affects SBS stations on Channel 0, not commercials or translator services, we understand.



ELECTRONIC TELECOM

The carbon transmitter, which has been used in Australia's telephones for more than 40 years, is being replaced by an electronic version.

Telecom says the new electronic transmitters will give greatly improved performance and reliability.

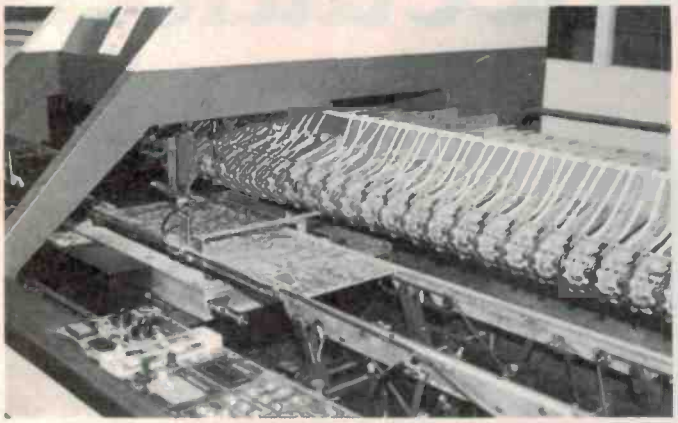
Orders worth $2.4 million have been placed with NEC Australia and AWA for manufacture and supply of the electronic transmitters.

NEW PCB HOLE MASK

Scope Laboratories has released a new thick latex-type liquid for masking PCB holes to prevent their closure during wave soldering.

Called Scope Spot Mask, the liquid is designed to be quicker to apply and faster to peel off then masking tape.

Other benefits include easy shaping of the masking layer, an anti-run ingredient and film strong enough when dry to allow reasonable areas to be peeled off in one piece.



Denon's dust free factory. This insertion places electronic components onto circuit boards faster than the eye can see.

DENON'S DUST-FREE HOME

Shirakawa, an ailing farming community just north of Tokyo, is the new home of Nippon Columbia's fast-growing Denon audio division.

Denon has opened a huge 87,395 square-metre plant at Shirakawa, on the outskirts of the world-famous Nikko-Nasu National Park.

The site offered Denon a clean-air environment, while the farming community, which had suffered a gradual decline in population due to agricultural mechanisation, gained new jobs in a non-polluting industry.

Denon has carried the clean-air philosophy inside the buildings — for example, employees must replace their shoes with special slippers once they enter the plant. This dust-free atmosphere is regarded as vital for the delicate audio-manufacturing processes used by Denon.

TELEPHONE OF THE FUTURE

The International Telephone and Telegraph Corporation (ITT) in the United States is developing a 'smart' telephone which will be able to listen, talk and obey by understanding speech and giving verbal responses.

A demonstration unit has already been built at ITT's advanced technology centre in Connecticut. This unit can decipher a human voice and make the appropriate verbal response. For example, when the user says "Call John Jones" into the phone mouthpiece, the unit replies "Ringing John Jones" and the labelled "John Jones" rings.

The unit also reponds to "help" for emergencies, "find" for directory assistance and "forward" for transferring calls to another telephone.

ELECTRON-BEAM INVENTION EARNS GRANT

A signal sampling and conversion system has earned a $3310 grant from the Federal Department of Science and Technology's Assistance to Inventors Scheme.

David Spalding, of Castle Hill (NSW), has designed an electron-beam system that processes and analyses complex and fast electronic signals.

Announcing the grant, the Minister for Science and Technology, Mr Barry Jones, said the invention could have important applications in advanced computer and communication fields.

The grant will be used to fund the design and manufacture of optical photodiode arrays and integrated circuits for the system.

LIGHTNING SEMINARS

A major revision to the Australian standard on lightning protection (AS 1678) will be published in November.

To coincide with its issue, the Standards Association of Australia will hold a series of seminars in November to introduce the new recommendations.

Topics to be discussed include lightning phenomena and characteristics, the rolling sphere principle, banding earthing, isolation and insulation of lightning protection systems and hazards to occupants of buildings from potential differences caused by lightning.

For further information, contact **the SAA offices in Melbourne (03)347-7911, Sydney (02)929-6022 or Brisbane (07) 221-8605.**

SELF-HELP TELEVISION

Australia's first self-help television reception scheme (STRS) has been approved for Western Australia's diamond-mining township of Argyle.

The Federal Government scheme enables communities in isolated rural areas to receive television broadcasts via the Intelsat IV communications satellite.

Programmes originate from the Perth studios of the ABC and are relayed over Telecom landlinks to the OTC station at Carnarvon. From there, the material is beamed to the satellite, which re-transmits programmes back to the dish-shaped antenna installed in the township. Household antennas are then able to pick up signals in the normal way.

The STRS scheme involves the community purchasing and installing a translator, which can be used to receive programmes transmitted by commercial stations as well as the ABC.

Planning and licencing procedures have been simplified to speed provision of the service. However, all applications are subject to approval by the Federal Minister for Communications, Mr Michael Duffy.

INNOVATIVE LEAD-ACID BATTERY DESIGN

Under the Federal Government's Assistance to Inventors Scheme, James Mackaness, an engineer of Cheltenham (NSW), has received $10 000 to manufacture prototypes of a new lightweight lead-acid battery.

Mr Mackaness designed the battery after discovering that almost half the lead used in conventional batteries was wasted. By using much finer lead for the conducting function, and substituting polypropylene for the structure, he reduced wasted lead by 70%.

Known as a lead-acid automotive (LAAUTO) battery, Mr Mackaness' design also eliminates the need for the heavy — and expensive — lead grids used in conventional lead-acid batteries. This not only reduces the weight, but improves the charging and discharging rates.

While the battery's main market is presently in the vehicle industry, it offers a number of new applications, particularly for portable tools, machines, lighting and electronics.

NOTES & ERRATA

Project 1520, Wideband Amp. July '83, page 74. Capacitors C6 and C8 are shown on the overlay as 2p2 while the Parts List and circuit shows C6 as 3p3 and C8 as 10p. The latter values are correct.

Project 421, Three-way Loudspeakers, Sept. '83, page 86. On the pc board overlay the labels on the two capacitors are reversed — C1 is the 2 uF capacitor, C2 the 8 uF capacitor. The values shown are in the correct position. The Parts List and circuit diagram are correct.

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There are two courses per year. Applications close mid-March for a July entry and early August for a January entry.

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BIGGER HEADQUARTERS FOR HEWLETT-PACKARD

Major extensions have been opened at Hewlett-Packard's Australian head office, in Blackburn, Victoria.

The extensions, which cost $5 million, have given the company an additional 5400 square metres of floor space.

Since it was established in 1967, Hewlett-Packard's Australian subsidiary has grown from 25 employees to more than 500.

A considerable amount of the space at the Blackburn headquarters has been allocated to the Australian Applications Centre (AAC) for the development of local software packages.

The AAC was formed in February 1982 and employed one person. Now, 30 people work in the AAC, which develops and adapts software specifically for Australian conditions.

DICK SMITH'S MARKETING MANAGER

Jim Rowe has been appointed marketing director for Dick Smith Electronics. For the past four years, Mr Rowe has been technical director for Dick Smith Electronics and, prior to that, spent 20 years with *Electronics Australia*, the last nine as editor.

BRAIN TRANSPLANT FOR TASMAN TURTLE

Tom Moffat has been appointed head of research and development for the Hobart-based electronics firm Flexible Systems. Mr Moffat will be working on the final development of the Elami personal robot, expected to be on the market before Christmas.

He replaces Alan Branch, the designer of the well-known Tasman Turtle educational robot (ETI April-July 1982), who has been appointed director of robotics for Commodore Computers in Dallas, Texas.

Other projects under development at Flexible Systems include a scaled-down 'Son of Elami' and accessories for popular small computers, such as a speech synthesizer for the Commodore VIC-20. ETI readers will know of Mr Moffat through his articles on the Microbee. These will continue as normal.

An experienced journalist as well as an electronics engineer, Mr Moffat has worked as a television producer/reporter and for NASA during the early days of the American space programme.

SAA STANDARD FOR RADIO INTERFERENCE CAPACITORS

The Standards Association of Australia has published a new standard on fixed capacitors for radio interference suppression.

The standard, AS1541.14, which is technically identical with IEC Publication 384-14, specifies standard ratings and characteristics for fixed RFI suppression capacitors for voltages between conductors which do not exceed 500 V at frequencies of 100 Hz or less. Appropriate test methods, test severities and performance requirements are stated, as are minimum requirements for shock hazard protection.

This standard also applies to combinations of capacitors within one enclosure but capacitors intended for special environments would need to meet extra requirements. The standard does not apply to capacitor/resistor combinations.

AS1541.14 requires to be read in conjunction with AS1541-1 (Fixed Capacitors for Use in Electronic Equipment, Part 1, Terminology and Methods of Test), as the test methods named in the standard are selected from AS1541.1 and are not completely described.

Copies of AS1541.14 can be purchased from any SAA office for $13.40, plus $2.50 postage and handling charge.

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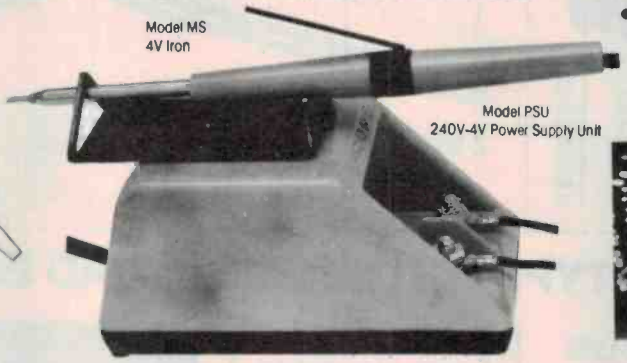

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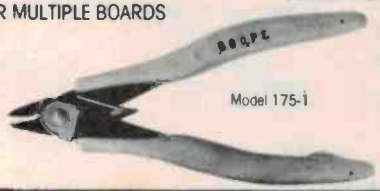

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The ins and outs of video enhancers

Jonathan Scott

Just as an equaliser and noise reduction system is used to restore lost quality and fidelity with audio tape recording, a 'video enhancer' is used to improve picture quality from video tapes. But video is quite different to audio, and video enhancers will be unfamiliar to many readers. This article will put you 'in the picture'.

VIDEO CASSETTE recorders have become a popular consumer item, in the category of 'every home should have one'. However, they are a relatively recent arrival on the domestic market and people are just getting used to the idea of owning one.

Many of the tricks of the trade haven't filtered through to the owners of VCRs and the accessories and additional gadgetry are not yet fully appreciated. An analogy to this situation is the appearance of dynamic expansion units and conductive fibre dust bugs long after the release of other hi-fi components.

This article explains the functions of a video enhancer and the differences between units.

To put it simply, a video enhancer is a tone control for the eye. The analogy here would be with a graphic equaliser, which is a tone control for the ear.

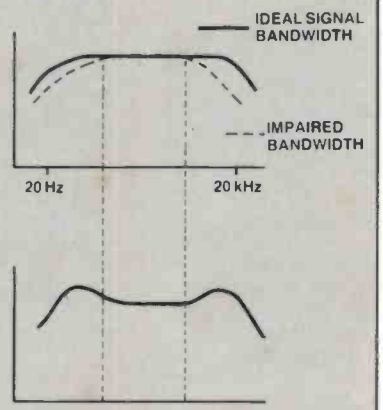
The bandwidth (frequency range) of a complete video signal is 5 MHz. However, VCRs have bandwidths of less than 5 MHz due to the way the video signal is rearranged for recording. Typically, the signal would be 3 dB down around 3 MHz.

Consequently, after one recording/playback of the programme material there is some degrading of the sharpness. After two or more recording stages there is a severe loss of the high frequency components. This affects the picture by blurring the sharp edges where there is a change of luminance, or contrast.

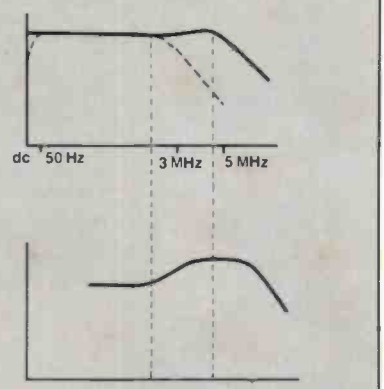
The eye is very tolerant of luminance non-linearities, or distortions, but is very sensitive to the loss of the high frequency content and so the 3 dB drop at 3 MHz looks bad.

If there is a 3 dB drop in the high frequency component of music you will only detect a certain retirement of the cymbals and other high-pitched instruments. However, a 3 dB drop at the high frequency end of a video signal causes a smudging or smearing of the image and the fine print becomes illegible.

Figure 1. This shows the ideal effect of the tone control response. The original response shape is recovered when the degraded signal is fed through the filter. This is the basic idea behind video enhancing.



1(a) Audio. Tone control response to correct for loss



1(b) Video. Low end response, down to dc, is recovered (if lost by ac coupling) by a dc restorer circuit.

To make matters worse, this effect is only in the horizontal component and not the vertical direction of the video signal. When you're looking at the picture it would be hard to pick this up, but it does impart a strange, abnormal look to the picture which is difficult to define. The vertical resolution, or effective bandwidth, is largely unaffected because of the horizontal scanning pattern of the TV image.

A video enhancer aims to restore some of the lost frequency components, in the same way as you might try to bring back the cymbals to a piece of music by winding up the treble knob. See Figure 1.

There are some video enhancers around which are only capable of this basic function, however four problems stand in the way of such a system and limit its success.

Colour subcarrier signal

The colour subcarrier signal gives the trace the information about the colour it should be writing in. This signal is added to the video information before transmission and is removed before viewing. This technique is used as it effectively leaves a colour signal B & W compatible.

While it is desirable to boost the contrast past of the video information it is necessary to hold the subcarrier amplitude fairly constant. Most VCRs have some tolerance or degree of latitude for the amplitude of this part of the signal, but it is often not above 3 dB. A better video enhancer is designed with a 'unity gain notch' at a frequency of 4.43 MHz. See Figure 2.

Some VCRs don't have this problem as they have a built-in enhancer which intercepts the path of the signal before it contains the subcarrier. However, these circuits are generally not accessible and are not able to be adjusted for varying external effects, such as the state of the video signal. These enhancers are usually set to give only a small improvement in signal.

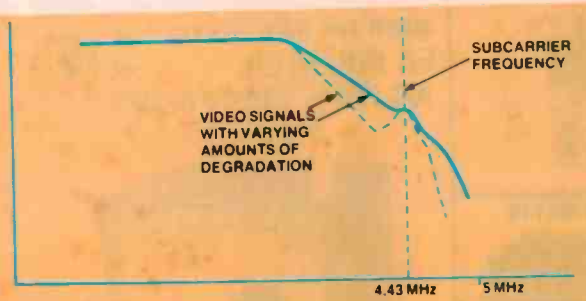


Figure 2(a). The first complication to pure high frequency boost is the presence of a subcarrier at 4.43 MHz. This signal must not be seriously tampered with.

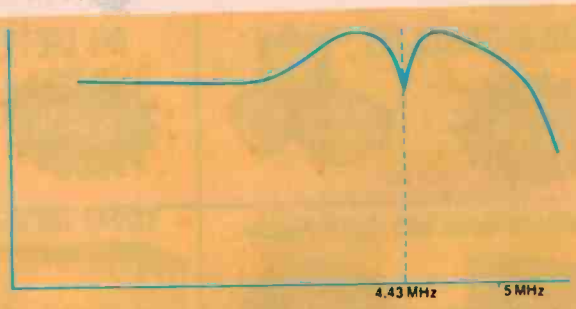


Figure 2(b) The typical enhancer is careful not to touch the subcarrier frequency.

Synchronising pulses

Synchronisation pulses in with the video signal are susceptible to over-enhancement. Some video enhancers are designed to leave the synchronising part of the waveform alone. This is sometimes achieved by reducing the enhancement of negative-going edges.

Generally the pulses will tolerate a considerable amount of over-enhancement before the hold of the picture is upset and usually some other problem arises before this happens.

Noise

When the signal is enhanced so is the noise. This is annoying as it manifests itself as 'snow' or random crud scattered over the picture. However, this is not necessarily a limiting factor as it is possible to tell the difference between the noise in the signal and those parts in the signal which it is important to enhance.

The edges between different levels of luminance in a picture are the parts of the waveform which cause the most annoying effects when the signal is degraded. And the more contrast there is in a picture, the more it will suffer.

Noise, however, is concentrated around the 'black' end of the video signal. Therefore, a level-sensitive amount of boost in the enhancement circuit will produce more enhancement around the 'white' end of the range. This allows a greater amount of boost to be applied overall before the physical limits of recovery are reached. See Figure 3.

Enhancers with this facility are easily identified as the degree of black boost to white boost is generally varied by a knob on the front panel. This knob may be labelled as 'GAMMA', from the technical description of the non-linearity response, 'CORE' or similar video jargon words.

In practice, boosting the sharpness of the picture and subduing the noise is optimised by adjusting the 'ENHANCE' and 'GAMMA' controls. These controls are, to some extent, interactive and it takes practice to achieve a good setting. However, these functions cannot eliminate existing noise, nor can they stop all of it.

The fact that the small-signal response of an enhancer is level sensitive makes it rather tricky to list the specifications. To quote a frequency response curve or specify the amount of boost at some peak frequency is to miss the point of why the circuit was designed.

The GAMMA control should have a sufficient range to be able, at one end of travel, to effectively disarm itself and pass all signal levels equally to the enhancer. At the other extreme of its travel this control should be able to refuse all signals to the enhancing circuitry, implying that no signal level was sufficient to warrant enhancement.

The effective range between these two extremes should be a smooth transition from no enhancement to normal enhancement. Any radical transitions would cause the rate of change of luminance in the ramp signal to alter sharply.

Overshoot

The main limiting factor in enhancement is overshoot. It is a fundamental property of filters that increasing the high frequency response causes overshoot on the sharp transitions passing through the system.

Overshoot on video signals manifests itself as small shadow lines which can be seen immediately to the right of any vertical line separating light and dark areas in the picture. This is, of course, not desirable and it doesn't look very natural.

Therefore, the effective limit of recovery of sharpness is determined by the amount of overshoot which is tolerable. Beyond some point of degradation, response restoration will be impossible without the annoying shadow lines. The situation is worse on transitions going from dark to light, and from left to right.

Some degree of latitude in this respect can be achieved by another signal level dependant function. The basic idea is that video signals are a standard level, or amplitude, from black to white. Overshoot on large signals would normally exceed the standard level and are more capable of producing the unpleasant visual effects.

A 'clipping' function, which prevents the boosting of signals exceeding the standard level, will attenuate the offending overshoot on the full dynamic range transitions. See Figure 4.

This function will also help to clean up synchronisation signals, if they are enhanced along with the video signals. There is not usually an adjustment control provided for setting the clipping level as the levels involved are fixed in normal systems.

Conclusion

After studying all the complexities involved in a video enhancer, it was decided that some video enhancers are better than others. There are full signal processing units around which actually separate out the coded components of the signal and process them separately.

The signal can be modified by these units with the flexibility of a graphic equaliser. However, they are not yet suitable for the domestic market when you consider their cost and the functions they offer.

The simple video enhancers have a limited number of functions but they are very cheap. A unit in the middle price range would be adequate for the amateur who only wants to do the occasional editing and avoid the signal degradation imposed when using a 'domestic' video recorder. ●

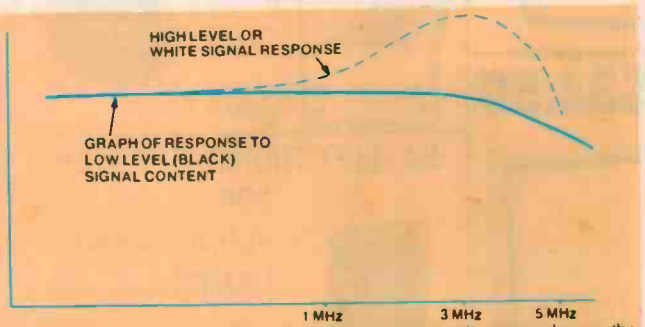


Figure 3. Amplifying all the high frequency components may enhance the noise. However, as noise is usually most visible when attached to low level signals, these may be selectively ignored.

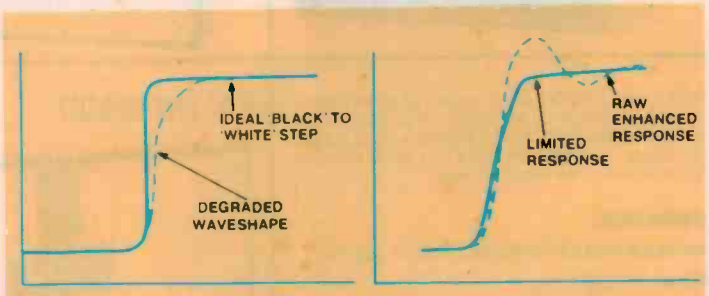
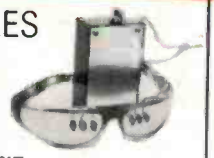


Figure 4. Enhancement of high frequency sinewave components causes overshoot and ringing. This is excessive on large steps in the video signal. Circuits to limit this are sometimes included.

BOGGLE GOGGLES



$9.60

Short form

PH METER

$129

with probes

Tacho/dwell meter with digital display

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MAY EA 1982

12/240 volt Inverter 40 WATTS

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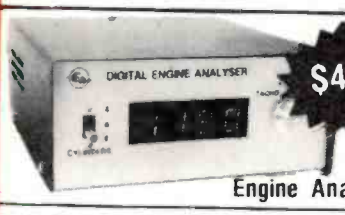
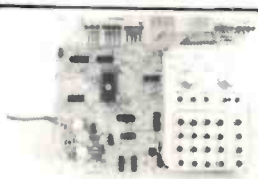


$48.50

Engine Analyser Kit



Eprom Programmer

$55.00

JANUARY EA 1982 INCLUDES TEXTOOL SOCKET

SPECIFICATIONS FOR 300W INVERTER

Nominal Supply Voltage	12V DC
Output voltage	see table
Frequency	50Hz ± .005%
Regulation	see table
Maximum Load	300VA
Current Limiting	30A (primary)
Efficiency	see table

Resistive load W	Output voltage (RMS)	Input current (A)	Efficiency (%)	Battery life 40Ah/20h rate (minutes)
no load	210	1.2	0	–
40	235	4.5	60	240
100	240	11.3	62	80
140	240	15.0	69	60
200	240	20.1	78	50
240	240	24.0	79	32
300	235	29.6	82	28

REMOTE INFRARED TV SOUND CONTROL

$40

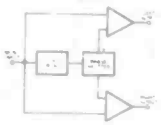
E.A. JANUARY "83".

Designed to relieve the long-suffering TV viewer from painful, brain-killing advertisements, our TV Sound Control provides remote control of volume. It gives eight steps of control, including full off, when total silence is called for. Give yourself a break and relieve advertising tedium today.

$55.00

STEREO SYNTHESISER FOR TUNERS AND VCRs

Enjoy the benefits of stereo sound from your video cassette recorder, TV or AM tuner with this Stereo Synthesiser. The circuit uses just four ICs and is easy to build.



$189.00

Analogue and Digital Storage CRO Kit

EA POWER UP

$38.50

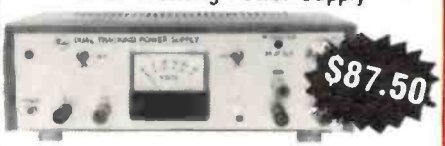
EA NOV 1982

Led Head Lightchaser

(Battery and headband extra)

$12

Duel Tracking Power Supply



$87.50

100w Sub-Woofer Amplifier

$85.00

JULY EA 1982

EA DIGITAL READOUT FOR SW RECIEVERS

$72.00 COMPLETE

OCTOBER EA 1982

EA EASY-TO-BUILD FREEZER ALARM

$21

OCTOBER EA 1982

PLUG PACK REGULATOR

$14

Plugpack Extra

Want to add digital frequency readout to an AM radio or shortwave communications receiver that uses an old-fashioned analog dial? This unit features a bright four-digit LED display, 1kHz resolution, and a 0.2s update time that's fast enough to follow the tuning knob.

SPECIFICATIONS

Ranges (full scale): 0-10MHz and 10-30MHz (optional).

Display: Four digit

Resolution: 1kHz with division switch set to divide by one; 10kHz with division switch set to divide by 10.

Sensitivity: Less than 100mV from 500kHz to 30MHz.

Offset frequency: Prototype set to 455kHz, but any offset frequency can be programmed.

EA THEREMIN $34.50

JUNE EA 1982

EA ELECTRONIC STARTER FOR FLUORESCENT LAMPS

$5

OCTOBER EA 1982

ROD IRVING ELECTRONICS

425 HIGH STREET, NORTHCOTE 3070, MELBOURNE, VICTORIA. Ph (03) 489 8131. Telex No. 38897

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Introducing the Sony Compact Disc Player.

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WIRELESS REMOTE CONTROL Full-function remote control.

3-WAY MUSIC SEARCH ☐ Instant direct access to any selection with the 10-key pad on remote control unit. ☐ AMS (Automatic Music Sensor) allows access to the beginning of next or previous selection. ☐ 2-speed bi-directional search to find any desired music passage.

REPEAT FUNCTION Program to repeat the entire disc, one selection, or a specific portion of music.

3-FUNCTION DIGITAL READOUT DISPLAY ☐ Selection number. ☐ Time lapse of selection being displayed. ☐ Remaining time on the disc.

LINEAR SKATE DISC LOADING Just press the button, platter control and cueing are automatic.

Get even more perfect sound with the Sony Digital Audio Component System, "Precise Series".

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DYNAMIC STEREOPHONES ATH-50
L
audio-technica
MCR RM4960L

"To accurately test our cartridges, we created the world's finest stereo headphones."

To test our cartridges for the improper tracing and signal-to-noise ratios that an ordinary speaker would not register, we needed highly sensitive stereo headphones.

To obtain the accuracy that our reputation demanded, we had to create our own.

The present ATH series is the second generation of Audio Technica headphones, subtly refined and further improved.

Lightweight, comfortable precision instruments, they reflect Audio Technica's unrivalled reputation for reliability and the intelligent application of advanced audio technology.

And now Australian hi-fi enthusiasts will discover Audio Technica stereo cartridges, stereo headphones, stylii, microphones, tone arms and other accessories more readily available through an expanded dealer network.

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MCR/RM4960R

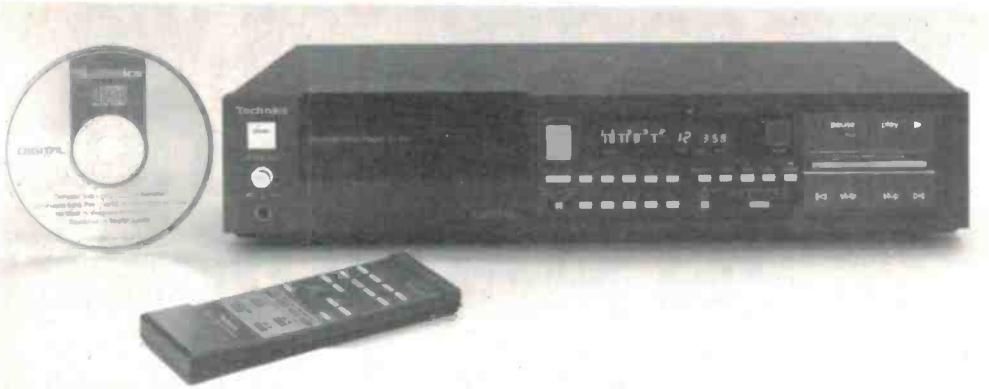
THREE CD PLAYERS FROM TECHNICS

Technics has expanded its range of compact-disc players to three models — and at the same time has revealed that it has developed its own CD manufacturing process.

The two new models are the SL-P7 and SL-P8, and they are scheduled to be available in Australia before the end of the year.

Technics introduced its first CD player, the SL-P10, late last year. The SL-P10 is a front loading player with multi-functional display, easy operation and 63-step random-access programming. Functions include repeat (single track or whole disc), search, intro-skip and timer recording capability.

The SL-P10 uses a semiconductor laser pickup with twin parallel suspension and three-beam tracking servo. The pick-up, its drive mechanism and the ultra-compact brushless direct-drive motor are built into a precision optical desk in an aluminium diecast chassis. Original LSIs, ICs and microprocessors are employed for error correction, servo control, 16-bit digital-to-analog conversion and other functions.



Technics has labelled the SL-P7 and SL-P8 as its 'second-generation' CD players. They are a result of the same design policy that produced the SL-P10, but they have their own unique features. For example, the SL-P8 features 14 program keys which allow free selection of disc areas to be played, and in which order they are to be played. The programmable capacity is 32 steps.

Meanwhile, Technics has announced that it has developed its own CD manufacturing process and is operating its own custom disc press. In addition, the Osaka-based company says it is planning to offer a CD test disc under its own brand.

For further information, contact **National Panasonic, 95-99 Epping Road, North Ryde NSW 2113. (02)887-5333.**

▲

NAKAMICHI MOBILE SYSTEM

Nakamichi has re-entered the automotive sound market with a three-part system which the Japanese company claims could rival the finest home-system equipment.

The Nakamichi Mobile Sound System consists of the TD-1200 tuner/cassette deck, the PA-300 power amplifier and the SP-400 speaker system.

The TD-100 combines a 10-preset AM/FM-stereo tuner and an audio-reversing cassette deck. Nakamichi says response from 20 Hz to 22.000 Hz is ±3 dB, wow and flutter is less than 0.045% and the signal-to-noise ratio is better than 70 dB, with Dolby-C noise reduction.

Another feature of the TD-1200 is a personal system-lock code, which is intended to discourage theft and prevent unauthorised use.

The three-way SP-400 speaker system spans the range from 50 Hz to 22 kHz.

For further information, contact the Australian distributor, **Convoy International, 400 Botany Road, Alexandria NSW 2015. (02)698-7300.**

AIWA's MIGHTY MIDGET

Scheduled for launching in October, the AIWA DX-1000 — the world's slimmest compact-disc player — is expected to go on sale in Australia early in 1984.

Measuring just 7 cm high, 33 cm wide and 30 cm deep, the 5.6 kg DX-1000 will initially be marketed in Japan and Europe.

The DX-1000's digital/analogue converter has been precision-adjusted by laser trimming, and a new circuit design enables lower distortion, improved signal-to-noise ratio, wider stereo separation and better overall performance.

AIWA says the extremely compact size has been made possible by the horizontal slide-in auto-loading mechanism. Nine LSIs and miniaturised laser pickup and mechanism contribute to the size reduction.

Three microprocessors and one LSI are employed for full servo control, enhancing operation dependability and simplifying use.

The DX-1000, which has a rated dynamic range of more than 90 dB, is compatible with AIWA's V-700 component system.

For further details, contact **AIWA Australia, 14 Gertrude Street, Arncliffe NSW 2205. (02)597-2388.**

NATIONAL'S LATEST GOODIES

National's latest additions to its already extensive range of home video equipment are the NV-600A and NV-788A video cassette recorders and the WVP-200N colour camera.

Aimed at the 'middle market', the front-loading NV-600A has an 11-mode wire-less remote-control handpiece, cue and review at five times normal speed, one-touch timer recording and an automatic tuning synthesiser for exact tuning.

The 'de luxe' NV-788A is the first VCR that allows up to eight hours recording on a single tape. It also has a five-head system for improved recording and playback quality.

Both the NV-600A and the NV-788A use the VHS system.

The WVP-200N camera has a 5 MHz Saticon tube which gives a high resolution of 350 lines and accurate colour reproduction with a minimum required illumination of 25 lux. Other features include two-channel audio for stereo recording, compact and light weight (about 2 kg) and a two-frame title-writing capability in seven colours.

For further details, contact **National Panasonic, 95-99 Epping Road, North Ryde NSW 2113. (02)887-5333.**

POCKET TELEVISION SETS

Sanyo has started production of pocket-size LCD-based television sets with 75 mm and 100 mm screens.

Sanyo says it has overcome major problems with the driving systems, while the development of a 'stacked liquid-crystal matrix panel' has produced clear pictures. The panel combines a newly developed liquid crystal display with amorphous silicon thin-film transistors.

Reliability has also been improved, along with contrast, wider viewing angle and response speed.

The 100 mm screen model has a display size of 60 x 80 mm, and an overall size of 253 x 30 x 113 mm. The reception bands include both UHF and VHF and the batteries provide four hours of viewing.

No other information has yet been released.

▲

DISCWASHER GOES VIDEO

Discwasher, the American company which made its reputation with record-cleaning accessories, has launched a cassette-style cleaner for video-cassette recorder heads.

The Discwasher video head cleaner, which is available in both VHS and Beta formats, is claimed to be totally non-abrasive to the highly delicate VCR head system, while effectively removing dirt and tape oxides which ruin both picture resolution and audio clarity. Discwasher is also marketing a range of video connector cables, in 1.5 metre lengths. They feature high-purity copper conductors for improved signal and static protection, and come ready for hook-up without wire-stripping.

For further details, contact the Australian agent, **Arena Distributors, 642 Albany Highway, Victoria Park WA 6100. (09)361-5422.**

HOWDEY, PARTNER . . .

TEAC Australia has released what it calls 'the ultimate personal stereo' — the TEAC Partner, Model PC-7RX.

The Partner incorporates continuous automatic reverse and a noise reduction system to eliminate tape hiss. This has previously been a problem with personal stereos, due to the very nature of headphone listening.

Available options include the LS-X3, an internally amplified mini-speaker system and the TP-7 AM/FM stereo tuner.

Meanwhile, TEAC Australia has been appointed Australian distributor for the Japanese range of Denon cassette and open-reel tapes. Denon is recognised as one of Japan's leading manufacturers of magnetic tapes and produces one of the largest ranges available.

For further details, contact **TEAC Australia, 115 Whiteman Street, South Melbourne Vic. 3205. (03)699-6000.**

Hand made effects

Professional quality effects you build yourself

Amdek takes the mystery out of effects units. Amdek kits are very high quality effects units you build yourself. The circuit board comes pre-assembled and tested. You wire it all together yourself. You save over equivalent built up effects units and gain in several important ways:

Know how it works

Detailed assembly manuals explain how the circuit works and how it goes together with the rest of your system.

Make your own sound

The manuals of most models show you how to alter your effect unit to create your own original sounds. Build the effect in its original form and then remodel it to your own sound!

No special tools

All you need is a soldering iron, Phillips screwdrivers, small screwdrivers, pliers and nippers. Just follow the step by step instructions in the assembly manual and build your own hand made effects unit.

Look at the range!

Amdek gives you a huge and continually widening range – all using the latest technology.

Distortion Kit (DSK-100). Modifiable points 2.
Phaser Kit (PHK-100) Modifiable points 0.
Compressor Kit (CMK-100) Modifiable points 4
Tuning Amp Kit (TAK-100) Modifiable points 1
Electronic Metronome (EMK-100) Modifiable points 2
Chorus Kit (CHK-100) Modifiable points 0
Flanger Kit (FLK-100) Modifiable points 0
Percussion Synthesizer Kit (PCK-100)
Includes external trigger input, hitting board, adjustable attack and delay.
Stereo 6ch mixer (MXK-600)
Includes panpot, mike and line inputs.
Delay Machine (DMK-100)
25-300 ms delay.
Graphic Equalizer (GEK-100)
Ten band, bypass switched.
Rythm Machine (RMK-100)
Up to 16 patterns in 12 or 16 steps. 4 sound sources, sequential performances of patterns.
Power Supply (PDK-5)
Powers up to 5 effects.

New Releases

Available November '83

Handclapper (HCK-100)
Output level controlled by pad strike or input from external signal. Dry and thick sounds.
Octaver (OCK-100)
Input, one octave and two octaves down seperately adjustable.
Delay Machine DMK-200
Delay from 20-300msec

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Glover & Assoc. ROL/536

Sansui compu-receiver Z-9000

Louis Challis

A compu-receiver? Sounds interesting. And it is. So what is it? It's an integrated receiver-amplifier. It looks good and has some sophisticated features and controls that offer quite a lot if you don't want to get into 'system' hi-fi.

THE SANSUI Quartz Synthesiser Compu-Receiver is one of the most visually attractive high technology receivers produced by Sansui. Its avant-garde design is symptomatic of a growing trend in Japan to design equipment with a space age or sci-fi appearance.

No doubt it was also intended that this unit should have a superlative technical performance. However, when a manufacturer attempts to take all the latest concepts and available technology and put the lot into one large cabinet there are bound to be a few problems. Murphy's law applies elsewhere in the world, so why not for the Japanese too.

The Z-9000 receiver has an astounding range of functions which allow you to listen to radio programmes and play records, tapes and compact discs. However, the Sansui research and development engineers have come up with a fairly sensible design concept in which the computer-oriented features and controls need only be accessed if one really needs them. So you don't have to learn how to use them all if you don't want to.

The internal microprocessor can be programmed to start and stop the receiver for one, two or three daily programmes at preset starting and stopping times, with mixed inputs of AM, FM or an external cassette deck. The internal memory has the ability to store eight AM and eight FM station frequencies. The display tells the time when the unit is not acting as a receiver or amplifier.

SANSUI COMPU-RECEIVER Z-9000

Dimensions:	*550 mm wide x 150 mm high x 395 mm deep (excluding the external hinged looped aerial)*
Weight:	*15.2 kg*
Manufacturer:	*Sansui in Tokyo, Japan*
Distributor:	*Vanfi (Australia) Pty Ltd, 283 Alfred St, North Sydney NSW 2061. (02) 929-0293*
Price:	*Rrp $1399*

Frontal

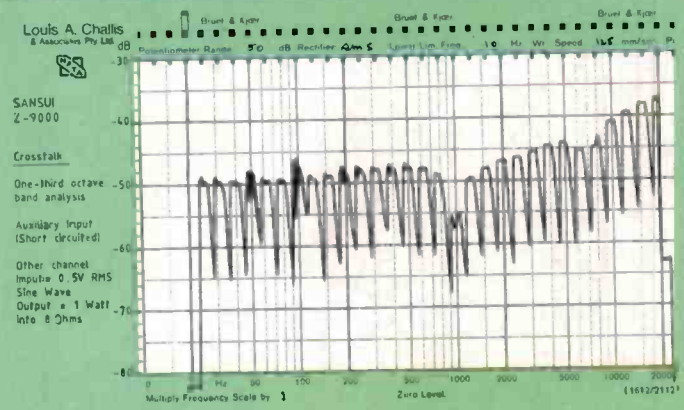
The Z-9000 is unusually large, a result of the demands the designers have placed on the available space on the front facia. The large array of space-competing features is intended to attract the intending purchaser, impress guests and provide all the functions for which the unit could be purchased.

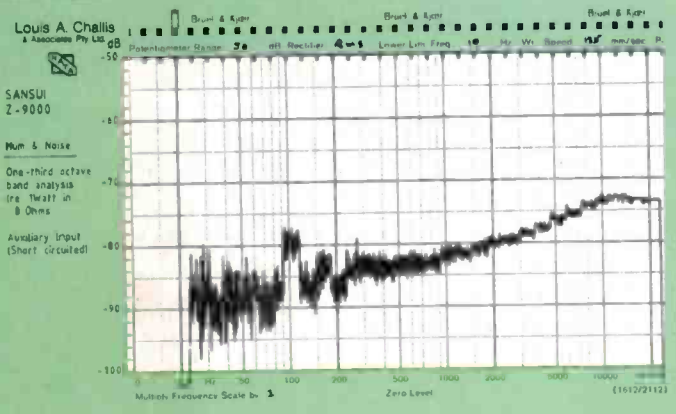
The front facia of the receiver is divided into four distinct zones for control and display. The designers have handled these requirements in three different ways.

The two end sections, with the primary controls, are constructed with brushed satin aluminium with either engraved lettering or silk screened lettering on the controls. In the centre of the unit is a large, clear plastic, encapsulated module with multiple illuminated displays and a small keypad section with fifteen keys and two supplementary controls to input data and control the microprocessor.

The left-hand side of the front facia features a seven-band graphic equaliser providing ±10 dB gain or attenuation. The designers have elected to use non-standard centre frequencies of 60 Hz, 150 Hz, 400 Hz, 1 kHz, 2.5 kHz, 6 kHz and 15 kHz. This choice of frequencies is not as good as the standard octave-band centre frequencies. However, it still allows excellent equalisation for deficiencies in the programme content and, to a limited extent, for the deficiencies in loudspeakers or room characteristics.

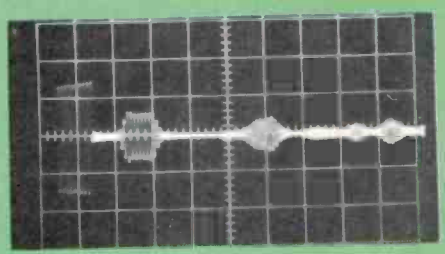
Also in this area is a balance control and a microphone mixing control with associated single tip-and-ring-sleeve microphone socket. As the unit has a hefty 120 watts per channel power output capability, the designers have sensibly decided to incorporate three speaker circuits and associated ▶





pushbutton switches. However, the logic circuitry only allows two out of the three systems to be paralleled at the same time. These switches also provide preferential priority; the A system has priority over the B system, and the B system has priority over the C system.

Four small pushbutton controls adjacent to the graphic equaliser provide wide or narrow band FM intermediate frequency stage selectivity, a graphic equaliser activate or defeat switch, a high filter switch and a subsonic switch.



Reverberatioin test. Reverberation set at maximum. 10 ms/div.

The internal reverberation control is the only control in this unit whose requirement I can really question. It has a separate control for diverting the reverb function to either the source material or the external microphone circuit. The level of reverberation is controlled by a small potentiometer.

The central display unit features two, bright blue, plasma displays at the top, with the double row plasma display on the left providing a dual function. It has the ability to monitor the power level fed into a nominal eight ohm speaker load using dual 12-segment displays covering the range 0.003 watts to 120 watts for each channel. There is also a separate display which operates in conjunction with the volume preset control. When this display is activated it indicates the power level and intended sound level to which the unit will automatically adjust itself when initially switched on.

It could be argued that this is exactly the function that the old fashioned push-pull switch/volume control provided on your radio of yester-year, without the hoo-haa of the plasma display. Notwithstanding, it is attractive to look at and will undoubtedly be popular on the American market.

When this function is selected you can set the nominal audio output power level, indicated on the plasma display, using the 'rocker bar' volume control on the right hand side of the receiver. When you are aurally or visually satisfied with the sound level you simply press the volume 'preset' located below the volume control 'rocking bar', memorising the preferred power output.

One problem with this system is that the discrete steps of attenuation adjustment provided by the rocker bar are far too large, in the order of three to four decibels per step, which are about twice as large as they should be. Pressing the memory switch also activates the preset light on the bottom right hand corner of the display module, temporarily holding the level setting of the plasma display module before the display reverts to a normal peak power mode.

On the right-hand side of the visual display module is a 24-hour clock which doubles as a frequency display for AM and FM. It also uses a blue plasma-type display which is clearly visible from up to five metres during the day or night.

In the lower section of the display module is an optical 'reverb' indicator which uses two interference gratings with rear illumination. The tuning indicator uses five separate yellow LEDs to indicate the signal strength. The threshold of these lights is at 14, 26, 32, 35 and 38 dBf respectively (where 0 dBf is 10^{-15} watts into the receiver's aerial).

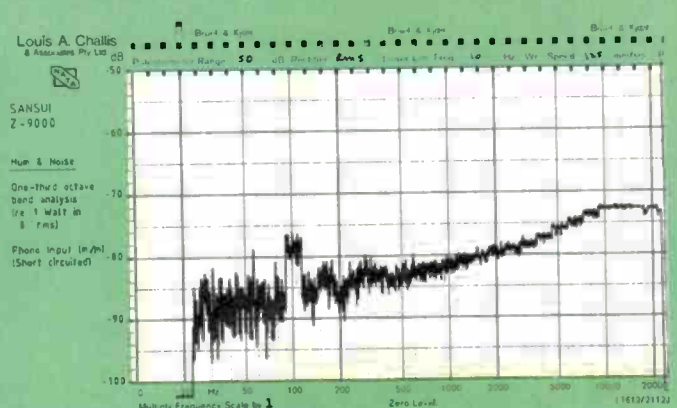
Two additional small LEDs indicate whether the station frequency is locked on to the channel centre frequency, and an FM stereo indicator light indicates that a stereo station pilot tone has been detected.

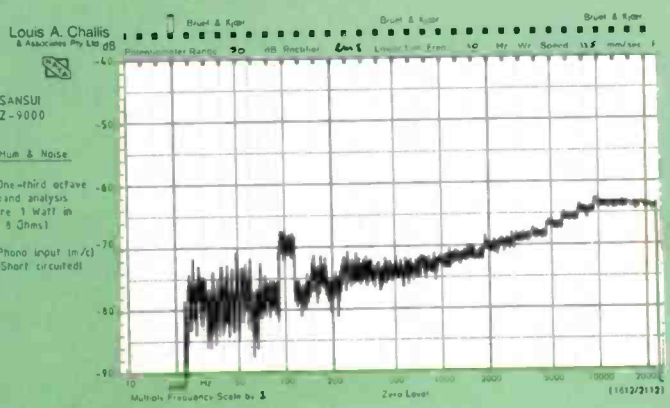
Below the reverb display and the tuning indicator are three yellow bezels to indicate which of the loudspeaker systems are connected to the output stage. The connection priority for these is controlled by the microprocessor which, in the event of two or more buttons being pressed simultaneously, determines the precedence.

In the bottom left-hand corner of the display module are two programme indicators for displaying whether a moving magnet or a moving coil cartridge has been selected, as part of the phono cartridge indication. The associated displays show whether FM, AM, auxilliary or tape 1 has been selected. Other displays show whether tape 1 is being copied to tape 2, whether tape 2 is connected or whether a tape is being monitored.

A large red eight-segment display is used for the values of one to eight to indicate which frequency channel of either the AM or FM has been selected. It is left up to you to remember or note down which number corresponds to which station. The last two indications show whether the volume preset control has been activated and whether the −20 dB muting switch is functioning.

To the right of these controls is the 15-button keypad. Ten switches are used to key in frequencies or times. Keys 1 through 8 are used to select the stations for AM and FM.





Keys 1 and 2 are for selecting the start and finish time for preset programme one. Similarly, keys 3 and 4, 5 and 6 are for selecting the starting and finishing times for programmes two and three. Key number 9 is for reselecting the last FM station that was listened to and key number 0 is for the last AM station that was listened to.

There are five separate grey keys. The top two are used for raising and lowering the indicated frequency of stations when in the manual tuning mode. The central key labelled 'M' is for memorising a frequency in conjunction with the keypad number. The key labelled 'S' allows the receiver to sequentially monitor and hold each of the preset stations in the keyed-in sequence, holding each for a few seconds. The key labelled 'C' displays the time for approximately five seconds during the period when the receiver is displaying the frequency of a radio station.

Below the keypad is a small pushbutton which, in the tuning mode, controls the activation of manual or automatic tuning or, when the receiver is tuned to a station, controls the selection of mono or stereo. At the bottom right-hand corner of the control module is a rotary control for the selection of the clock and timer modes, the checking of the clock setting and timer modes, the setting of the programme preset times and it can also clear the programme preset times.

It is very simple to set a program or a frequency. The program is flexible enough to allow the setting of FM, AM and even tape or tape copying for any or all of the three programme segment times provided.

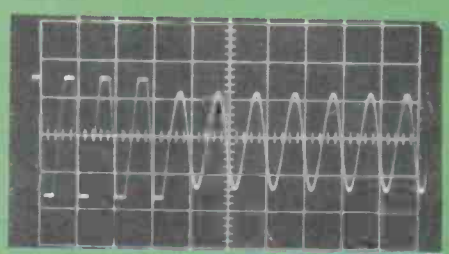
The most important controls are a set of large, brushed satin, aluminium push and rocker switches located on the right-hand side of the unit. These include a large rocker switch with upward and downward pointing arrows for the volume control, and the volume preset control immediately below it. These two controls are flanked on the right-hand side by five large pushbutton switches clearly labelled phono, FM, AM, auxillary and tape 1. The activation of any one of these switches automatically turns the power on, and the unit which previously just displayed the time comes to life.

To the right of these switches is a small pushbutton which selects either moving magnet or moving coil sensitivities. Below is the muting switch, the tape 2 switch and the power standby switch. This switch de-activates the unit to a standby condition so that only the time is displayed. Below the power standby switch is the tip-ring-and-sleeve headphone socket which balances the microphone socket at the other end of the unit.

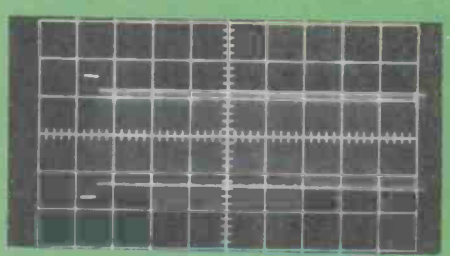
R-sup

The rear of the unit features three sets of colour coded turn-to-lock loudspeaker sockets and three ac outlets of the parallel pin type (which I would expect to be blanked off in the units supplied for normal Australian sales). There are also the normal input and output connections for two tape recorders, a single pair of sockets for phono input (moving magnet and moving coil) and links between preamplifier output and power-amplifier input.

Transient overload recovery test. 10 dB overload re rated power into 8 ohms with both channels driven. Overload duration: 20ms; Repetition rates: 512 ms.



1ms div.



50 ms/div.

Instead of the normal loop stick antenna for AM this unit features a hinged and moulded loop coil antenna which is practical and suprisingly, after an absence of approximately 35 years, back in vogue again.

The cabinet of the receiver is fabricated from particle board veneered with a durable plastic-simulated veneer. This is combined with a heavy weight, generously perforated, slotted steel casing.

Inside engineering

On opening up the back of the Z-9000 receiver I was confronted by what appeared to be a fairly simple set of electronics grouped into four distinct areas. Two separate pc boards with the RF stages are located on the top board and the audio frequency preamplifier stages are located on the lower board at the left-hand side of the unit.

The centre of the receiver contains the main power supply, voltage regulator, protective fuses and capacitors at the front. Towards the rear are a two-stage heat sink and a liquid vapour, phase cooling heat pipe. The Sansui engineers have gone to a great deal of trouble to ensure that the heat from this very high powered output stage is dissipated.

The three loudspeaker output circuits are protected by individual protective relays controlled by associated circuitry. The right-hand side of the receiver contains the very large power output transformer with its full magnetic screening and the primary multi-finned, liquid vapour, phase cooling radiator.

The front of the receiver contains a very large pc board extending the full width behind the front of the panel. It connects the graphic equaliser stage and all of the other controls with the liquid crystal and LED display circuits used for the 'compugraphic' functions of the receiver. This circuitry is protected by a rear mounted metal cover. ▶

SOUND REVIEW

The receiver contains a significant amount of parallel and conventional screened wiring to connect the three major external circuits with the graphic display pc boards located in the front of the receiver. The circuitry is neatly layed out but the RF circuitry is not as impressive as I would expect in a receiver with so much potential.

Objective testing

The objective testing of the receiver proved to be an eye-opener but not in quite the way that I had expected. The RF performance is generally good although not as good as I would have liked. The mono sensitivity for a 26 dB signal-to-noise ratio is 10 dBf, which is almost exactly the same as the 10.3 dBf that the manufacturers claim.

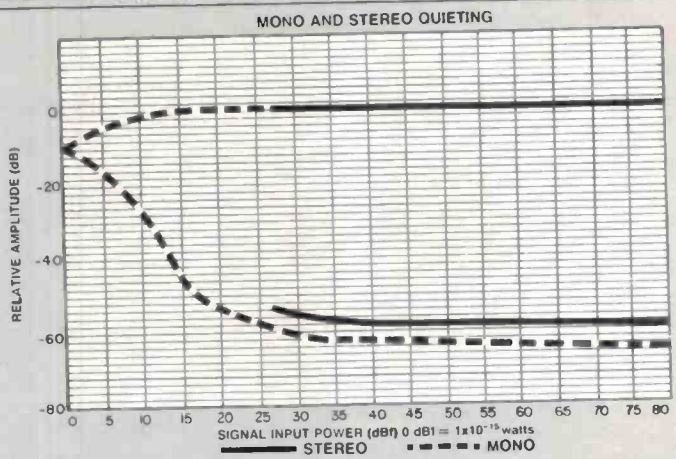
The stereo sensitivity is determined by the automatic stereo detection circuit which only comes into action at 27 dBf. I have estimated the equivalent stereo sensitivity at approximately 20 dBf for a signal-to-noise ratio of 46 dB.

Notwithstanding, the 50 dB quietening sensitivity figures which we recorded are better than those of the manufacturer. However, the signal-to-noise ratio never gets much better than 65 dB because of the internal noise produced in the audio preamplifier stages. The manufacturers claim ultimate signal-to-noise ratios of up to 80 dB on mono and 76 dB on stereo, however, our measurements could not approach these figures.

The band width of the FM stage and its stereo separation are excellent being particularly flat, smooth and offering real hi-fi performance. The AM performance is modest and totally uninspiring, typical of most Japanese receivers.

It is with the audio section of the receiver that I have my main complaints. The distortion capabilities of the main amplifier are truly first class, as confirmed by the IEC high frequency-total difference frequency distortion measurements. However, these results are degraded by the preamplifier stage. While the distortion figures for the output stage alone are close to 0.001%, this figure deteriorates to less than 0.01% when the preamplifier stage is included in the test.

This is a shame because Sansui make valid and justifiable claims for their 'super feed forward' circuitry which are justified, but not when connected to preamplifier stages of lesser capability. For example, the harmonic distortions at the one watt level and the 120 watt level are far below the potential of the power output stage. This problem also manifested itself in the signal-to-noise figures which were inferior to what I would have expected from an amplifier as good as this. Instead of figures of the order of 80 dB(A) we measured a noise performance of only 65.5 dB(A) on the phono input and 66 dB(A) on the auxillary input.



The channel separation and cross-talk are typically 48-50 dB which is adequate, but is a little less than I would expect from this receiver. The main output stage, however is absolutely first class and provides a healthy 120 watts of output power into eight ohms with both channels driven and 2.7 dB of headroom.

Subjective testing

The subjective evaluation of the unit has an ergonomic performance which, to a large extent, makes up for many of the minor failings highlighted by the objective testing. The designers have produced a very functional receiver. The unit is capable of performing like a minicomputer and I was soon able to obtain many performance features that other receivers are just not capable of.

When I used the unit at home I found that the best features were the broad band mode and the narrow band FM reception mode. The selectivity and sensitivity were more than adequate for Australian listening conditions, generally providing a first class performance.

In the amplifier mode the graphic equalisers are a decided advantage and they provide a first class and practical function. I soon found that I could equalise the system response to cater for non-uniformity in the listening room acoustics, speaker acoustics and, depending on the content, limitations in the programme content itself.

The preset function on the volume control is useful only in that it duplicates the characteristics of a volume control that one would leave at a preset position when switching off the power. The steps that the digital volume control provides were not pleasing and a smaller incremental step seems to be an almost essential requirement.

When listening to recorded programmes on the local FM stations or playing high quality records through the unit, one is not aware of the limited signal-to-noise ratio. And the limited number of steps provided by the rocker bar's volume control system are not a problem.

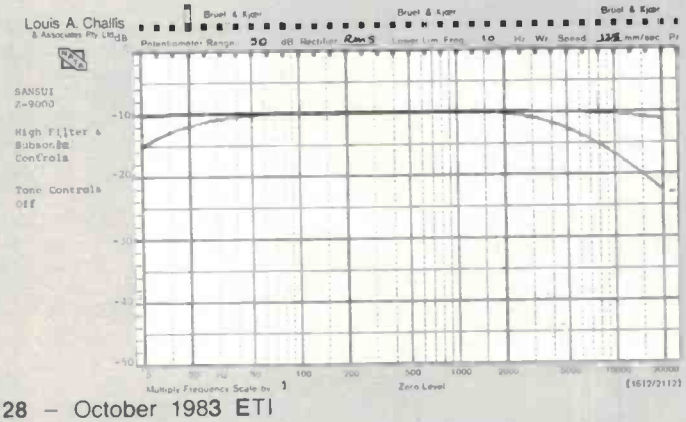
What is obvious is that the receiver has an absolutely superb transient response, tremendous output power and an attractive visual appearance.

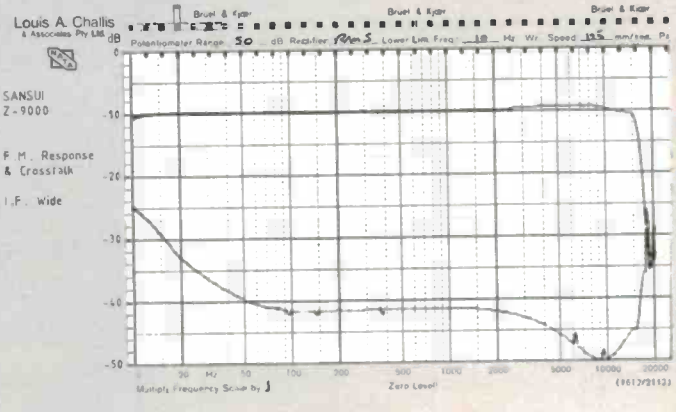
Conclusion

The Sansui Z-9000 receiver performs well in the RF range. The audio frequency performance is generally good but Sansui should try to improve it further by redesigning the preamplifier stages.

The receiver is very large; much too large for a racking system, thereby requiring a shelf, piece of furniture and suitable space for its incorporation.

The Sansui Z-9000 has all the thrills and frills that the intending user may want if he wishes to impress his friends. While I am suitably impressed by those features, I believe that Sansui should have spent a little more time and trouble refining the technical performance so that the electronics fully matches the potential promised by the front panel of the receiver.





MEASURED PERFORMANCE OF SANSUI RECEIVER Z-9000

FREQUENCY RESPONSE :

(-3dB re 1 Watt, 0.5V Input to Aux.)

	Tone Controls Defeated		
Left	3.0 Hz	to	63 kHz
Right	2.5 Hz	to	63 kHz
	Tone Controls Centred		
Left	3.0 Hz	to	62 kHz
Right	3.0 Hz	to	60 kHz

SENSITIVITY:

(for 1 Watt in 8 ohms)

	Left	Right
Aux.	13.0 mV	14.0 mV
Tape	13.0 mV	14.0 mV
Phono M/M	640 uV	650 uV
Phono M/C	70 uV	70 uV
Overload M/M	50 mV	55 mV
Overload M/M	7.6 mV	7.4 mV

INPUT IMPEDANCE:

	Left	Right
Aux.	47k ohms	47k ohms
Tape	47k ohms	47k ohms
Phono m/m	50k ohms	50k ohms
Phono m/c	= 100 ohms	= 100 ohms

OUTPUT IMPEDANCE: 64 milliohms (@ 1kHz)

HARMONIC DISTORTION :

		100Hz	1kHz	6.3kHz	
(A) (At rated power of 120 Watts into 8 ohms = 31 Volts)	2nd	-65.5	-64.7	63.8	dB
	3rd	-77.8	-82.4	-89.6	dB
	4th	-86.0	-94	-94.1	dB
	5th	-83.9	-84.7	-	dB
	THD	0.05	0.059	0.065	%
(B) (At 1 Watt into 8 ohms)		100Hz	1kHz	6.3kHz	
	2nd	-80.1	79.8	-83.0	dB
	3rd	-83.3	-	-	dB
	4th	-92.3	-	-	dB
	5th	-89.9	-	-	dB
	THD	0.013	0.01	0.007	%

TRANSIENT INTERMODULATION DISTORTION : Low (Less than 0.1%)

(3.15kHz square wave and 15kHz sine wave mixed 4:1)

NOISE AND HUM LEVELS:

(re 1 watt with 8 ohms) with volume control set for 1 watt output with, 0.5V input (Aux.) 5mV input (Phono M/M) 0.5V input (Phono M/C)

AUX.	-63.5 dB(Lin)	-66 dB(A)
PHONO M/M	-63 dB(Lin)	-65.5 dB(A)
PHONO M/C	-54 dB(Lin)	-56.5 dB(A)

MAXIMUM OUTPUT POWER AT CLIPPING POINT :

(IHF-A-202)

(20mS burst repeated at 500mS intervals) = 120 VP-P

= 225 Watts

∴ Dynamic Headroom = 2.7 dB (re 120 Watts)

A.M. TUNER SECTION.

Antenna Moveable Loop

Frequency Range 522kHz to 1611kHz

Frequency Response : (See curve) 100Hz - 2kHz

E114

TUNER DATA SHEET

F.M. TUNER SECTION (measured at 98MHz unless otherwise stated).

FREQUENCY RESPONSE : 87.65 - 108 MHz

USABLE SENSITIVITY (40kHz deviation)

Mono for S/N 26dB	9.0 dBf
Stereo for S/N 46dB	20.0 dBf

(Stereo Sensitivity estimated from curves due to muting)

FREQUENCY RESPONSE (see curves) (Includes generator response) Below 10Hz to 16.5kHz

SEPARATION (see curves) (Includes generator) 30dB

IF Bandwidth : Narrow Mode : Stereo Zin : 75 ohms Dev : 40kHz

Input level dBf	Modulated Output dB	Noise Output dB
80	0	-59
58	0	-58
32	0	-56
28	0	-54
27	0	-53

Muting occurs below this level.

IF Bandwidth : Narrow Mode : Mono Zin : 75 ohms Dev : 40kHz

Input level dBf	Modulated Output dB	Noise Output dB
80	0	-65
33	0	-62
29	0	-60
22	0	-55
17	0	-50
15	0	-45
13		-35
11	-1.0	-30
8	-3.0	-24
3	-6.0	-14

F.M. QUIETING & S/N RATIOS.

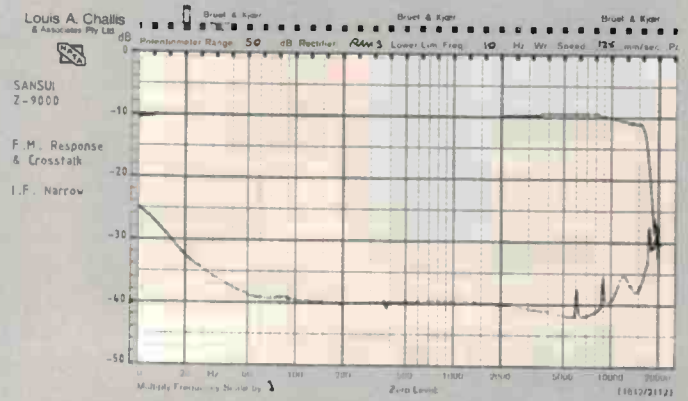
IF Bandwidth : Wide Mode : Stereo Zin : 75 ohms Dev : 40kHz

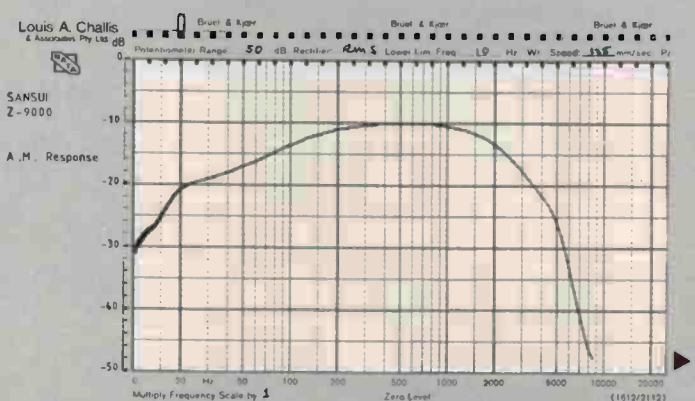
Input level dBf	Modulated Output dB	Noise Output dB
80	0	-59
58	0	-58
32	0	-56
28	0	-54
27	0	-53

Muting occurs below this level.

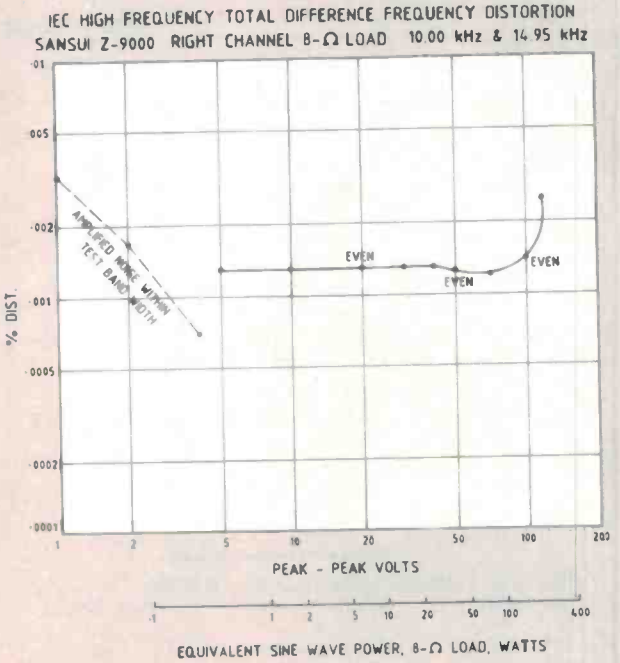
IF Bandwidth : Wide Mode : Mono Zin : 75 ohms Dev : 40kHz

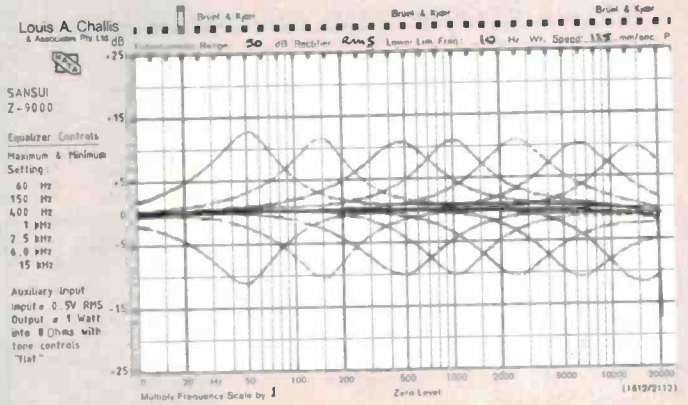
Input level dBf	Modulated Output dB	Noise Output dB
80	0	-65
33	0	-62
29	0	-60
22	0	-55
17	0	-50
15	0	-45
13	0	-35
11	-1.0	-30
8	-3.0	-24
3	-6.0	-14

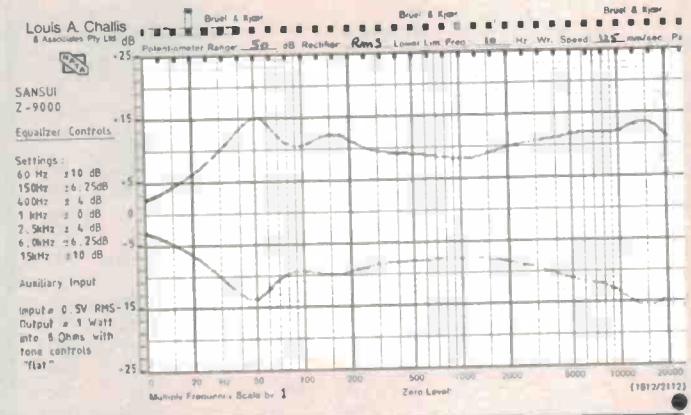




SOUND REVIEW







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The new generation of ALLSOP 3 computer care products.

Increasing emphasis on computers has meant increasing demand for quality cleaning systems like ALLSOP 3. Long recognized as world leaders in fidelity cleaning, Allsop introduces a new array of unique products, specially created for this new era. Each system utilizes the unique ALLSOP 3 cleaning solution and provides the same effective results people have come to expect and ask for by name. What's more, leading manufacturers recommend ALLSOP 3 cleaning products for use in their computer equipment. So, call or write for more information on how you can order ALLSOP 3 Computer Care products.

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SOME COMPUTERS ARE BETTER THAN OTHERS

	SPECTRAVIDEO SV 328	SPECTRAVIDEO SV 318	APPLE II E	ATARI 800	COMMODORE 64	BBC MODEL B	DRAGON 32	SPECTRUM
COMPUTING POWER FEATURES								
BUILT-IN ROM	48K	32K	16K	10K	20K	16K	16K	16K
EXPANDABLE TO	96K	96K	N/A	42K	N/A	64K	N/A	N/A
BUILT-IN EXTENDED MICROSOFT® BASIC	YES	YES	YES	ADDITIONAL COST	NO	NO	YES	NO
BUILT-IN RAM	80K*	32K***	64K	48K	64K	32K	32K	16K
EXPANDABLE TO	256K**	256K**	64K	NO	N/A	32K	64K	48K
KEYBOARD FEATURES								
NUMBER OF KEYS	87	71	63	61	66	73	53	40
USER DEFINE FUNCTIONS	10	NO	N/A	4	8	10	N/A	N/A
SPECIAL WORD PROCESSING	YES	YES	NO	NO	NO	NO	NO	NO
GENERATED GRAPHICS (FROM KEYBOARD)	YES	YES	NO	YES	YES	YES	YES	YES
UPPER/LOWER CASE	YES	YES	YES	YES	YES	YES	YES	YES
GAME/AUDIO FEATURES								
SEPARATE CARTRIDGE SLOTS	YES	YES	NO	YES	NO	NO	YES	NO
BUILT-IN JOYSTICK	NO	YES	NO	NO	NO	NO	NO	NO
COLORS	16	16	15	128	16	16	9	8
RESOLUTION (PIXELS)	256x192	256x192	280x160	320x192	320x200	256x640	256x192	256x192
SPRITES	32	32	N/A	4	8	?	16	?
SOUND CHANNELS	3	3	1	4	3	1	3	?
OCTAVES PER CHANNEL	8	8	4	4	9	3	5	3
A.D.S.R. ENVELOPE	YES	YES	NO	NO	YES	YES	NO	NO
PERIPHERAL SPECIFICATIONS								
CASSETTE	2 CHANNEL	2 CHANNEL	1 CHANNEL	2 CHANNEL	1 CHANNEL	2 CHANNEL	?	?
AUDIO I/O	YES	YES	NO	YES	NO	?	?	?
BUILT IN MIC	YES	YES	NO	NO	NO	NO	NO	NO
DISK DRIVE CAPACITY	256K	256K	143K	92K	170K	100K	?	?
(LOW PROFILE)	YES	YES	NO	NO	NO	NO	NO	NO
CP/M® COMPATIBILITY (Standard 80 column								
CP/M® 22 programs)	YES	YES	NO****	NO	NO*****	YES	NO	NO
CP/M !*	YES	YES	NO	NO	NO	NO	NO	NO

Specifications are subject to change without prior notice.

Microsoft is a registered trademark of Microsoft Corporation
CP/M is a registered trademark of Digital Research, Inc.

* 64K user addressable plus 16K graphic support
** 240K user addressable plus 16K graphic support
*** 16K user addressable plus 16K graphic support
**** Apple II can accept modified 40 or 80 Column CP/M
***** Commodore 64 accepts 40 column CP/M
? Data not available

OURS IS MUCH BETTER

When you start comparing Spectravideo's SV-318 to other personal computers, you'll find there really is no comparison. The SV-318 is the only logical choice, because it does more than some computers costing 4 times as much. And its abilities simply embarrass other computers in this price range.

The SV-318 isn't just more capable. It's much more capable. No other computer at even twice the price comes near its 32K ROM expandable to 96K. Or to its 32K RAM expandable to 144K. And no other computer has a built-in joystick/cursor control—an immeasurably useful feature when it comes to playing your favorite video game. Further, the SV-318 has, as its resident "language" Extended Microsoft Basic, the industry standard. It even has built-in CP/M (standard 80-column program), so you can immediately utilize over 10,000 existing software programs.

The SV-318 isn't just more expandable. It's much more expandable. Unlike many other so-called computer systems, all our important peripherals are available at once. That means you can get almost full usage out of your SV-318 from the day you buy it. With the Super Expander, Data Cassette, Floppy Disk Drive, Dot Matrix Printer, Graphic Tablet and SV-800 Series Expansion Cartridges, there's almost no end to the work you can do. Or to the fun you can have. The SV-318 is well designed to interface with new options as they become available, too. All this adds up to a computer you'll grow into, not out of.

The SV-318 is not only eminently affordable, it's the first real bargain of the computer age! Besides business application, home budgeting, word processing, programming and self-teaching, the SV-318 is the best entertainment value in town. Not only can you use it with your TV or color monitor to play hundreds of different video games.

FOR UNDER $500

With the optional SV-105 Graphic Tablet you can draw pictures, graphs, charts and other visual images on your TV screen. Considering what you get for what little you pay, the SV-318 is once again the only logical choice.

Whether you're investing in your first computer, or are already well versed in today's most important machine, you'll find that the SV-318 is the only logical choice for you.

SPECTRAVIDEO™

SV·318

PERSONAL COMPUTER

VIDEOACTIV ELECTRONICS

VIC: 70 St. Kilda Road, St. Kilda. 3182 Ph: (03) 537-2000. **N.S.W.:** P.O. Box 474, Edgecliffe. 2027 Ph: (02) 328-1190. **W.A.:** Jerdon Agencies, 25 Gladstone St., East Perth. 6000 Ph: (09) 328-5299. **QLD:** Franklin Agencies, 3 Marie st., Milton, 4064 Ph: (07) 369-0496. **TAS:** Dennington Enterprises, 46 Canning St., Launceston. 7250 Ph:(003) 318-551.

SAY "G'DAY BOB"

First, it was personal computers, now it's 'personal robots'. The ". . . age of personal robots" is not "virtually upon us" — it has arrived in the form of Bob and Fred and Elami and who knows how many to come. Your editor's August editorial on the subject was certainly prophetic.

Two major 'launches' of personal robots occurred several months ago, Androbot of the U.S. launching 'Topo'. 'B.O.B.' and 'F.R.E.D.' at the Chicago Summer Consumer Electronics Show, and the Swiss-based RE Foundation launching 'Elami'.

Androbot was started by the man who started the highly successful Atari company, Nolan Bushnell. He gathered together a group of gifted mathematicians, scientists, engineers and marketing minds to develop the series of personal robots.

In what they describe as ". . . a major coup", Futuretronics Australia Pty Ltd has secured the exclusive Australian rights to distribute the Androbot products.

Topo is battery powered and stands about a metre high. The 'body' is ABS plastic with a steel base which supports the unique angled wheel drive. An onboard microprocessor controller runs Topo and communications with your computer is via an infrared link. Topo can be fitted with a speech board which allows speech in many languages as well as singing!

B.O.B. is Androbot's top-of-the-line. B.O.B. stands for "brains on board" as it contains two Intel 8086 16-bit mircoprocessors and three megabytes of memory! This robot is 'independent' as ultrasonic sensors allow it to move around, determining the range of objects in its path within 38 mm. Infrared sensors allow B.O.B. to detect humans and either go to them or follow them. B.O.B. can communicate via stored speech or with programmable speech using your own voice. Better still, B.O.B. responds to voice commands!

F.R.E.D. is the 'baby' of the Androbot range. This robot is run from your computer via an infrared link and can be controlled from the keyboard or a joystick. It features a pen (as per the 'turtle' genus of robots) and can show you where it's been. The software constantly updates F.R.E.D.'s progress and downward-looking sensors make sure F.R.E.D. doesn't fall down any holes or over table edges.

Initially, interfacing for Topo and F.R.E.D. will be for Apples, but interfaces for all the popular personal computers will shortly follow. Further details are available from **Futuretronics Australia Pty Ltd, 1076 Centre Road, Oakleigh Vic. 3166.**

The distribution of Elami has been secured by Flexible Systems, of Tasman Turtle fame. Described more as an "electronic friend", Elami has a small screen for a 'face' which responds to voice communications. Further details on Elami are given on page 35.

K-TEL'S TWO-FOR-ONE VIDEO GAME CARTRIDGE

K-Tel has expanded its activities into the sphere of video game cartridges with the launch of the Xonox Double Ender range.

The Xonox system offers two games on one cartridge. Both ends of the Double Ender contain separate 8K memory chips delivering full play value. They can be played on existing Atari 2600 (initially) and Commodore VIC-20 (from late November) systems.

The initial release is the "Spike's Peak/Ghost Manor" Double Ender.

"Spike's Peak" features five different screens during which Spike has to reach the summit of a mountain infested with wild bears, vicious eagles, abominable snowmen, poisonous cactii and a host of other nasties. Spike also has to watch his body temperature during his ascent — if he's too slow, he'll freeze to death.

"Ghost Manor" is a five-screen game in which the player must reach a friend trapped in the attic of Ghost Manor, doing battle with ghosts, ghouls, witches, bats and even Dracula on the way. If that's not enough, the player must then get back out of the house with the friend before the roof collapses.

For further information, contact **K-Tel International, 46 Pyrmont Bridge Road, Pyrmont NSW 2009. (02)660-0011.**

BREADBOARDS

Breadboards for Prototyping

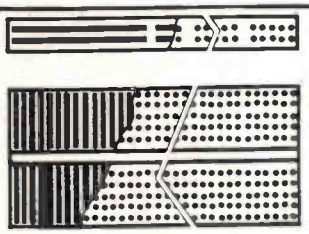
This inexpensive range of modular interlocking units enables a quick, easy way of experimenting with new circuits and ideas. There are two main units consisting of a Terminal Strip or distribution strip and a Central plug-in unit.

Points to remember:

- Boards accept 20 to 29 AWG solid wire
- Dual In line Package (DIP)
- The boards accept all sizes including LS1, MS1, RTC, TTL, DTL, and CMOS integrated circuits.
- Passive components such as resistors, capacitors, chokes will fit.ng.
- Boards are keyed to enable simple "adding on" so that larger circuits can be designed and tested.
- All boards are mounted on a ground plane so that they are ideal for HF, high speed and low noise applications.
- Components used in this system can be re-used and there is no heat to damage components so that they can be used almost indefinitely.

Errors & omissions excepted

Dealer and School enquiries especially welcome on these products



THE INSIDE FEATURE
Beneath the patterned face of the sockets rests an array of remarkable spring clips, designed to grasp and connect groups of 5 leads in the socket, long rows in the distribution strip.

100 HOLES

P11000

1–9 $2.50 | 10+ $1.95

640 HOLES

P11005

1–9 $8.95 | 10+ $7.95

640+100 HOLES

P11007

1–9 $11.95 | 10+ $9.95

640+200 HOLES

P11009

1–9 $13.95 | 10+ $11.95

1280+100 HOLES

P11010

1–9 $15.95 | 10+ $13.95

1280+300 HOLES

P11011

1–9 $24.95 | 10+ $21.95

1280+400 HOLES

P11012

1–9 $28.95 | 10+ $24.95

1920+500 HOLES

P11015

1–9 $44.95 | 10+ $38.75

2560+700 HOLES

P11016

1–9 $59.95 | 10+ $49.95

CRYSTALS

CAT No.	PRICE 1–9	PRICE 10+
Y11000 1 MHz	$11.50	$9.50
Y11003 1.8432 MHz	$7.50	$6.50
Y11005 2 MHz	$6.90	$6.50
Y11007 2.3040 MHz	$6.50	$5.90
Y11008 2.4576 MHz	$6.50	$5.90
Y11010 3 MHz	$4.90	$4.25
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Available from:

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425 High St., Northcote, Vic. (03) 489 7099

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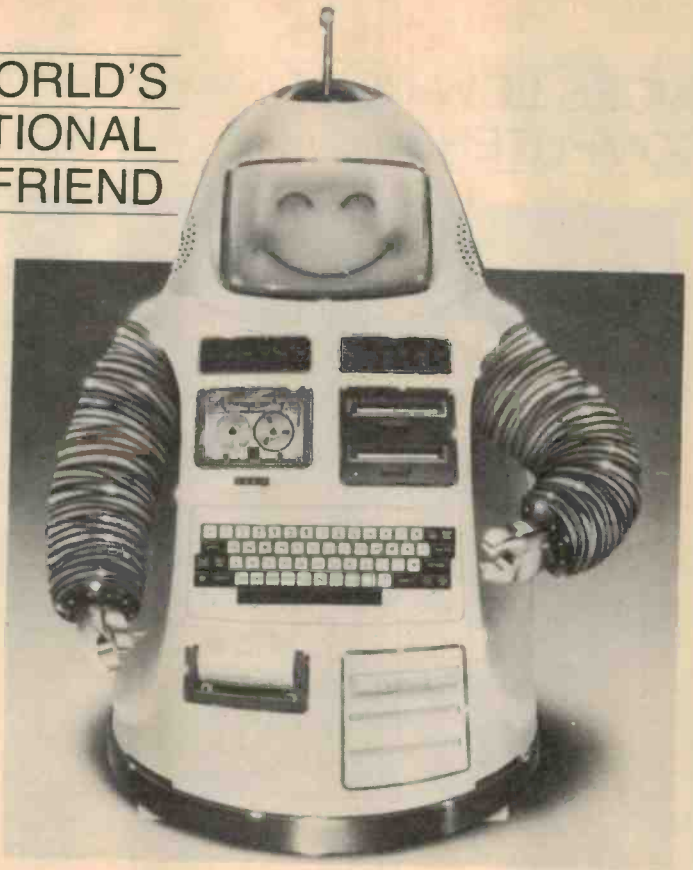
ELAMI: THE WORLD'S FIRST EDUCATIONAL ELECTRONIC FRIEND



Elami, claimed to be the world's first educational electronic 'friend', has gone into full-scale production in Hong Kong, at the rate of 30000 units a month.

The group of scientists behind the non-profit project refuses to call Elami a robot. According to development chief Uwe Mèffert, "Elami isn't a robot, not a slave and not a computer — Elami is a family friend."

The friend does have relatives in the computer, robot and other electronic families, however. Basic Elami has an amber monitor for a face, which can produce many different facial expressions as conversation is picked up and recognised by voice recognition circuits. Elami answers using integrated circuits for voice synthesis.

The basic model is likely to sell for less than US$500 and can speak 150 words. However, add-on units give a 600-word vocabulary.

"Elami's abilities are limitless," claims Mèffert. "The young Elami has many uses, including handling educational programs and video games. A more senior member of the family can use the face as a full-colour television, adding local shows to the repertoire. This elder Elami also has the latest 3" disk drives for a greater memory and even more uses, with a four-colour plotter printer."

Only 900 mm tall, Elami was developed by a group of leading scientists who brought a string of internationally acclaimed educational games and toys to children, including the Pyramix puzzle, which sold millions.

Prices of the models that make up the Elami family vary from less than US$500 for the younger family member to about $1500 for the elder relation.

Elami's price has been kept low to encourage parents to buy the educational pet. All profits will go to the RE Foundation of Knowledge, Resources and Energy, CH-8034, Zürich, Bellerive-strasse 10, Switzerland, a non-profitmaking educational and scientific research institute.

All members of the family share key qualities. They can listen and talk, and they are capable of 'exploring' their homes, remembering where they have walked and storing the knowledge in a cassette-deck brain.

"We've created a friend who can be expanded in many ways," says Mèffert. "The basic Elami will be a perfect pal, but the relations could prove to be more suited to some people. Best of all, we have plans to offer a maturing package: add-on circuits to accelerate Elami's growth."

For instance, plug-in boards will add to Elami's vocabulary, while disk drives added later will increase the overall knowledge.

"Elami can be a full, user-friendly computer immediately and later additions will produce a student's, or adult's, best friend as a complete computer sytem."

Next year, a touch-screen keyboard will be introduced to allow Elami to pick up instructions by a simple stroke of the cheek.

For further information, contact the Australian agent, **Flexible Systems, 219 Liverpool Street, Hobart Tas. 7000. (002)34-3064.**

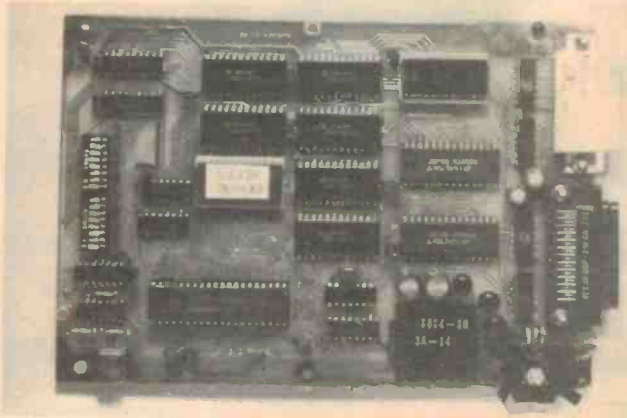
DATASETTE CLEANING SYSTEM

The Allsop non-abrasive wet system is for cleaning the datasette system of your personal computer. It is claimed to completely remove particles that distort video quality and impare memory response. Therefore, it should improve the program reproduction.

All you do is put a couple of drops of the cleaning solution on to the felt pads and insert the cleaner into the computer like a conventional datasette tape. Then activate the drive for 30 seconds. The datasette should be cleaned every 5-10 hours of use.

A refill kit is available with extra felt pads and solution.

More information can be obtained from **Allsop Fidelity Accessories, P.O. Box 246, Double Bay NSW 2028. (02)357-2022.**



THE SMART CONNECTOR

Designed by IQ Systems to eliminate the problem of determining the correct RS232 interconnection normally encountered by data-communications users, the Smart Cable SC821 is now available in Australia.

The SC-821, which is essentially an RS232 cable with on-board logic circuitry, can be used to interconnect any combinations of terminals, printers, modems, tape drives, disk drives, plotters and industrial equipment.

For more details, contact the Australian distributor, **Computer Communications, 50 Wimbledon Street, Cannington WA 6107. (09)458-9752.**

ATARI INTRODUCES LOW-COST 16K AND 64K COMPUTERS

Two low-cost, expandable home computers are part of the new line of Atari microcomputers scheduled for release in Australia before the end of the year.

The Atari 600XL home computer, with 16K RAM, is a beginner's model that can be expanded with a large array of peripherals, including a 64K expansion board. The 800XL home computer, with 64K RAM, making it powerful enough to handle complex programs, is aimed at college students and home users.

Both computers come with 24K of ROM, built-in Atari BASIC; a Help key which can be used with a wide variety of Atari software, 62 full-stroke alphanumeric keyboard with international character set, full screen editing, deleting backspace key, program-interrupt key, inverse video key to reverse background type colour, tab keys and serial and processor ports for expansion.

In addition to the full spectrum of 256 colours, Atari has supplied a four-voice 3¾-octave sound generator. With an attachable stereo cassette program recorder, the computer can accept a computer program from one track and audio signals from another track connected to a television, making sight and sound programs possible.

The 600XL and 800XL can perform word-processing with the Atari Writer program. As well, it can become a home video arcade with such games as Pac-Man, Star Raiders and Donkey Kong.

The 600XL will sell for around $399 and the 800XL for $599.

For further information, contact **Futuretronics Australia, 1076 Centre Road, Oakleigh Vic. 3166. (03)579-2011.**

LOW-COST GRAPHICS

Microprism, a versatile multi-colour graphics system, has been released by SME Systems.

The S-100 buss system consists of a set of GDC-512 boards connected through a CMC-100 colour palette board and appropriate software and firmware.

The Microprism system can be used on any S-100 mainframe computer or any computer with an S-100 adaptor.

Each of the boards has on-board firmware that translates the commands, such as 'Draw Vector', which are then performed by the on-board computer. The graphics are displayed in a 512 x 490 resolution format on a standard video monitor.

A full eight-colour card system can choose and display 256 colours out of a palette of more than 16 million colours. A two-board system can display four colours, four boards can display 16, and so on.

The boards are priced at $825 each for the GDC-512 and the CMC-100. A typical eight colour system would total $3300, excluding tax.

The Microprism colour system is available from **SME Systems, 22 Queen Street, Mitcham Vic. 3132.**

Club Call

The Townsville Microbee User Group (T-MUG) meets at 7 pm on the second Monday of the month. Another 'user' meeting is held later in the month.

Meetings are held at Town and Country Computers, CTL Centre, Anne St, Aitkenvale, Queensland.

Anyone interested in the group should contact the president, Chris Hayes on (077) 79-6065 ah or the secretary, John Johnson on (077) 79-5628 ah.

The Spectravideo Computer Users Group of Tasmania wants to help Spectravideo computer owners to achieve the most from their machines. As these computers are new and powerful their owners have a lot to learn. It is hoped that by joining this club the learning experience will be faster and more fun.

The membership fee is $15. This entitles members to the newsletter that will soon be published and to discounts in computer equipment as they become available to the club.

Monthly meetings of the club will soon be held and members will be notified by mail. For more information contact Mr P. W. Deckert, 48 Heather St, Launceston, Tas 7250. 44-4836.

Microbee users in the Gold Coast area who are interested in starting a user group exchange information and programs should contact Col McLaren, Labrador Qld. Phone 31-4610 Labrador ah.

The **Chip-8 User Group** continues to cover the special needs of Chip-8 users.

'Dreamer', the newsletter which comes out every two months, will have a new editor, Frank Rees, from the September Issue. The 1802 and 6800 based Chip-8 computers shall all be catered for.

For details, contact Frank Rees, 27 King St, Boort Vic. 3537.

If anyone is interested in forming a **Jupiter Ace User Group**, contact Helge Nome, P.O. Box 183, Ravenshoe Qld 4872.

The **ZX 81 Software Exchange** has announced that a new member, John Vizard, has been appointed to the ZSE team.

For more information regarding ZSE, send a stamped, self-addressed envelope to either Chris Tueno, 5 Muir St, Mt Waverley Vic. 3149 or John Vizard, 11 Edith St, Dandenong Vic. 3175.

ETI-690 LITTLE BIG BOARD OPTIONS

Adaptive Electronics, the Melbourne-based computer Systems company and sole representative for Tandon Drive Products in Australia, is able to offer a large number of optional accessories to suit the ETI-690 64K Z80 STD board project.

The accessories include hard disk drives, floppy disk drives, card cages, chassis, controller boards, host interface cards and MP/M version upgrade cards.

Disk drives are based on the Tandon 500 and 800 Series drives. The hard disk drives range in capacities from 5M to 15M, formatted. The Tandon 8" slimline floppy drives are also available.

Power supply and casing is available as an optional extra for the hard drives. A range of Konan controller boards is available for use with the drive units.

Adaptive Electronics has developed locally a host interface card and BIOS to help run the system. Supply of the source list for the BIOS is available but, as an alternative, Adaptive can supply it as a complete CP/M disk ready to run on the system.

Optional MP/M versions, with MP/M upgrade cards, are also available. This means that a business or professional user can expand the system to allow up to three users at one time.

The hard disk drive may be purchased as separate cards and drive or it can be purchased as a complete unit with case, power supply, fan, controller card and all cabling.

Adaptive Electronics has just released its new range of Adaptel cases with a power supply built in, suitable for housing one or two floppy disk drives, with or without hard disk.

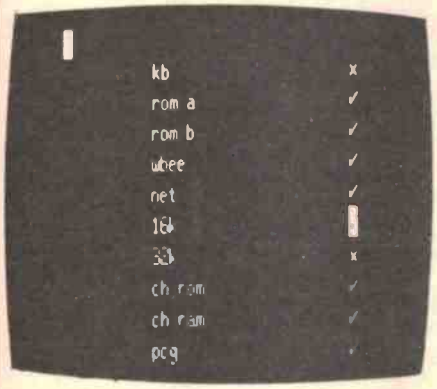
The features of the new case are a quality aluminium front panel, efficient internal layout, provision of a buss for expansion, adequate cooling and ventilation, professionally finished metalwork offering slots at rear for multiple cables and expansion, and provision for hard disk mounting.

It has a low profile suitable for desk-top or under shelf mounting with a key switch on the front panel.

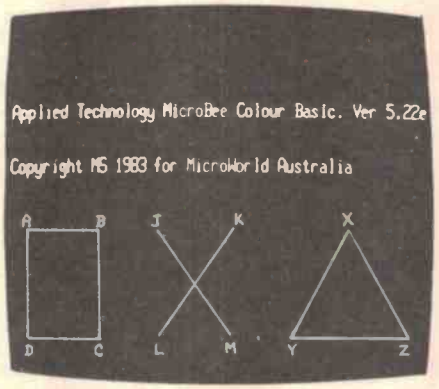
The Adaptel case is available as a separate item or the entire unit is available completely assembled and tested, minus the Little Big Board.

Delivery of these items is estimated to be 2-4 weeks. For details, phone **Adaptive Electronics, (03)267-6800.**

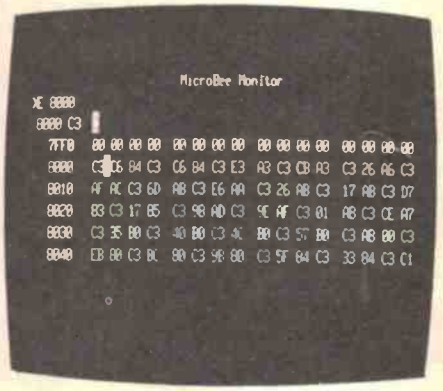
Now! Australia's leading AC microbee® ahead with totally operation.



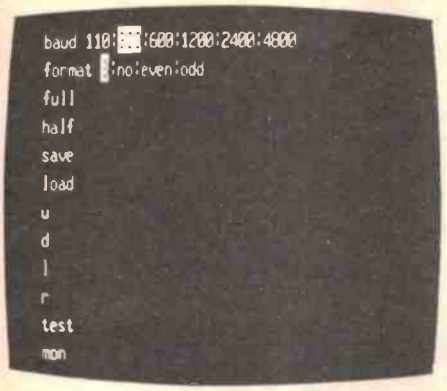
SELF TEST.



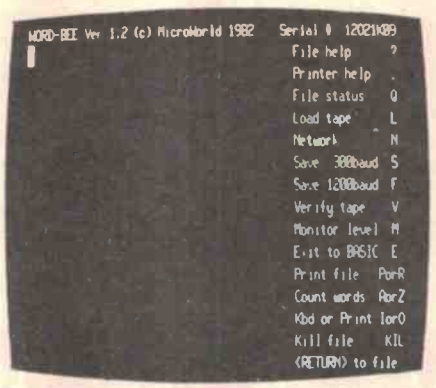
BASIC WITH GRAPHICS



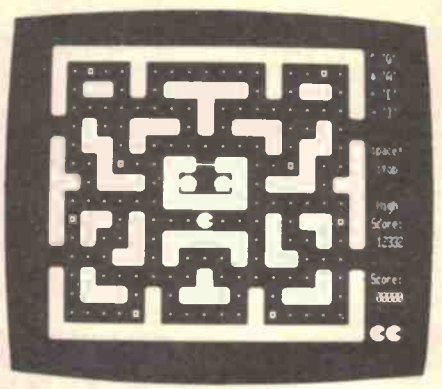
MONITOR



NETWORK



WORDBEE



ARCADE GAMES

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729 Glenferrie Rd, Hawthorn, Melbourne. Phone 818 2244

141 Stirling Highway, Nedlands, Perth. Phone 386 8250

Cooleman Court, Weston. Phone 88 6384

Microbee dealers:

NSW: **Electronic Agencies,** 117 York Street, Sydney. 115 Parramatta Road, Concord. **Compu-K,** 7 Casino Street, South Lismore. **Comput/Ed,** 8 Park Arcade, Park Avenue, Coffs Harbour.

ACT: **Computech,** Belconnen Churches Centre, Benjamin Way, Belconnen.

VIC: **Computerland South Melbourne,** 37 Albert Road, Melbourne.

S.A.: **Key Computers,** 1061 South Road, Edwardstown. 77 Grenfell Street, Adelaide.

W.A.: **Altronics,** 105 Stirling Street, Perth.

QLD: **Software 80,** 200 Moggill Road, Taringa. **Electrographic Office Systems,** 25 Grafton Street, Cairns.

Town and Country Computers, CTL Centre, Anne Street, Aitkenvale, Townsville.

TAS: **Central Data,** 14A Goodwin Street, Launceston.

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THE ERGONOMIC TERMINAL

Beehive International's new ATL-004 VDU, released in Australia by Datatel, is claimed by the American manufacturer to be ergonomically superior to any other terminal on the market.

According to the Utah-based Beehive International, the perfect ergonomic terminal should have a small desktop 'footprint', a low-profile detached keyboard and a non-glare display which adjust by tilt and swivel. All these 'essentials' are incorporated in the ATL-004.

Other features of the ATL-004 include soft-function keys, programmable smooth scroll and selectable 80 or 132 character lines.

Of the 27 display lines on the 25.5 cm screen, two are reserved for a 'user-friendly' interface indicating the current operating modes and status and the current action of the programmable function keys.

Each of the 512 displayable characters is represented in a 9 x 13 dot-cell matrix. The characters include the standard 128 ASCII set, plotting symbols for business graphics, icons, Roman numerals, superscript and subscript characters, bar codes and graphic symbols. Characters may also be represented double high and double wide.

The ATL-004 uses two microprocessors, an 8085A-2 running at 10 MHz to control all terminal functions and communications, and an 8039 for the intelligent keyboard.

As standard, the unit contains 10K of RAM, expandable to 40K, and 24K bytes of ROM contain the terminal algorithm. Of total RAM, 2K is non-volatile CMOS supported by nicad battery. This may be expanded to 8K.

Communications supported by the ATL-004 include asynchronous and isochronous, split baud rates to 19.2K baud, X-on/X-off protocol and RS232C and 20 mA current loop interface.

The ATL-004's tilt range is 20° and swivel is 360°. The all-up weight, including the keyboard, is 13.5 kg. Power consumption is 60 W.

Further details are available from **Datatel, 19 Raglan Street, South Melbourne Vic. 3205. (03)690-4000.**

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140.000uF...15v..$5.50
39.000uF...20v..$4.00
10.000uF...25v..$3.00
30.000uF...25v..$4.50
50.000uF...25v..$4.75
60.000uF...30v..$5.00
3.100uF...40v..$2.00
21.000uF...40v..$4.50
2.000uF...50v..$2.00
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Spectravideo's SV-318 – bound to cause a market shake-up

Jonathan Scott

The SV-318 home computer offers a remarkable amount for a remarkably low price and can be optioned-up to a very sophisticated machine. Many of the features offered are not currently available on other home computers. Here's a machine worth very serious consideration for both the first-timer and old hand.

EVEN BEFORE you open the box in which it comes, you can tell that the manufacturers of the SV-318 put a lot of careful thought into where their machine is going, what it will be required to do and what peripherals it may need to have. Although rather off-puttingly full of superlatives and sales talk, the rear panel of the box tells the purchaser (or prospective purchaser) just what the machine is good for — such as educational jobs, word-processing, games, etc — and what peripherals are available for immediate conenction, with a brief summary of each one's capabilities. We appreciated this — it was much more informative than the dull wrapper which customarily encloses units sent to ETI for review, even if it did look a bit slick and 'Americanised' in its sales approach.

You will see as this review progresses that almost every aspect of the machine has been thought out very carefully and the design taken to the limit. Although Spectravideo only came into existence in January, it must be doing big business somewhere, because the degree of design care and deliberation which has gone into this machine is immense. Such an investment of skilled manpower does not come in a parcel as cheap as this unless the company is selling a lot of machines to cover costs. This review will not be the last you hear of this computer.

The computer itself is the standard larger-than-a-keyboard size, about 400 mm x 220 mm, standing about 80 mm high at the back and sloping down to 50 mm at the front of the keyboard. This makes it marginally larger than a Microbee and much smaller than an Apple. The power supply is external, supplying ac to the main unit via a proprietry cable. An external power supply is not unusual these days in a domestic machine. We were pleased to see that the supply unit had its own mains cable, rather than the annoying sort which consists of a black box larger than a plugpack with three prongs protruding directly from the body to form the plug. These are a nuisance to plug into the wall and often necessitate an extension cord as well.

The SV-318's power supply came in a metal enclosure, which isn't aesthetic but it is tough.

The RF modulator is also external, supplied with power and video signal from a single socket on the back. If you are equipped to handle video directly, which is desirable if you are using the colour graphics with a decent monitor, then you must make up or buy a cable. It uses a 5-pin DIN on the computer end and whatever you want for the monitor on the other end. The modulator also came with a cable to link it to the TV and a switch unit to allow a quick change from the TV antenna to the modulator.

This is an excellent way to organise the set-up — immediately usable in the usual domestic situation and readily upgradeable if you want.

While installing these cables we got our first inkling of the main drawback of this machine; the RF cable was unable to make a good contact with the RCA connector on the modulator. Had we not had an audio RCA-to-RCA cable handy we would not have been able to get the monitor going.

The whole feel and look of the modulator box and its accessories was cheap. This, as you will see, is a successful strategy — the unit is *remarkably* cheap — but it is an everpresent facet of the machine's character. To put it in perspective, however, many other home computers suffer the same problem.

The keyboard is one of the rubber key types. It is provided with special function keys, editing keys, graphic character select keys (acting in addition to the shift and control keys) and an inbuilt joystick. However, it is still rather dicky to use at any speed.

If a computer must have rubber keys for cost effectiveness these are good ones; they provide some tactile feedback, while others do not. They are hard rubber rather than the useless spongy ones, and the lettering is bonded on sufficiently well that we could not scratch any of it off as we have done on other people's machines. It is fine for the 'seek-and-destroy' type of typist who deliberately presses each key separately, but it will not support fast or touch typing. We would like to have had

the option of paying $25 to $45 more and having a nicer typewriter-like keyboard.

The SV-318 has a big brother, the SV-328, which has a 'proper' keyboard and other improvements such as larger memory and built-in functions such as wordprocessing.

It is possible that the keyboard alone could be upgraded. The keys are an integral unit plugged into the motherboard, and so could be replaced in a few seconds with another set, or hopefully with one of the SV-328 upmarket keyboards.

The joystick on the right of the keyboard is one of the four-switch types, rather than a proportional sort, but it is quite adequate for cursor control. Very few machines have nice 'analogue' joysticks; the Atari for instance, is the simple four-switch type, giving one-of-eight direction selection. The SV-318 joystick has a removable 'stick', which leaves a small disc with four finger indents if you prefer a more key-like movement feature.

Only the latest models of computers have the idea of a joystick (multidirection) control built into the main box. Apple's latest upmarket offering, the Lisa, has a 'mouse', a small hand-sized box which is moved by the operator to control cursor (or icom, as the mouse-pointer on the screen is termed) movement. The latest series of HP-200 machines has an analogue 'wheel' which permits very fast cursor movement, with the shift key changing the cursor movement direction from horizontal to vertical.

Both of these machines respond more quickly than the SV-318 because the latter regards the joystick merely as four keyboard keys. Hence the keyboard repeat-on-hold feature affects joystick operation. But the inclusion of the control on the front panel as standard is still a great feature absent from many other machines.

The next feature to catch the eye is the range of connectors. On the top surface, behind the keyboard, is a games cartridge slot. As you will see shortly, this machine is capable of fantastic graphics (comparable to an Apple) and comprehensive sounds (multivoice chords!) so that the games have the potential for true arcade-quality effects. More on this later.

On the side next to the power connection and on-off switch are two connectors with nine pins each. One is clearly marked 'joystick', while the other is unlabelled beyond the number 1. As little hardware documentation was supplied with the unit we could only speculate from the electronic contents as to what these did.

We think that the joystick connector merely provides a second joystick function. (We were provided with such a joystick.) The other connector remotes the keyboard function should this be desired. No remote keyboard was supplied or offered.

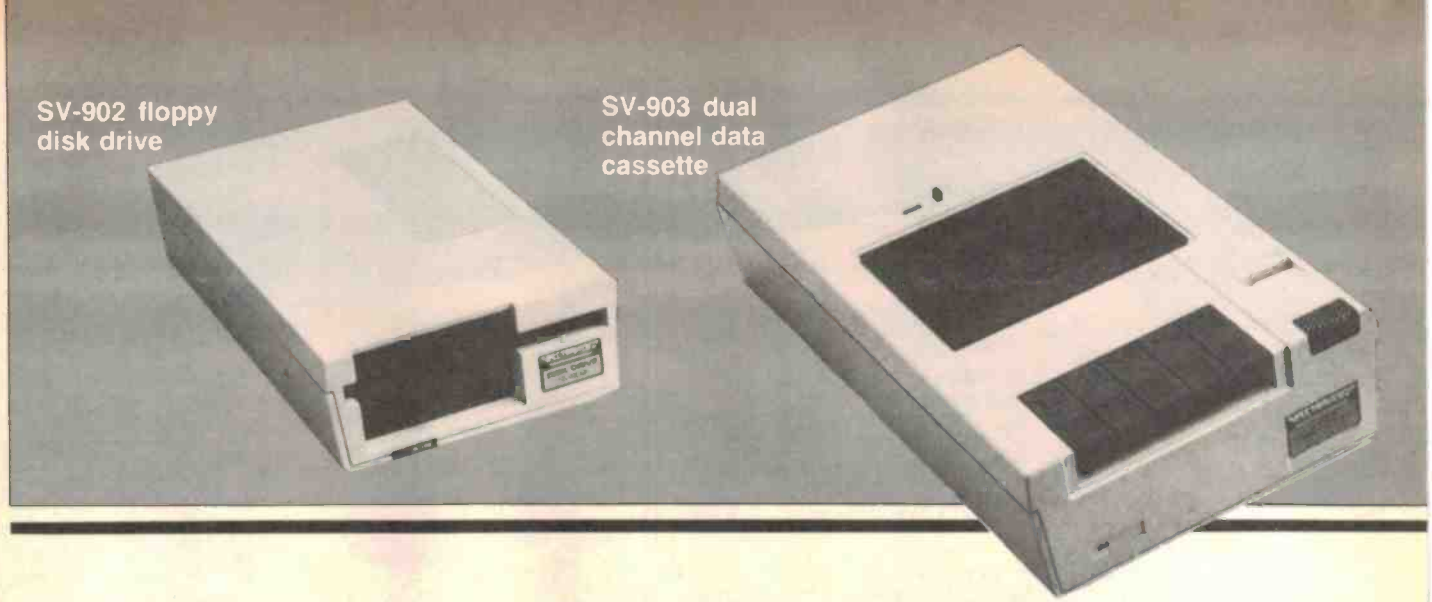
On the rear are two connectors in addition to the 'video' one. One is the main system expansion buss and the other is the audio cassette tape interface. The audio interface is not standard. It is a pc board edge connector type, the socket being on the tape drive end and the SV-318 merely exposing an edge of its main board. The connector provides not only data 'in' and 'out' lines but also power to the drive. The drive can be turned on and off at BASIC level, and offers a voice channel as well as data, with an eye to voice and video synchronisation by a resident program.

While is it initially disappointing that the unit denies immediate use of the normal domestic cassette player, we warmed to the way Spectravideo has organised this. Consider firstly, one can attach the connector and patch it to your recorder if you desire, ignoring the control functions; secondly, if you are going to do any significant recording at all it is a decided convenience to have a cheap recorder dedicated to the job and always left with the computer.

The Spectravideo unit is cheaper than it would otherwise be as it has no power supply requirements, and hence beats buying a 'cheapo' tape recorder on both price and performance. (See later.)

On the inside

The internal construction of the SV-318 turned out to be much better than expected. The pc board has gold-plated edge connectors and is screen printed with component labels. It is almost totally enclosed by metal ▶



plates to reduce interference. The frequency accessed connector for games cartridges is strongly mounted and reinforced with anodised aluminium guides, which double as the supply regulators' heatsink.

The ROMS, the CPU, sound and video processors, as well as PIA chips, were all socket-mounted. This is unusually good for such a machine. The operating system (OS) and BASIC EPROMS all live on a demountable piggy-back pc board and are clearly marked with the version number.

The literature claimed the CPU, a Z80, runs at 3.6 MHz. I suspect that this frequency is not locked to the video system as there are no less than three separate crystals in the circuit. 3.6 MHz is probably the correct value no matter what frequency is used in the TV control side of the circuit.

Firmware

Having discussed the SV-318's hardware, we can turn to the firmware. In a nutshell, the BASIC in this machine is about the *best* we have seen in a domestic machine. It is Microsoft 32K BASIC with some suitable extensions to match the hardware. It supports double precision. It has extensive interrupt control allowing jumps asynchronously to defined routines when an interval expires, when an error is dectected, when a stop command occurs from the keyboard, when a particular special function key is pressed or when 'sprites' (video images) collide. It has complete format statements, extensive string manipulation commands, good input/output supporting statements and excellent machine level interface with the ability to pass parameters.

It has all the usual arithmetic, logical and comparison operators. It has all the usual arithmetic and transitional functions. The operating system part of the language allows renumbering, merging of program segments (with a disk), deleting of large segments, changing memory banks and full tracing of program lines at execution time.

It has a number of convenient facilities which make using the language smooth and easy: you can turn on and off the click emitted at each keystroke to acknowledge its receipt; you can define string as well as numeric functions; you can effectively un-dimension arrays to recover memory lost in a 'DIM' statement; you can generate an error message, in plain English as their OS does, using numeric coding and you can swap contents of variables.

The BASIC level colour graphic commands are superb: they will draw lines, circles and ellipses, fill in areas, set points to specific values, read point values, change background, border and image colours, PEEK and POKE to video RAM, place images on screen with OR, AND or XOR with current video data and move pre-defined patterns, called 'sprites', around the screen — all at the BASIC level. It has a BASIC access to a graphic 'macro' language which allows you to put a plotting function directly to the video controller *via* a string variable. There are 15 colours, counting white.

The sound commands are even more impressive. You can send control characters to the sound processor to generate tones of several envelope waveshapes and 15 selectable amplitude levels, from each of three separate generators, over a range of many octaves. Noise can be added to these, individually if desired. Using the sound macro language in string format via the PLAY keyword, you can specify notes of the tempered music scale, including sharps and flats.

All this adds up to a totally impressive array of commands, all built into the ROM system inside the SV-318. We have seen very few functions implemented in a BASIC machine which are not included or superseded here.

Brickbats

Our first complaint with the SV-318 was the tacky keyboard. The next *and only other* shortcoming is documentation. Supplied with the basic machine are two books. The first looks like a BASIC manual, but turns out to be a tutorial book for the first-time user. It is well-pitched, and effective for the average user who has never used a computer before, but it is incomplete in its teachings. This manual also contains hardware documentation. This is precious little; it merely gives a brief pinout description for the various connectors and a simple memory map diagram. It also contains a glossary, video worksheet, etc.

The other book is a quick reference manual which lists the commands included in the BASIC and OS. This book has a couple of typographical shortcomings. It also appears to have some omissions. For instance, I discovered that the machine has a function 'TIME' which was not even mentioned in the quick reference guide. It seemed to assume that you had no disk or other peripherals, as well. While we found no other hidden keywords, there is no way of knowing if there are more. (We found TIME because it is used in one of the examples concerned with another command in the tutorial book.)

Needless to say, these two books will prove inadequate for anyone who delves deeply into BASIC programming. If you intend to do anything serious with the machine you will have to purchase the 'BASIC Reference Manual'. This is supplied as a loose leaf octo folder. Each BASIC keyword is treated as a separate alphabetical entry with full description. 'TIME' is absent from this one as well, so our confidence in it is not complete. It is nevertheless a very comprehensive and informative document.

Cassette storage

The SV-903 cassette drive supplied with the computer is very simple in its form, yet comprehensive. It has the usual play/record/FF/rewind functions and an 'in use' LED, similar to a disk drive. There's a microphone with on/off switch and a counter, too. It is powered, as we have already mentioned, from the SV-318 power supply, and has motor on/off capability as well as a line to inform the OS whether it is actually running or not. This makes it very nice to use.

A load operation will respond with 'press play on cassette' if the cassette is not already operating. It also turns it off when the load is completed. The data rate is 1800 baud, which is pretty fast for an 'ordinary' unit. For this reason the makers recommend the use of 'data quality' cassettes, though an ordinary high quality audio tape should suffice. There is a 'verify' facility in the OS so you can confirm a good recording.

The included microphone and stereo recording system permit the use and development of voice-supported programs. This is very neat, especially for tutorial-type programs. We did not, however, receive any documentation explaining how this might be done. Indeed, the drive specifications were the only information we received beyond the descriptions of the BASIC cassette interface commands.

SV-601 super expander (left) 'Quickshot' joystick (right)

Cassette operation was quite reliable, though we have not, of course, run it extensively. The OS will search for particular filenames or load the first headed file found. It will load and save BASIC and binary files. After 10 to 15 reads of an ordinary high quality audio cassette recorded with a very long program it gave occasional "I/O error" messages but always read correctly on a subsequent try. This is typical for a high bit-rate unit such as this, and should not be taken as a bad sign.

As no hardware documentation was available we cannot make any comments beyond these.

Joystick

We also received a 'Quickshot' joystick connector and three demonstration cassettes. The joystick plugged into the external joystick connector and provided a second four-way control for two-player games. It is a very exciting-looking control, sculptured as are some arcade ones, and sporting a fire button on the top of the handle and another on the base. It also has suction caps on the base which hold it firm, even to a polished wood table. The only drawback is that it puts the built-in joystick to shame!

The cassettes included two games. The first was a 'Space Invaders' variant. The second was a 'Tank' variant. Both exhibited excellent graphics and the tank one had a lot of imaginative features. However both had drawbacks in comparison to the arcade originals. The tanks could move only as rooks in chess, that is, no diagonals or smooth turns; the gun in the space invader one was apt to intermittantly halt when trying to fire and move at the same time.

For these reasons and others, I feel that these two games were not making full use of the machine's abilities. This is not at all uncommon — many computers are not dedicated to a particular game, as are arcade machines. What we are saying is that there are, and will be, games which are too crudely implemented for every machine, so if you are a bit picky, look (or play) before you buy.

The SV-318 is capable of good fast and intricate games, but not all games will be like this! Nevertheless, several 10-year-olds were quite happy playing with these deficiencies, so perhaps it is an engineering adult's problem to see the shortcomings of certain games.

We were not supplied with any plug-in cartridges, games or otherwise, so we could not assess how well these have been done. I expect that the minor bugs will be sorted out before any programs are committed to ROMs and sent out as cartridges.

The third cassette was a BASIC tutorial, as promised at the end of the tutorial manual. It was not, however, as advanced as we would like and contained a lot of material simply repeated from the original book. There is mention in the user's manual/tutorial book of a more advanced BASIC tutorial but that was not sent with the review material.

Expansion

Also supplied for review was the SV-601. This connects to the buss expansion plug and provides power and connection to up to six expansion modules and a disk drive. A disk controller card and disk drive, and a RAM expansion card were provided. The latter left us with 42K of RAM for BASIC, once the 16K of video RAM plus OS overheads were removed. With the DOS booted, 26K remained. The card was marked '64K' expansion, which suggested that we should have got a lot more than 64K total, but no configuration of the switches on the card would give us more on power-up.

The further RAM is assessible by bank switching by the user, although there was no documentation supplied to explain the switch functions or how the memory map changed on bank switch. The memory we had did not come wrapped in its own box but in the expander rack, so presumably the explanation follows when you get the module in its virgin state.

The disk controller can handle two drives, which are sold separately. The drives are slim 5¼"-standard units, offering a single-sided capacity of just under 164K with a transfer rate of 250K bits per second, or about 30K bytes per second. By comparison, this is about 25% more storage than an Apple disk with comparable speed capability.

There is not really a great deal to say about the drive — it is very traditional. I might criticise the amount of space DOS consumes, but then Apple DOS is the same; this DOS is, in addition, slightly better permitting merges, etc. The disk accesses use the same commands as the tape drive, only adding a mass storage specifier. This tells the computer which mass storage device is to be used for this job. I feel that there should be, and may eventually be, more low level DOS documentation available as there has come to be for the Apple and other well used machines. But for the time being, you must stick to BASIC level access.

Summing up

It seems that the SV-318 is designed for that niche of computer users who are not sure if they are going to become fanatics, but have enough interest to buy a decent machine and leave the door open for expansion and learning. I would strongly advise that the '318 be purchased with the tape drive which, being very fast and handy, is adequate for non-professional, non-fanatic use. The pricing structure seems to reflect this also.

The '318 itself is very well priced at $499. I feel that competition from other new units, such as the Coleco Adam and the like, will push the price down. The '318 retailed in America for US$299 (about A$330) in June this year.

The tape drive is $149, which is good current Australian value for a unit tailored to a machine. Thus, for $650 now, you can have a machine with superb capability, expandability and the promise of things to come. (Spectravideo is intending to provide a cartridge to support MSX, the Japanese "standard" OS, and already provides a small support adapter which permits the use of Coleco games cartridges.)

The disk drive, however, demands the purchase of the expander ($249) and a controller ($249) as well as the drive itself ($549). Thus you are looking at a minimum of $1050 to get fast mass storage. These prices are par-for-the-course for what you get (CP/M ability among other things) but this is not the kind of value represented by the initial system. If you are expecting to advance to a disk drive, start looking at the SV-328, which is more the level you are aiming at. (Serious!) So here is what we would recommend.

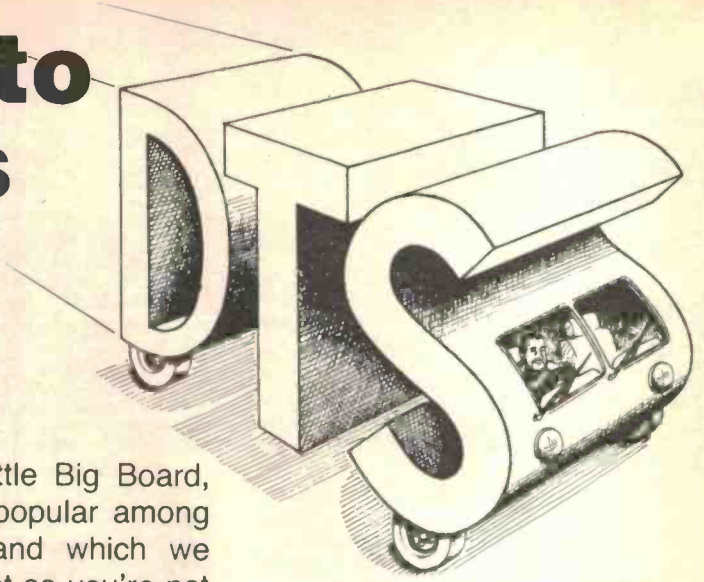
Domestic/pleasure system

SV-318 (32K)	$499
Tape drive	$149
and optionally, joystick	$25
	$673

Professional/business system

SV-328	$899
Disk + controller	$798
Expander	$249
optionally; printer, 80-column card, etc.	
	$1946 to $3000 ●

Introduction to the STD Buss



Roger Harrison

Our feature project this issue, the ETI-690 Little Big Board, employs the "STD Buss", a buss that's quite popular among microcomputer hardware system engineers and which we think will become popular among hobbyists. Just so you're not in the dark, this article provides a brief introduction to its 56 pins and what they're all about.

THE STD BUSS was devised by the American Pro-Log Corporation. It standardises the physical and electrical aspects of modular microprocessor card systems with a dedicated and orderly interconnection scheme employing a 56-pin printed circuit edge connector, with 28 pins per side of a double-sided board. The standardised pinout lends itself nicely to a bussed motherboard system that permits any card to work in any slot.

Before we go any further, I can hear you all asking ". . . just what does 'STD' *mean*?"

Nothing.

It's just a name, a mnemonic if you like. It is *not* an acronym for 'standard'.

It happened like this (Approximately. This is a folk tale, but true): Once upon a time, a bunch of engineers at Pro-Log Corporation devised a 56-pin buss for 8-bit mircoprocessor systems. Once that was done, the hard work came along — finding a name for it. Well, they racked their brains and tossed all sorts of ideas into the melting pot but none gelled. Finally, in sheer frustration, or in a sheer stroke of creative genius, someone said "Why don't we call it the 'STD' buss?". And they did. They all lived happily ever after and the STD buss grew and flourished until, today, cards of numerous sorts, varieties and applications are produced by over 100 manufacturers the world over.

It's nice buss-time story, isn't it?

Next question. Why does ETI use "buss" instead of "bus", like Pro-Log do?

Back in the dim, dark ages (circa 1979), when the magazine was just settling into this microprocessor/microcomputer business, the terms *bus* and *buss* were bandied about with gay (but not limp-wristed) abandon. Since time immemorial (B.C. — literally, 'before computers'), the term *bus* referred to a power supply 'bus bar'; a single, heavy duty conductor that trundled all round a circuit delivering power where it was needed.

Problem was, when computers came along, and along with the first hobby computers came the 100-pin S100 bus/buss, what was one to call a multiconductor interconnection carrying not only several power circuits, but signals as well? Some used the term *bus*, others, *buss*. As the S-100 thingo comprised more than one conductor, it seemed to us that *buss* was a logical adjective/noun/verb for such things. End of second lesson. No correspondence will be entered into.

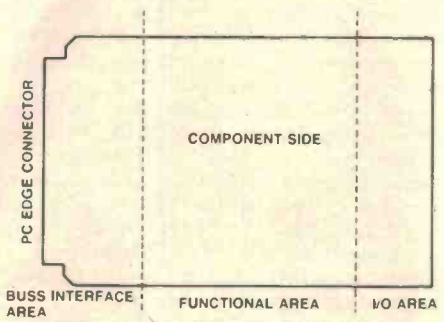


Figure 1. Layout of an STD buss card.

Where the story really starts

Boards for the STD buss have a standard mechanical specification and a standard organisation. Figure 1 shows how the boards are laid out. All the buss interface circuitry is located adjacent to the 56-pin pc edge connector. The circuitry to provide whatever function the board has been designed for occupies the middle area of the board, while any input/output (I/O) interfacing and connections are located at the outer end of the board. This concept gives an orderly signal flow accross the cards. Any peripheral and I/O devices can be connected to the system according to their own unique connector and cabling requirements. Figure 2 illustrates the general applications flexibility achieved.

The general mechanical specifications of an STD card are illustrated in Figure 3. The odd-numbered pins, beginning with pin 1 and going through to pin 55, are on the *component side* of the card, while the even numbered pins, from pin 2 through to pin 56, are on the opposite side. A slot may be cut between pins 25 and 27 (26 and 28 on the other side) if a card needs to be keyed so that it can only be inserted one way up. Alternatively, the slot may be cut between pins 27 and 29 (28-30).

The edge connector is a dual 28-pin type with 0.125 inch (3.18 mm) pin centres meant for mounting on 0.5 inch centres, connector-to-connector, and accepting standard cards of 4.5" x 6.5" x 0.062" (imperial), 114 x 165 x 1.65 mm (metric). Cards no longer than 165 mm are found, however.

Pin definitions

The pinout of the STD buss is organised into four functional groups:

- Dual power busses — pins 1-6 and 53-56

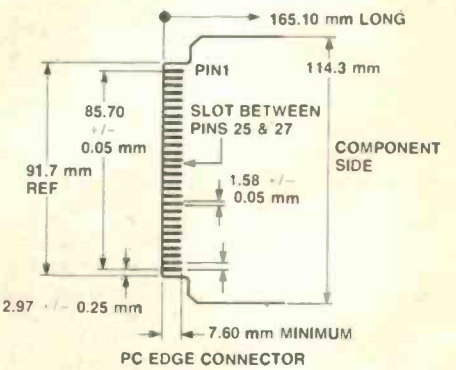


Figure 3. STD buss card general mechanical design.

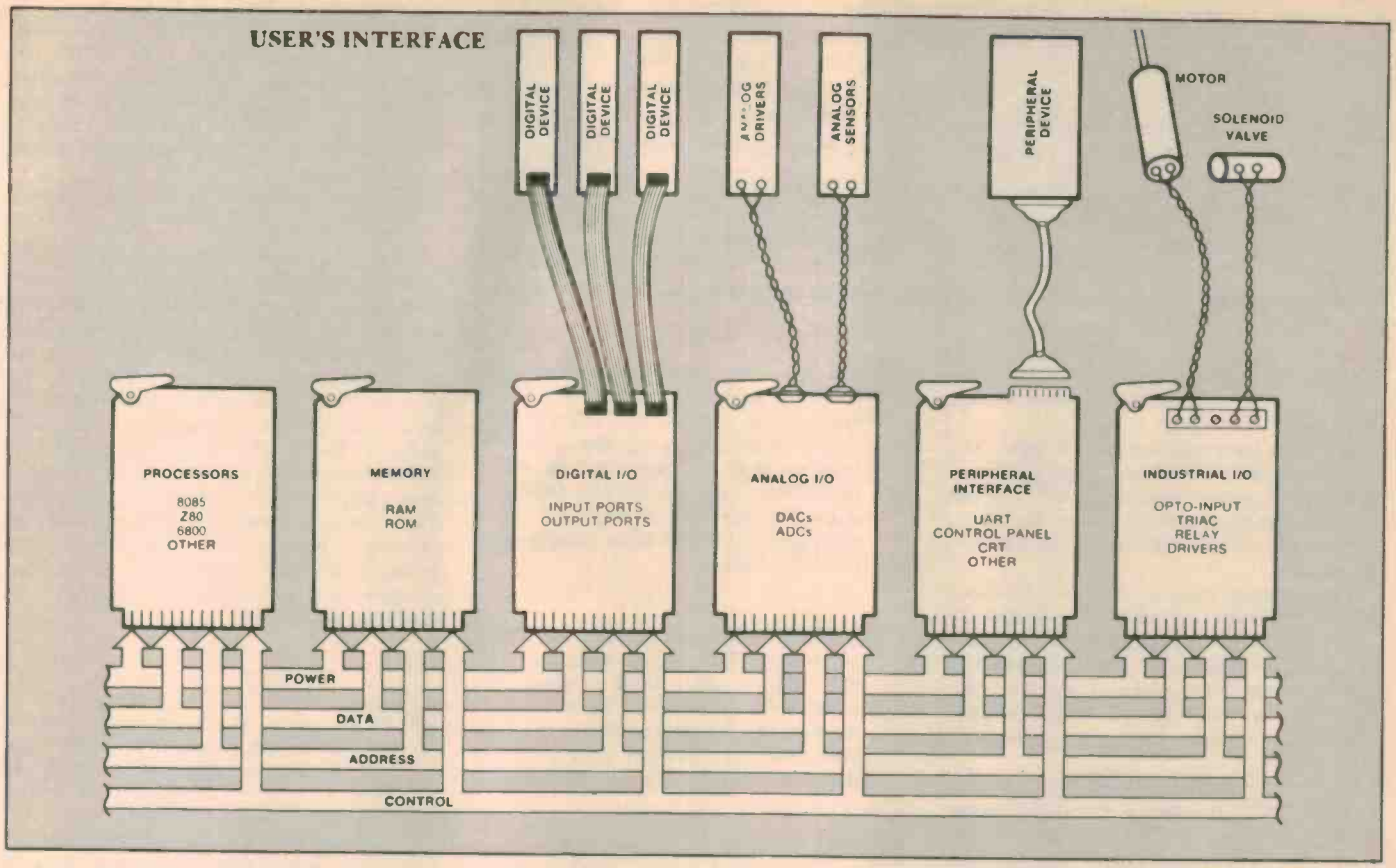


Figure 2. Showing the general versatility of the STD buss.

- 8-bit data buss — pins 7-14
- 16-bit address buss — pins 15-30
- control buss — pins 31-52

The organisation and pin functional specifications are listed in Table 1 and illustrated in Figure 4.

The dual power busses accommodate both logic and alalogue power supply distribution. Up to five separate power supplies can be used with two separate ground returns, as shown in Table 2 here.

The **data buss** is an 8-bit, bi-directional tri-state buss. That is, signals may flow either into or out of any card on the buss and any card is required to release the buss to a high impedance state when not in use. The buss can thus assume any of three conditions: logic high, logic low or high impedence (virtually open-circuit).

The direction of the data is normally controlled by the processor card via the control buss. The data direction is normally ▶

Figure 4. Below. Edge connector pin list, looking from either side of the board.

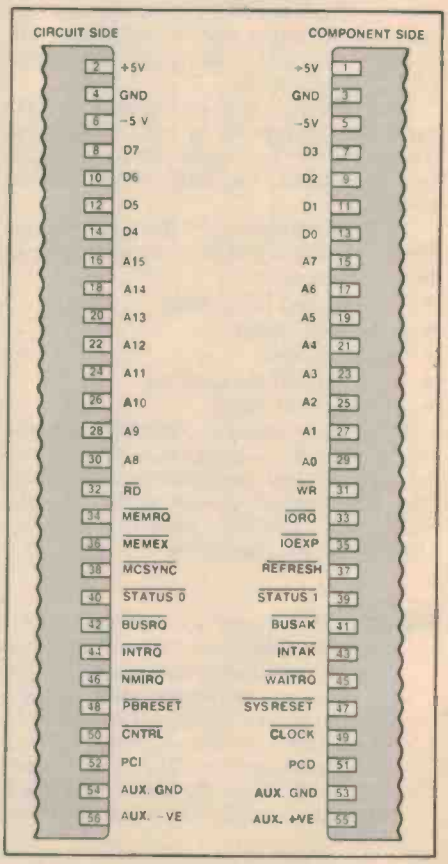


Table 1. STD buss pinouts with signal flow referenced to the processor card.

	COMPONENT SIDE				CIRCUIT SIDE			
	PIN	MNEMONIC	SIGNAL FLOW	DESCRIPTION	PIN	MNEMONIC	SIGNAL FLOW	DESCRIPTION
LOGIC POWER BUS	1	+5VDC	In	Logic Power (bussed)	2	+5VDC	In	Logic Power (bussed)
	3	GND	In	Logic Ground (bussed)	4	GND	In	Logic Ground (bussed)
	5	VBB #1	In	Logic Bias #1 (-5V)	6	VBB #2	In	Logic Bias #2 (-5V)
DATA BUS	7	D3	In Out	Low-Order Data Bus	8	D7	In Out	High-Order Data Bus
	9	D2	In Out	Low-Order Data Bus	10	D6	In Out	High-Order Data Bus
	11	D1	In Out	Low-Order Data Bus	12	D5	In Out	High-Order Data Bus
	13	D0	In Out	Low-Order Data Bus	14	D4	In Out	High-Order Data Bus
ADDRESS BUS	15	A7	Out	Low-Order Address Bus	16	A15	Out	High-Order Address Bus
	17	A6	Out	Low-Order Address Bus	18	A14	Out	High-Order Address Bus
	19	A5	Out	Low-Order Address Bus	20	A13	Out	High-Order Address Bus
	21	A4	Out	Low-Order Address Bus	22	A12	Out	High-Order Address Bus
	23	A3	Out	Low-Order Address Bus	24	A11	Out	High-Order Address Bus
	25	A2	Out	Low-Order Address Bus	26	A10	Out	High-Order Address Bus
	27	A1	Out	Low-Order Address Bus	28	A9	Out	High-Order Address Bus
	29	A0	Out	Low-Order Address Bus	30	A8	Out	High-Order Address Bus
CONTROL BUS	31	WR•	Out	Write to Memory or I/O	32	RD•	Out	Read Memory or I/O
	33	IORQ•	Out	I/O Address Select	34	MEMRQ•	Out	Memory Address Select
	35	IOEXP	In Out	I/O Expansion	36	MEMEX	In Out	Memory Expansion
	37	REFRESH•	Out	Refresh Timing	38	MCSYNC•	Out	CPU Machine Cycle Sync
	39	STATUS 1•	Out	CPU Status	40	STATUS 0•	Out	CPU Status
	41	BUSAK•	Out	Bus Acknowledge	42	BUSRQ•	In	Bus Request
	43	INTAK•	Out	Interrupt Acknowledge	44	INTRQ•	In	Interrupt Request
	45	WAITRQ•	In	Wait Request	46	NMIRQ•	In	Nonmaskable Interrupt
	47	SYSRESET•	Out	System Reset	48	PBRESET•	In	Push-Button Reset
	49	CLOCK•	Out	Clock from Processor	50	CNTRL•	In	AUX Timing
	51	PCO	Out	Priority Chain Out	52	PCI	In	Priority Chain In
AUXILIARY POWER BUS	53	AUX GND	In	AUX Ground (bussed)	54	AUXGND	In	AUX Ground (bussed)
	55	AUX +V	In	AUX Positive (+12V DC)	56	AUX -V	In	AUX Negative (-12V DC)

•Low-level active indicator

PIN	DESCRIPTION	COMMENTS
1 & 2	Logic Power	Logic Power Source (+5VDC)
3 & 4	Logic Ground	Logic Power Return Bus
5	Logic Bias Voltage	Low-current Logic Supply #1 (-5V)
6	Logic Bias Voltage	Low-current Logic Supply #2 (-5V)
53 & 54	Auxiliary Ground	Auxiliary Power Return Bus
55	Auxiliary Positive	Positive DC Supply (+12V)
56	Auxiliary Negative	Negative DC Supply (-12V)

Table 2. The dual power busses (pins 1-6 and 53-56) accommodate logic and analogue power distribution.

affected by such signals as *read* ($\overline{RD}$), *write* ($\overline{WR}$) and interrupt acknowledge ($\overline{INTAK}$).

The data buss uses *active-high* logic. The processor card will 'release' the data buss in response to a buss request ($\overline{BUSRQ}$) input from an alternate system controller as in, for example, direct memory access (DMA) transfers.

The **address buss** is a 16-bit, tri-state, active-high buss. It provides the full 16 address lines for decoding by either memory or I/O. Normally, the address originates from the processor card which will release the buss in response to a buss request ($\overline{BUSRQ}$) input from an alternate controller.

Memory request ($\overline{MEMRQ}$) and I/O request ($\overline{IORQ}$) control lines distinguish between memory and I/O operations. The particular microprocessor employed determines the number of address lines in use and how they are applied.

The address buss can handle a system with 65 536 (64K) different addresses. Thus, you can have up to 64K of memory on a card. More memory can be accommo-ju dated by a paging system and cards with memory as large as quarter-megabyte (265K) are available.

Most of the processors available on STD cards can address up to 64K of memory. These include the popular Z80 and Z80A, the 8085/8085A, the 6502, 6800, NSC800 and 6809.

The **control buss** gives the STD buss its flexibility. The signal lines are grouped into five separate areas:

- memory and I/O control
- peripheral timing
- clock and reset
- interrupt and buss control
- serial priority chain

The memory and I/O control lines, as the title implies, provide signals for fundamental memory and input/output operations. The following six control signals are the main ones, generally used in simple or straightforward applications:

$\overline{WR}$. Pin 31 — *write* to memory or I/O; tri-state, active-low. When the signal appears on this line data can be written to memory or output port latches, indicating that the buss holds data to be written to in the addressed memory or output device. The write signal originates from the processor which also provides the output data to the buss.

$\overline{RD}$. Pin 32 — *read* from memory or I/O; tri-state, active-low. When this signal appears on pin 32 the selected I/O device or memory gates data onto the buss so that the processor or other buss-controlling device can read the data. The read signal originates from the processor which then accepts data from the buss.

$\overline{IORQ}$. Pin 33 — I/O *address select*; tri-state, active-low. This signal indicates that the address lines hold a valid I/O address for an I/O read or write. It is used on the I/O cards and is gated with either the read ($\overline{RD}$) or write ($\overline{WR}$) to designate input or output operations.

$\overline{MEMRQ}$. Pin 34 — *memory address select*; tri-state, active-low. This signal indicates that the address buss holds a valid address for memory read or memory write operations. It is used on memory cards and is gated with either $\overline{RD}$ or $\overline{WR}$ to designate memory operations.

IOEXP. Pin 35 — *I/O expansion;* high — expand, low — enable. This signal expands or enables I/O port addressing. An active-low enables primary I/O operations. An example of its use is to allow common address decoding in memory-mapped I/O operatins. Simple systems can generally strap this signal to ground.

MEMEX. Pin 36 — *memory expansion;* high — expand, low — enable. This signal expands or enables memory addressing. An active-low enables the primary system memory. MEMEX allows memory overlay such as that found in bootstrap operations. A control card may switch out the primary system memory to make use of an alternate memory. Simple systems can generally strap this signal to ground.

Peripheral timing control lines provide control signals that enable using the STD buss with a microprocessor's own peripheral devices. As the STD buss is intended to service any 8-bit microprocessor, and most peripheral devices are processor-specific, four control lines of the STD buss are designated for peripheral timing. They are defined specifically for each type of microprocessor so that it can best serve its own peripheral devices. As a result, the STD buss is not limited to one processor or processor family. The four signals are generally defined as below and specifically defined for nine common microprocessors as shown in Table 3.

$\overline{REFRESH}$. Pin 37 — *memory refresh* (dynamic); tri-state, active-low. This signal refreshes dynamic memory. It may be generated on the processor card or on a separate control card. The nature and timing of the signal may be a function of the memory device or of the microprocessor. In systems without refresh, this signal can be any specialized memory control signal. Simple systems with static memory may disregard $\overline{REFRESH}$.

$\overline{MCSYNC}$. Pin 38 — *machine cycle synch.;* tri-state, active-low. This signal occurs once during each machine cycle of the processor. (Machine cycle is defined as the sequence that involves addressing, data transfer and execution.) $\overline{MCSYNC}$ defines the beginning of the machine cycle. The exact nature and timing of this signal are processor-dependent. $\overline{MCSYNC}$ keeps specialized peripheral devices synchronized with the processor's operation. It can be used for controlling a buss analyser, which can analyse buss operations cycle-by-cycle.

Table 3. Peripheral timing-control lines for various 8-bit microprocessors.

	REFRESH* PIN 37	MCSYNC* PIN 38	STATUS 1* PIN 39	STATUS 0* PIN 40
8080	—	SYNC*	M1*	—
8085	—	ALE*	S1*	SO*
NSC800	REFRESH*	ALE*	S1*	SO*
8088	—	ALE*	DT/R*	SSO*
Z80	REFRESH*	(RD*+WR*+INTAK*)	M1*	—
6800	—	Ø2*	VMA*	R W*
6809	—	EOUT* (Ø2*)	—	R W*
6809E	—	EOUT* (Ø2*)	LIC*	R W*
6502	—	Ø2*	SYNC*	R W*

STATUS 1. Pin 39 — *status conrol* line 1; tri-state, active-low. This signal provides secondary timing for peripheral devices. When available, it is considered as a signal for identifying an instruction fetch.

STATUS O. Pin 40 — *status control line 0*; tri-state, active low. This signal provides additional timing for peripheral devices.

Interrupt and buss control lines allow the implementation of such buss control schemes as direct memory access, multiprocessing, single stepping, slow memory, power-fail restart and a variety of interrupt methods. The STD buss includes provision for a serial priority chain but parallel priority schemes can be implemented. There are six interrupt and buss control lines, as follows:

BUSAK. Pin 41 — *buss acknowledge;* active low. The BUSAK signal occurs at the completion of the current machine cycle and indicates that the buss is available for use by a requesting controller. The controlling processor responds to a BUSRQ by releasing the buss and giving an acknowledge signal on the BUSAK line.

BUSRQ. Pin 42 — *buss request*; active-low, open collector drive. This signal causes the controlling processor to suspend operations on the STD buss by releasing all tri-state STD buss lines for use by another processor. The STD buss is released when the current machine cycle has been completed. BUSRQ is used in applications requiring direct memory access (DMA). In complex systems, it can be an input, an output, or it can be bi-directional, depending on the supporting hardware.

INTAK. Pin 43 — *interrupt acknowledge*; active-low. This signal tells the interrupting device that the processor card is ready to respond to the interrupt. For vectored interrupts the interrupting device places the vector address on the data buss during INTAK. This signal can be combined with a priority signal if multiple controllers need buss access. INTAK is not used in nonvectored interrupt schemes.

PARAMETER	LIMIT	REFERENCE
Positive voltage applied to logic input or disabled 3-state output	+5.5V	GND pins 3, 4
Negative DC voltage applied to a logic input or disabled 3-state output	-0.4V	

Table 4. Maximum ratings for the STD buss card edge connector pins. These are not the recommended operating conditions.

INTRQ. Pin 44 — *interrupt request*; active-low, open collector drive. This processor-card input signal conditionally interrupts the program. It is masked and ignored by the processor, unless deliberately enabled by a program instruction. If the processor accepts the interrupt, it usually acknowledges by dropping INTAK (pin 43). Other actions depend on the specific type of processor, the interrupt-related program instructions and the hardware support of the interrupt mechanism.

WAITRQ. Pin 45 — *wait request*; active-low, open collector drive. This input signal to the processor suspends operations as long as it remains low. Normally, the processor holds in a state that maintains a valid address on the address buss. WAITRQ can be used to insert wait states in the processor cycle. Examples of its use include slow memory operations and single stepping.

NIMRQ. Pin 46 — *nonmaskable interrupt*; active-low, open collector drive. This signal is a processor card interrupt input of the highest priority. It should be used for critical processor signalling. eg: power-fail indications.

The four clock and reset lines provide the STD buss with basic clock timing and reset capability. They are:

SYSRESET. Pin 47 — *system reset*; active-low. This signal is an output from the system reset circuit which is triggered by power-on detection, or by the push-button reset. The system reset buss line should be applied to all buss cards that have latch circuits requiring initialisation.

PBRESET. Pin 48 — *pushbutton reset*; active-low. Just connect the terminals of a normally-open, momentary-action pushbutton between here and ground. Some on-board debouncing may be required, depending on circuitry used.

CLOCK. Pin 49 — *processor clock*. This signal is a buffered processor clock signal for use in systems synchronisation or as a general clock source.

CNTRL. Pin 50 — *control*. This is a line that can be specified by the user and may be a processor input or output, typically used as an external clock input to the processor. It may be a multiple of the processor clock signal, if you wish, or a real-time clock signal, etc.

The two serial priority chain lines are provided for interrupt or buss control. They require logic on the card to implement the priority function. Cards not needing the chain *must* jumper PCI to PCO if a serial priority scheme is used.

PCO. Pin 51 — *priority chain out*. Signal from this pin is sent to the PCI input of the *next lower* card in priority. A card that needs priority should hold PCO low.

PCI. Pin 52 — *priority chain in*. This signal is provided directly from the PCO line of the *next higher* card in priority. A high level on PCI gives priority to the card sensing the PCI input. ▶

Table 5. Power buss voltage tolerances. Note that these voltage values are specified at the card pins, not at the backplane track.

CARD PIN	SUPPLY VOLTAGE	TOLERANCE	REFERENCE
1, 2	VCC (+5V)	±0.25V	GND pins 3, 4
5	VBB #1 (-5V)	±0.25V	GND pins 3, 4
6	VBB #2 (-5V)	±0.25V	GND pins 3, 4
55	AUX +V (+12V)	±0.5V	AUX GND pins 53, 54
56	AUX -V (-12V)	±0.5V	AUX GND pins 53, 54

STD BUS CARD PARAMETER	TEST CONDITIONS		MIN	MAX	UNITS
VOH (high-state output voltage)	VCC=MIN	IOH=-15 mA	2.4	—	V
VOL (low-state output voltage)	VCC=MIN	IOL=24mA	—	0.5	V
VIH (high-state input voltage)			2.0	—	V
VIL (low-state input voltage)			—	0.8	V
tR, tF (rise time, fall time)			4	100	NS

Table 6. Logic signal characteristics. These specifications apply over the specified temperature range for the STD buss and are compatible with industry-standard TTL logic.

Ratings

Maximum ratings for the STD buss card edge connector pins are listed in Table 4. Note, these are *not* recommended operating conditions. Above the voltage values specified, damage to components on the card is possible. The specific voltage at which damage occurs is component-dependent.

Cards should not be inserted or removed from the buss while power is applied.

Voltage tolerances for the various power rails on the STD buss are listed in Table 5. STD buss cards normally required +5 V for logic circuitry. Other voltages may be needed according to individual card functions and device types. Note that, with Table 5, the voltages are specified at the card pins, not the backplane tracks.

With regard to logic signals, the STD buss has been designed for compatibility with industry-standard TTL logic levels. Table 6 gives the general signal parameters.

Wrapping it up

Well, that wraps up a quick introduction to the STD buss. A little perusal shows just how versatile it is — *and* easy to use. It's great for card-based personal computer systems, for microprocessor controller systems, etc and it's just perfect for *robotics*. Aha! That should set you thinking.

Whether you're a hobbyist or work in the 'real' world, the STD buss has much to offer. Pro-Log Australia can offer the professional both engineering advice and support as well as products. And they're very 'user friendly', as the industry-standard buzzword goes.

For those who've progressed this far and are still bemoaning "... but it's only for 8-bit devices", worry not. Where there's a will, there's a way, the old saying goes, and 16-bit processor cards for the STD buss are already appearing. Devilish clever fellows, what! ●

ACKNOWLEDGEMENTS

ETI would like to acknowledge the advice and assistance of Mike Nash, Managing Director of Pro-Log Australia, for assistance with information and permission to use material from Pro-Log's ***STD Bus Technical Manual and Product Catalog****. Thanks must also go to Phil Delecretaz of Pulsar Electronics who raised the subject in the first place with their Little Big Board, now ETI Project 690.*

RECOMMENDED LITERATURE

For those interested in pursuing the subject further, two interesting and useful books are available, but pitched at essentially different readers.

For the **professional** there's Pro-Log's own *STD Bus Technical Manual and Product Catalog*. This was used as a basic reference for this article, but goes into more detail. Thoroughly recommended. And it's free. But you'll have to write on Company or Departmental letterhead to **Pro-Log (Australia) Pty Ltd, P.O. Box 1, Canterbury 3126 Vic.** The book is A4-sized, soft covered and runs to over 160 pages. Between its covers are complete mechanical and electrical specifications for the STD buss, details on buss practice and descriptions and specifications of a whole host of Pro-Log products for STD buss users. Pro-Log also has other literature to offer.

For the **hobbyist/technician**, but very useful to the engineer as well, there's *STD Bus Interfacing* by Titus, Titus and Larsen, published by Howard Sams. This is available through ETI Book Sales. (Aren't we good to you?). This weighty little tome measures 136 x 215 mm, is soft covered and runs to 286 pages, including a very comprehensive index. Six chapters cover what the buss is all about, addressing input and output port interfacing, interrupts and DMA, and some products. Two apendices explain the STD buss standard and voltage input configurations. It's written in an easy style and all device pinouts are given.

You can obtain a copy from us for $21.75, plus $2.75 post and handling. Ask for *STD Bus Interfacing, J0164P*. Send a cheque or money order, made out to Federal Publishing Company, to **ETI Book Sales, ETI Magazine, P.O. Box 21, Waterloo NSW 2017.**

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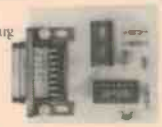

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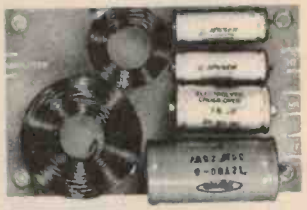

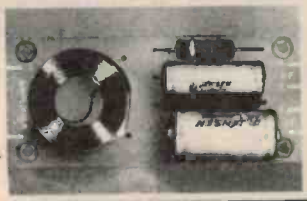

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The 'Little Big Board', a Z80-based computer with 64K RAM all on an STD buss board

Designed by Pulsar Electronics of Melbourne, this computer board can be used as a stand-alone system running under CP/M and its derivatives or as part of a larger system. With STD buss interfacing it offers great versatility and flexibility.

Roger Harrison

THE WORLD'S most widely used microprocessor must surely be the ubiquitous Z80. The microcomputer industry has adopted it in no uncertain terms. Z80-based microcomputer and microcontroller systems abound. Add another one to the list. But (and they all say it), this one's different.

When I first saw the "Little Big Board", I thought half the claims made by Pulsar Electronics referred to add-on system boards. A somewhat closer inspection showed it was all on the one board. Two boards will fit one above the other on this page of the magazine. Now, exactly what's on a Little Big Board.

The processor is a Z80A running at a full 4 MHz. There are 64Kbytes of dynamic RAM on-board, plus a single/double density floppy disk controller that will handle up to four drives of either 8" or 5¼". Two RS232 serial I/O ports are included with software-selectable communication bit rates from 50 bits per second (bps) to 19 200 bps. A 2K PROM provides bootstrap and monitor software and the CP/M version 2.2 operating system can be loaded from disk. A very handy inclusion is the battery-backed real-time clock and calendar. Interfacing for the STD buss (see *Introduction to the STD Buss* elsewhere in this issue) is included which permits the Little Big Board to be used in systems with other STD buss cards, over 1800 of which are manufactured by dozens of companies world-wide for all sorts of applications. There are memory cards, digital and analogue I/O cards, relay interface cards, ROM cards, dc and ac circuit driver cards etc, etc.

The Little Big Board is meant to be 'driven' from a serial terminal. For hobbyists, or those who need to assemble a low cost system, second hand terminals can be picked up for prices ranging from $350 or so to about $600, depending on features and condition. However, a Microbee IC makes a good serial terminal and has several advantages. If you already have a Microbee IC, the Little Big Board offers a cost-effective way to add disks and CP/M capability, and you still retain your Microbee software base! A new serial terminal will set you back around $800-$1000 while a Microbee IC plus green-screen monitor will cost just under $700. The drawback is, the Microbee only communicates at 1200 baud. But that's not necessarily a drawback to everybody.

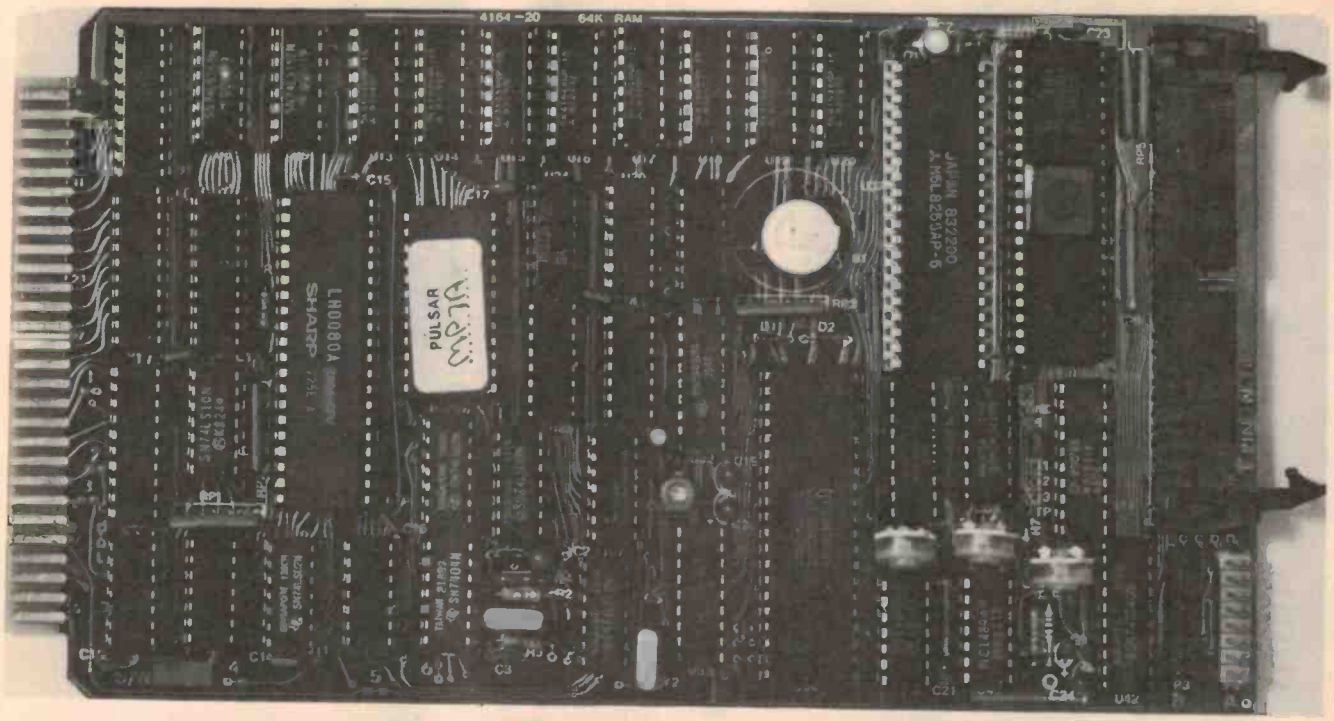
Because the Little Big Board is a Z80-based system meant for disk operation, the CP/M operating system is a 'natural' for it and Pulsar Electronics are marketing a "CP/M System Disk" which comes with CP/M version 2.2 plus an enhanced BIOS, PROM bootstrap and utility program package. More on this later. However, CP/M 2.2 is not the only operating system you can use with the Little Big Board. There's MP/M II, CP/Net, TurboDOS and Multi/OS available. I don't have the space to explain them all here, but if you've been around the computer industry a little while, the above operating systems will mean something to you. With MP/M and Multi/OS, you can tack several users into the system. More for the 'professional' than the hobbyist.

Having CP/M opens a whole raft of software packages to you. A positively huge range of software for numerous applications is available under CP/M, including the ubiquitous games plus plenty of computer languages, financial packages, word processing etc, etc. A great deal of public domain software is available under CP/M.

There are two RS232 ports on-board. One is used for the serial terminal, as explained earlier. The other can be used to drive a printer, a modem or other peripheral device.

ETI-690 LITTLE BIG BOARD — FEATURES

- Z80A microprocessor running at 4 MHz
- 64K of dynamic RAM on-board
- 2K of PROM containing bootstrap and monitor
- battery-backed, real-time clock and calendar
- floppy disk interface for up to four 8" or 5¼" drives (single or double density)
- full STD Buss interfacing
- board measures just 114 x 204 mm
- two RS232 ports on-board
- will run CP/M 2.2 operating system



Pulsar has produced a User's Manual which will be available with kits. It is a well produced, comprehensive document that includes details on printer interfacing, disk drive setting up, system architecture, system utilities, monitor commands, CP/M 2.2 BIOS and circuits. The latter comprise 12 'partitions' of the overall circuit and these have been assembled into four functional sections for this article to provide constructors with a more concise 'view' of the system and its operation.

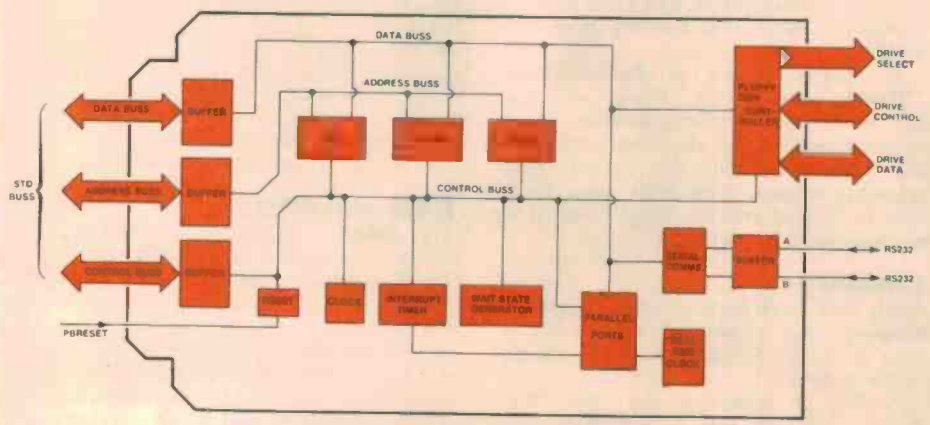
Disk drives

A wide variety of 8" drives can be accommodated by the Little Big Board. In general, most Shugart-compatible drives can be used (YE Data, Qume, Remex, Tandon etc). You can use Mitsubishi M2896-63 double-sided, double density 'half height' 8" drives as well as the Mitsubishi M4854 1.6M 5¼" slim-line drives. In addition, for the really ambitious, you can drive Tandon Winchester hard disks, or the XEBEC S1410 (which Pulsar recommend). Details on jumpering are given in the User's Manual.

A total of 64K of random access memory (RAM) is on-board along with a 2K EPROM containing monitor and bootstrap software (the latter for the CP/M operating system).

The two RS232 ports for peripheral interfacing by the user are implemented by serial communications circuitry. Floppy disk logic circuitry provides complete disk drive control of up to four drives as well as transferring data to and fro.

Figure 1.



A system clock, interrupt timer (for the CPU) and wait state generator complete the control section of the computer. A real-time clock is implemented via a spare parallel port on the programmable peripheral interface (PPI) chip which is part of the floppy disk logic.

Some simple reset circuitry, part of the control buss, permits external hardware resetting via the 'pushbutton reset' (PBRESET) line of the STD buss.

Printers

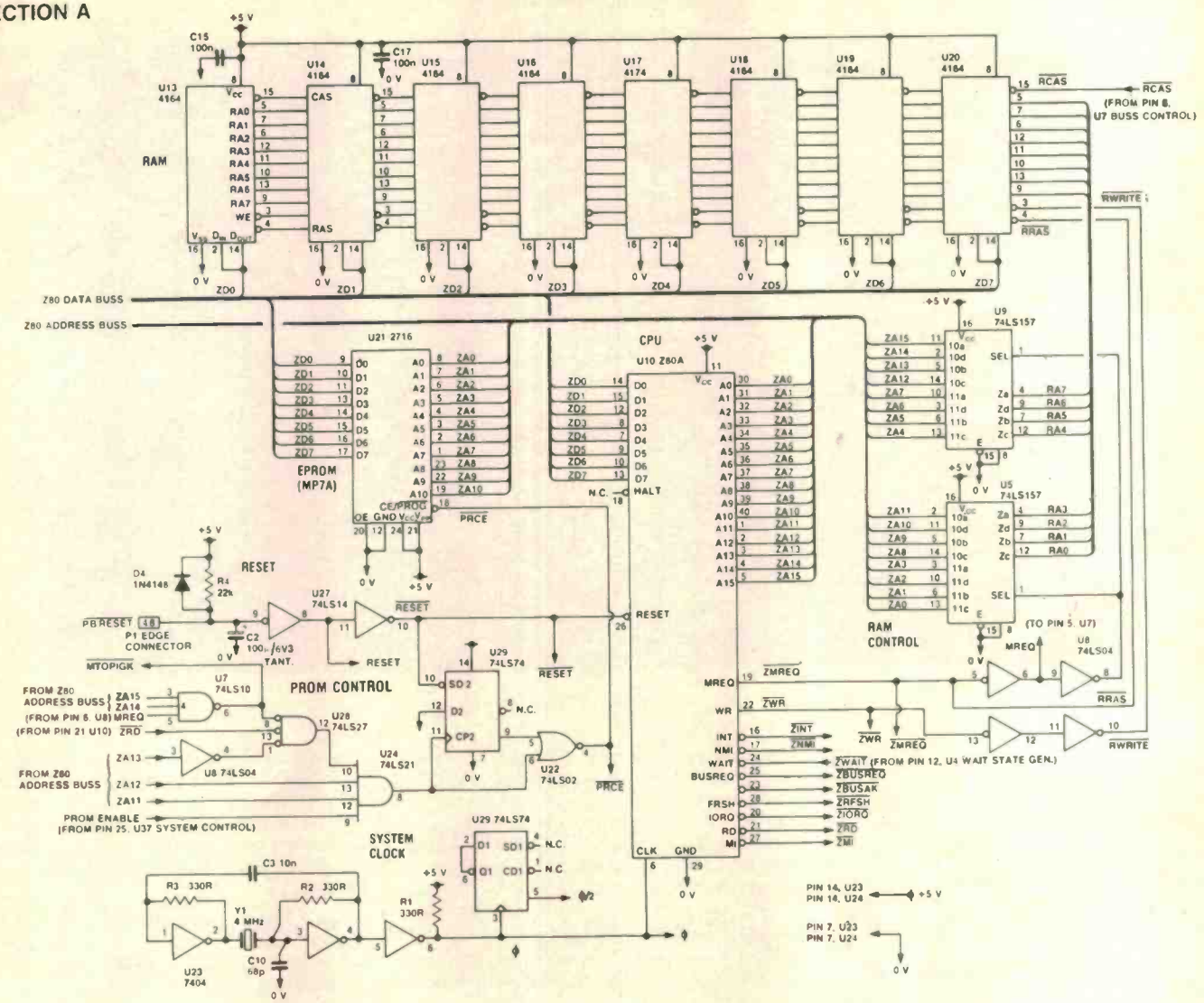
A wide choice of printers can be hooked up to Port B. The User's Manual lists nine. As there are many 'look alikes' in the printer market, that won't be the limit. Taking them alphabetically, Pulsar give details on interfacing the following printers: Alps (ASP-3500), Centronics 739, Epson MX80 III FT, HP 2631B, Itoh 1550, Microline 80, 82 and 84, and the Spinwriter 10.

The system

A block diagram of the Little Big Board is shown in Figure 1. It's pretty straightforward. STD buss practice is to have the buss interface adjacent to the buss edge connector, the general functional circuitry in the middle area of the board and the I/O at the 'user's' end of the board.

There are three busses on the board: the Z80 microprocessor (CPU) address and data busses plus a control buss. The entire Z80 address and data busses are buffered onto the STD buss connector. Some of the Z80 control signals are buffered onto the STD buss connector while other, internally-generated, control signals are passed to the STD buss also. ▶

SECTION A



Disk system

The Little Big Board is designed as a disk-based machine running the CP/M operating system — by far the most widely used microcomputer disk operating system. There is a *huge* variety of software available that runs under CP/M, including a host of 'public domain' (non-copyright) software. CP/M, if you didn't know, stands for "control program, microcomputers". It comes from the US company, Digital Research.

To run CP/M on the Little Big Board, you need to purchase Pulsar's "CP/M System Disk". These will be available either from Pulsar or through the kit suppliers supporting this project (see Shoparound in this issue). Pulsar are a licensed CP/M distributor. The System Disk costs $150.

Pulsar's CP/M System Disk is normally configured for double-sided, double-density 8" drives. On it, apart from the CP/M system, are fifty 'files' of utility programs you can use, program source code listings and the User Manual text. A list of the files is reproduced in Table 3, elsewhere in this article.

If you're new to CP/M, I can recommend two books, both available through ETI Book Sales. First, there's *How to Get Started With CP/M* by Carl Townsend. This 160 page soft cover book is for the CP/M novice, as the title suggests. It has ten chapters and six appendixes, including a useful glossary. It costs $19.95, plus $2.75 post and handling. Order it by quoting Book No. K0174A.

A lengthier tome is Rodney Zaks' 320-odd page *CP/M Handbook With MP/M*. This has eight lengthy chapters and fifteen appendixes. It also covers the multi-user version (MP/M). It's a very useful reference manual. This book costs $24.95 plus $2.75 post and handling. Order it by quoting Book No. K0173A.

Circuitry

I only have room here for a basic circuit description, not a detailed, blow-by-blow, How It Works. So, let's start at the 'heart' of the system.

Section A comprises the Z80 CPU, RAM, EPROM and system clock. The RAM and PROM control circuitry is also included. Note that a bar over a signal name indicates it is *active-low*.

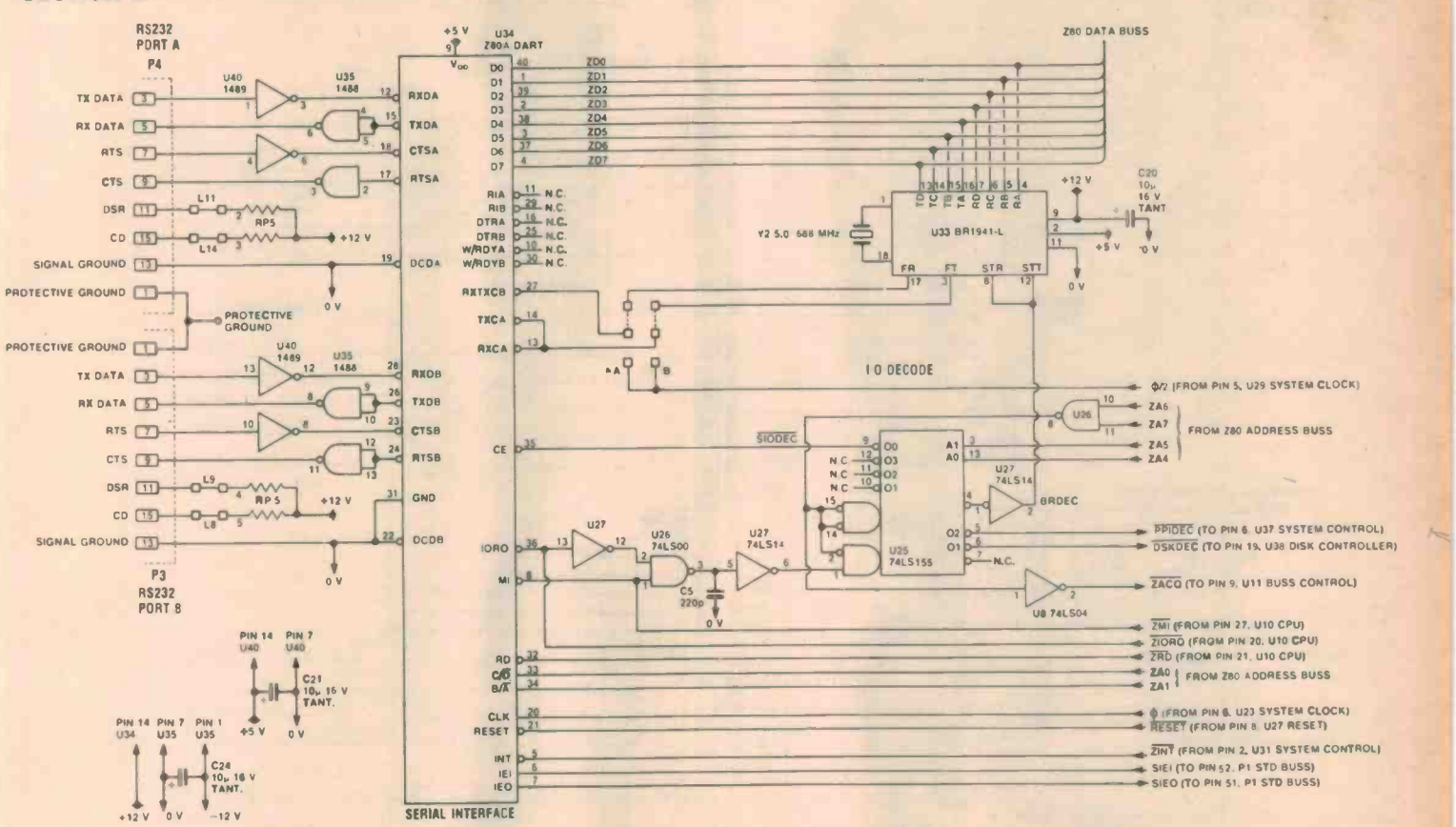
System clock

The system clock consists of a 4 MHz crystal oscillator using two inverting buffers from U23, a 7404. Positive feedback around the two cascaded buffers is provided by C3, input bias being furnished by resistors R2 and R3. Capacitor C10 provides some mode stability by limiting the speed of one buffer. Half of U29, a 74LS74 dual flip-flop, is used to divide the system clock output by two to provide the Ø/2 signal which is used on the CNTRL line (pine 50) of the STD buss.

RAM and PROM

The RAM comprises eight 4164 150 ns 64K x 1-bit NMOS dynamic RAM chips. The data-in and data-out lines of each RAM chip are paralleled and connected to one of the data buss lines. Address decoding for the RAM is done by two 74S157s — U5 for the lower four address bits, U9 for the upper four. The RAM row address select (RRAS) is simply driven, via buffers from U8, from the Z80's MREQ line (pin 19).

SECTION B



The RAM column address select ($\overline{RCAS}$) is provided by the buss control circuitry (Section D). The RAM write signal ($\overline{RWRITE}$) is derived from the Z80's WR line (pin 22) via two more buffers from U8.

The 4164 RAMs feature hidden auto-refresh and no refresh circuitry is required here.

The PROM control circuitry generates a chip enable signal ($\overline{PRCE}$) from the Z80 address buss and the system control buss.

Reset

The STD buss has a hardware reset line (pin 48 — PBRESET) so that a pushbutton mounted off-board can be used to reset the processor when necessary. Pin 48 of the buss is normally held high by R4, C2 being charged. This holds pin 9 of U27 high, pin 8 low and pin 10 high. Pin 10 of U27 drives the reset pin (26) of the Z80 CPU. When the external reset pushbutton is operated, pin 9 of U27 is pulled low, pin 8 goes high and pin 10 goes low, driving pin 26 of the Z80 low, effecting a reset. Capacitor C2 provides some switch debouncing while diode D4 clips any negative excursions of the reset input during switch operation.

Note that the PROM chip enable line ($\overline{PRCE}$) will be held high during a reset.

Section B comprises the serial interface and input/output (I/O) decoder. This section provides the interfacing for the two RS232 ports plus selection circuitry for deciding between serial I/O disk operation or the real-time clock.

Serial interface

The heart of the serial interface is a Z80 'dual, asynchronous receiver-transmitter' chip, or DART. (The DART was developed following abandonment of the 'fully asynchronous receiver-transmitter' chip as the chip designers' couldn't prevent it making rude noises on the serial output).

The DART has two serial port 'sets' — A and B (how original!). Data being received comes in on the RXDA and RXDB pins, while data being transmitted goes out on the TXDA and TXDB pins. A peripheral attached to an RS232 port may generate a "ready to send" (RTS) signal which is passed to pin 18 (port A) or pin 23 (port B) of the DART which then knows the data from the computer is "clear to send" (CTS). When the DART is "ready to send" data from the computer pin 17 of port A and pin 24 from port B will signal the condition to the "clear to send" (CTS) pins of the RS232 ports (pin 9 on each).

As the RS232 ports use signals driving from +12 V to −12 V, these levels have to be interfaced to the 0/+5 V levels required by the DART. This is effected by U35 and U40 (1488 and 1489, respectively).

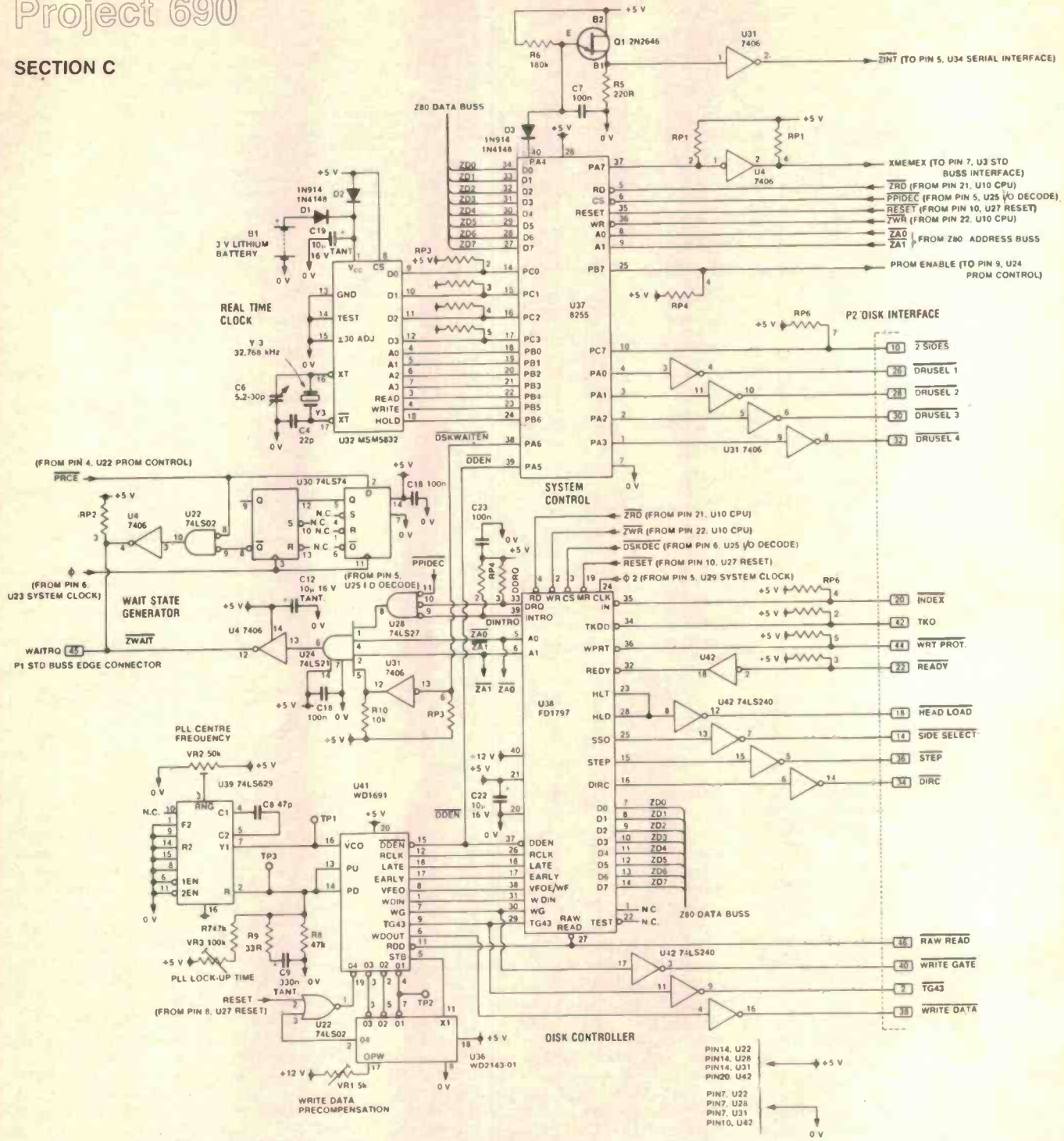
The communications baud rate for the two serial ports is determined by the 'clock' inputs to pins 13, 14 and 27 of the DART. The transmit and receive baud rates are the same (port A has its baud rate clock pins tied together). The clock rate is provided by U33, a BR1941 'dual baud rate clock' by Western Digital. This contains two 4-bit programmable dividers and an oscillator. Crystal Y2, 5.0688 MHz, is divided down to provide the appropriate clock rates from U33's 'FR' and 'FT' outputs. The division ratio is set by data from the Z80 data buss latched into the two dividers when the 'STR' and 'STT' pins are driven high by the BRDEC line from the I/O decode circuitry. Thus, the baud rate for the two RS232 ports is software selectable. The bootstrap PROM normally sets it to 9600 baud.

Other control signals required for the operation of the DART are derived from the control buss. Two pins of the DART interface directly to the priority chain input and output pins of the STD buss. Pin 6 of the DART provides the *Priority Chain Input* (PCI — pin 52) while pin 7 of the DART provides the *Priority Chain Output* (PCO — pin 51).

I/O decode

Selection of the current input or output is controlled by U25, a 74LS155. Four of the Z80 address lines are used to determine which output of the 74LS155 decoder is 'active'. Pin 4 activates the baud rate generator divider inputs, pin 9 ($\overline{SIODEC}$) activates the DART chip enable (pin 35), pin 6 ($\overline{DSKDEC}$) activates the chip select pin of the disk controller (U38) while pin 5 activates the chip select pin of the parallel interface (U37) which gives you the real-time clock. ▶

SECTION C



Section C comprises the disk controller, the system control, the real-time clock and the wait state generator. This section handles all the disk drive interfacing and provides the real-time clock data.

Disk controller

This consists of the Western Digital chip set comprising the FD1797 floppy disk controller and WD1691-WD2143 support chips. A 74LS629 (U39) phase-locked loop ensures 'clean' data from the disk read head is provided for the disk controller. Three trimpots — VR1-VR2-VR3 — permit setting the operating parameters for reliable operation.

The FD1797 takes the incoming data from the disk (which is serial) and puts it on the Z80 data buss (which is parallel) as required. U42 provides buffering as required betwen the disk controller circuitry and the disk interface, P2. More complete information on the operation of the disk controller chip set can be obtained from the Western Digital Data Book.

System control

An 8255 (U37) 'programmable peripheral interface' (PPI) chip does this job. Its chip select (CS) line (pin 6) is driven from the PPIDEC signal provided by the I/O interface. The 8255 has three I/O ports — A, B and C (more originality!). Port A has several roles. The first four bits (PA0 to PA3) provide the four DRUSEL signals for the disk interface, the fifth bit (PA4) signals the interrupt generator (Q1 and associated components), bit six (PA5) and bit seven (PA6) provide the 'disk drive enable' (DDEN) and 'disk wait enable' (DSKWAITEN) signals for the disk controller, while bit eight (PA7) provides the memory expansion signal (XMEMEX) for the STD buss interface.

The first seven bits of Port B on the 8255 take address and read/write/hold data to and from the real-time clock. Bit eight of Port B provides the 'PROM enable' signal

to the PROM control circuitry in Section A.

The first four bits of Port C (PC0 to PC3) take time data from the real-time clock for transmission to the Z80 data buss.

The interrupt generator consists of Q1 (a 2N2646 UJT), D3, R5, R6, C7 and one gate from U31. PA4 of the 8255 (pin 40) is normally low. Thus, diode D3 holds the emitter of Q1 low. The B2-B1 resistance of Q1 will be high and the voltage across R5 will be low, holding down pin 1 of U31. Thus, pin 2 of U31 will be high. When PA4 goes high, C7 will charge up until it reaches the emitter threshold voltage of Q1, which will then 'fire'. This will provide a sharp positive-going pulse to pin 1 of U31 which will provide a sharp negative-going pulse for the ZINT line. This signal 'interrupts' both the serial interface (U34 Z80 DART) and the microprocessor (U10 Z80 CPU).

Real-time clock

This employs the OKI MSM5832 Real-Time Clock chip (U32). This incorporates an on-chip oscillator and provides 12 or 24 hour clock data (hours/minutes and seconds), plus date, month and year (including leap year adjustments).

The real-time clock is powered by a 3 V lithium battery via D1 when power is disconnected from the pc board. It is normally powered from the +5 V rail via D2 when the Little Big Board is operational.

The on-chip oscillator employs a 32.768 kHz 'electronic watch' crystal. Trimming capacitor C6 provides for setting the oscillator precisely to frequency.

The time can be 'set' using monitor software in the EPROM. Details on the operation of the MSM5832 can be obtained from the manufacturer's data.

Wait state generator

This generates the ZWAIT signal used by the Z80 CPU (U10) when it needs to be 'held up' while some external operation is completed. The same signal drives the 'wait request' (WAITRQ) line of the STD buss.

The circuitry comprises U30 and parts of U24, U28 and U22 and U31 for buffering. The I/O decode, PROM control, system clock and disk controller circuits all provide inputs to the wait state generator.

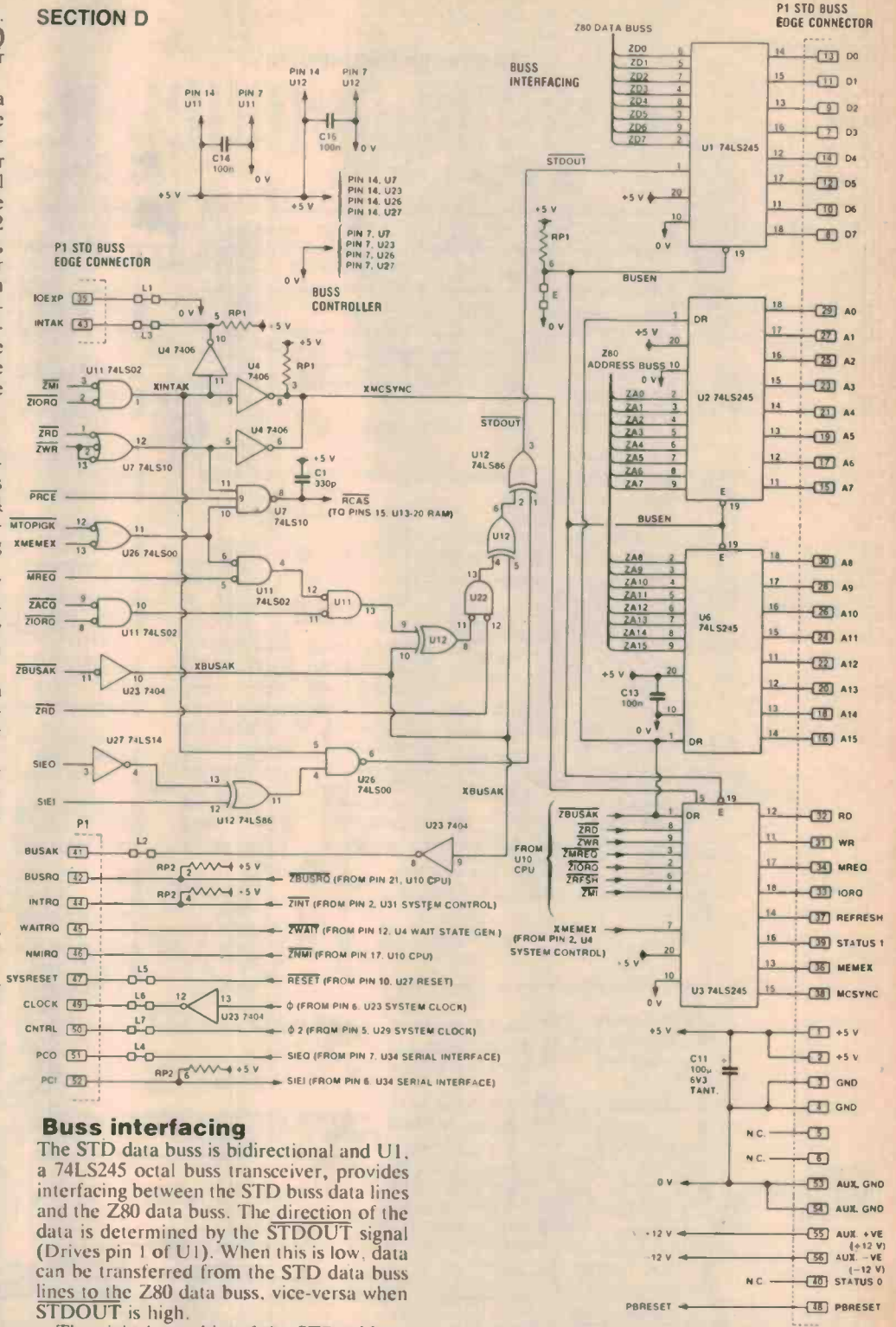
Section D of the circuitry comprises the STD buss controller and interfacing.

Buss controller

This gates on-board control buss signals to produce four 'controlling' signals: STDOUT, which determines the 'direction' of the data running between the STD data buss lines and the Z80 data buss on-board; XMCSYNC, which is buffered and drives the *machine cycle sync.* (MCSYSNC) line of the STD buss (pin 38); XBUSAK, which is buffered and drives the *buss acknowledge* (BUSAK) line of the STD buss; and XINTAK, which is buffered and provides the *interrupt acknowledge signal* (INTAK) for the STD buss (pin 43).

This part of the circuitry uses gates from U7, U11, U12, U22 and U26. Buffers from U4, U23 and U27 are also employed here. One three-input gate from U11 is used to derive the RAM column address (RCAS) signal for the 64K RAM chips in Section A.

SECTION D

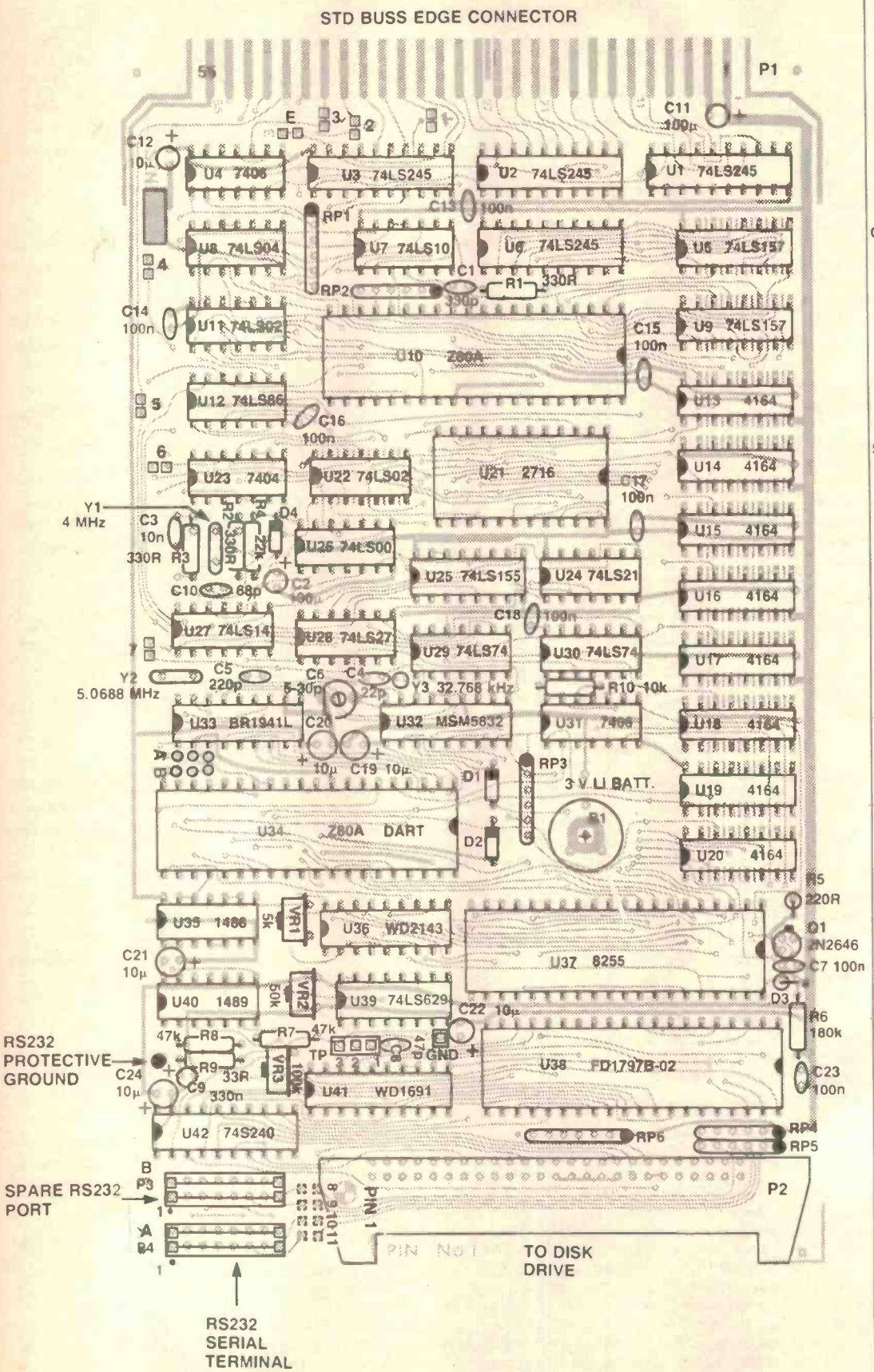


Buss interfacing

The STD data buss is bidirectional and U1, a 74LS245 octal buss transceiver, provides interfacing between the STD buss data lines and the Z80 data buss. The direction of the data is determined by the STDOUT signal (Drives pin 1 of U1). When this is low, data can be transferred from the STD data buss lines to the Z80 data buss, vice-versa when STDOUT is high.

The eight lower bits of the STD address buss are interfaced to the right lower bits of the Z80 address buss via U2, while the eight upper bits of each address buss are interfaced by U6. Both are 74LS245 octal data buss transceivers. The ZBUSAK signal from the on-board control buss determines the direction of the address data. This signal drives pin 1 of U2 and U6. When ZBUSAK is low address data can be transferred from the STD address buss lines to the Z80 address buss, vice-versa when ZBUSAK is high.

The on-board read (ZRD), write (ZWR), memory request (ZMREQ), I/O request (IORQ), refresh (ZRFSH), machine cycle 1 (ZM1) and memory expansion (XMEMEX) signals are interfaced to the STD buss via U3, another 74LS245. This, too, is controlled by the ZBUSAK signal. ▶



PARTS LIST — ETI-690

Resistors ..... all ½W, 5% unless noted
- R1, 2, 3 ..... 330R
- R4 ..... 22k
- R5 ..... 220R
- R6 ..... 180k
- R7, R8 ..... 47k
- R9 ..... 33R
- R10 ..... 10k
- RP1-RP4 ..... 5-bussed 10k SIP resisto
- RP5 ..... 5-bussed 1k SIP resistor
- RP6 ..... 7-bussed 150R SIP resistors
- RV1 ..... 5k min. cermet trimpot
- RV2 ..... 50k min. cermet trimpot
- RV3 ..... 100k min. cermet trimpot

Capacitors
- C1 ..... 330p ceramic
- C2, C11 ..... 100µ/6V3 tant.
- C3 ..... 10n 'bluechip' ceramic
- C4 ..... 22p ceramic
- C5 ..... 220p ceramic
- C6 ..... 5.2-30p trimmer
- C7, 13-18, 23 ..... 100n monolithic
- C8 ..... 47p ceramic
- C9 ..... 330n/6V3 ceramic
- C10 ..... 68p ceramic
- C12, 19-22, 24 ..... 10µ/16 V tant.

Semiconductors
- U1, 2, 3, 6 ..... 74LS245
- U4, U31 7406
- U5, U9 ..... 74LS157
- U7 ..... 74LS10
- U8 ..... 74LS04
- U10 ..... Z80A CPU
- U11, U22 ..... 74LS02
- U12 ..... 74LS86
- U13-20 ..... 4164 150ns DRAMs
- U21 ..... 2716 (MP7A)
- U23 7404
- U24 ..... 74LS21
- U25 ..... 74LS155
- U26 ..... 74LS00
- U27 ..... 74LS14
- U28 ..... 74LS27
- U29, U30 ..... 74LS74
- U32 ..... MSM5832
- U33 ..... BR1941L
- U34 ..... Z80A DART
- U35 1488
- U36 ..... WD2143-01
- U37 8255
- U38 ..... FD1797B-02
- U39 ..... 74LS629
- U40 1489
- U41 ..... WD1691
- U42 ..... 74LS240
- D1-D4 ..... 1N4148, 1N914

Miscellaneous
- B1 ..... 3V lithium battery (Matsushita)
- P1 ..... (board edge connector)
- P2 ..... 50-pin header (for disk drives); right-angle pc mount type.
- P3, P4 ..... 16-pin headers (RS232 ports)
- SK1 ..... 56-way edge connector socket
- Y1 ..... 4 MHz HC18/U crystal
- Y2 ..... 5.0688 MHz HC18/U crystal
- Y3 ..... 32.768 kHz watch crysta

ETI-690 pc board; IC sockets (see text) — 16 14-pin, 12 x 16-pin, 3 x 18-pin, 6 x 20-pin, 1 24-pin, 4 x 40-pin; power supply to suit (see tex 2 x 16-pin IDC header connectors (female); 2 DB15 IDC sockets; ribbon cable (16-way) to su etc.

Estimated price: $499 (rec. retail

(This includes documentation, blown EPROM set-up instructions)

Other signals for the STD buss control lines are taken directly from the on-board control buss. The system clock output is buffered by one buffer from U23, the output of which (pin 12) drives pin 49 of the STD buss (CLOCK).

The +5 V rail pins of the STD buss (1 and 2) are bypassed close to the edge connector by C11, a 100 µF tantalum capacitor.

Memory management

The Little Big Board, as you already know, comes with 64K of dynamic RAM and 2K of EPROM on-board. It has provision for external memory expansion using the memory expansion (MEMEX) control line of the STD buss.

The memory space is managed under software control through the System Control Ports via two control bits: EPROM ENABLE, bit 7 of System Port B (SYSPB — pin 25 of the 8255). When set, this overlays the top 2048 bytes (2K) of RAM space with the on-board EPROM. This bit is set, for example, when the resident monitor program is executing. When this bit is cleared, the full 64K of on-board RAM becomes available. The other control bit is NMEMEX, bit 7 of System Port A (SYSPA — pin 37 of the 8255). This is an inverted copy of the STD bus MEMEX control line. When set (false), this bit maps the entire address space onto the on-board RAM. When reset (true) this bit disables the bottom 48K of on-board RAM, switching the STD interface buffers to accommodate memory components on external cards. The top 16K of the address space is unaffected by the state of NMEMEX to provide a common block of memory for inter-process communication compatible with the MP/M operating system. This also, means the EPROM switching can operate independently of MEMEX.

External memory cards which incorporate bank switching control circuits can be used to expand memory to multiple 48K partitions.

A third type of memory mapping occurs only after a hardware reset. You normally do this immediately after power-up. A hardware latch unconditionally enables the on-board EPROM so that its origin lies at address 0000. This allows the first instruction fetches of the Z80 processor to access the EPROM. This latch must be reset before any RAM can be accessed. This is done automatically by any memory read to the top 2K of the memory space so that, typically, any EPROM resident software should begin with an absolute jump to an EPROM routine (see page 14, Section 5 of the User Manual).

Construction

Assembling the Little Big Board is quite straightforward. The pc board is double-sided with plated-through holes and has a solder mask both sides. The component side has component identifications silk-screened on the board. This and the accompanying component overlay will aid assembly. If you wish, IC sockets may be used throughout, otherwise they are optional, except for the EPROM, U21.

The first thing to do is familiarise yourself with the board and where all the components go. Note that all the 40-pin ICs face one way and the rest of the ICs face the opposite direction. Take note of the orientation of the SIP resistors.

If you are using IC sockets, these should be installed first. Take care to get them the right way round. Otherwise, commence with the discrete resistors. Note that R5 (adjacent to U20) is stood on end. Use a temperature controlled soldering iron with a conical-point tip of about 1-1.5 mm diameter. Don't apply more heat than necessary and make sure you have a component correctly in place before soldering as it is extremely difficult to desolder a component pin from a plated-through hole.

With the discrete resistors in place, next solder the three trimpots in. Access to VR1 can be restricted so angle it slightly so that it's towards either U35 or U36. VR2 can be similarly mounted as access to it may be partially restricted by U39 or U40. Both of these could be stood up high from the board, if you wish.

Next solder the capacitors in place, leaving the trimmer, C6, till last. Make sure you get all the tantalums in the right way round, otherwise, they're likely to go up in a quick burst of flame when you first power up!

Now the SIP resistors and the three crystals can be mounted. Make sure you get the SIP resistors correctly orientated. These can be followed by the four diodes and the UJT, Q1. Note that D5, adjacent to U37, is stood on end. Again, make sure they're orientated correctly.

The two 16-pin headers for ports A and B can be soldered in next, followed by P2, the 50-way disk drive connector.

The ICs can follow — making sure you get them the right way round (this cannot be stressed too often). Last of all, solder the lithium battery in place.

All finished? Time to *check everything thoroughly*. Look for unsoldered component pins, solder bridges between IC pins and dry joints. See also that no IC pins (or IC socket pins) have been bent under on the component side and have missed being soldered. Make sure there are no component lead wire offcuts sticking to either side of the board. Check the polarity of all tantalum capacitors and once again check the orientation of the ICs, the four diodes and Q1.

You are probably now ready to set it all up. But first, you'll need a little information on the serial ports (so you can at least attach a terminal) and the connection of disk drives.

Serial ports

Two 16-pin headers (P3 and P4) are provided for connection to the two RS232C serial interface ports. The pins of these headers have been assigned so that standard V24 type sockets can be easily wired up using flat ribbon cable and crimp-on connectors.

P3/P4 PIN #	RS232C PIN #	SIGNAL NAME	DIRECTION
1	1	Protective Ground	—
2	14	—	—
3	2	Transmitted Data	Input
4	15	—	—
5	3	Received Data	Output
6	16	—	—
7	4	Request to Send	Input
8	17	—	—
9	5	Clear to Send	Ouput
10	18	—	—
11	6	—	—
12	19	—	—
13	7	Signal Ground	—
14	20	—	—
15	8	—	—
16	21	—	—

Table 1. Serial Port connector (A — P4, B — P3) signals.

To make up the cables, first attach the 25-pin female V24 socket to one end of a length of 25-way ribbon. Identify the edge of the ribbon connected to pin #1 of the socket. Count 16 conductors from this edge and split the ribbon cable to allow the 16-pin header to be attached. Make sure that pin #1 of the header connects to pin #1 of the V24 socket. The remaining conductors should be cut short near the V24 socket. Table 1 lists the signals on the two serial port connectors.

Port A is initially configured for a 9600 baud terminal, while Port B is initially configured to drive a printer at 1200 bits/second, eight bits per character with even parity and one stop bit. The CP/M system disk has a program called "SETUP.COM" to temporarily change the communications rate of Port B if you want to attach a printer having different interface requirements.

Terminal setup

As supplied, the CP/M BIOS and PROM monitor are configured for an asynchronous serial console interface operating through Port A (P4) at 9600 bits/sec, seven bits/character, even parity and one stop bit. One supplier, at least (Altronics), has made monitor PROMs available to suit terminal communications with a Microbee.

Disk interface

The 50-way header (P2) provides a plug-compatible interface to all standard (Shugart connector) eight-inch floppy disk drives. A ribbon cable jumper connecting a 50-way header socket and up to four printed circuit card edge connectors provides all required data and control signals for the drives.

If you are making up your own cable, take care that you position the connectors in the right orientation and spacing required for your particular drives. Check the pin #1 position of all connectors (marked on the ▶

printed circuit boards) carefully before crimping the connectors to the cable. The 50-way ribbon will have a wire on one edge marked. Take this lead for pin #1 on the connectors. Do not attempt to re-use a crimp-on connector or a damaged length of ribbon cable if you make a mistake. Table 2 lists the signals carried by this cable.

PIN #	SIGNAL	PIN #	SIGNAL
2	Low Current	28	Drive Select 2
4	—	30	Drive Select 3
6	—	32	Drive Select 4
8	—	34	Direction
10	Two Sides	36	Step
12	—	38	Write Data
14	Side Select	40	Write Gate
16	—	42	Track Zero
18	Head Load	44	Write Protect
20	Index	46	Read Data
22	Ready	48	—
24	—	50	—
26	Drive Select 1		

All odd-numbered pins are signal ground.

Table 2. Floppy disk connector (P2) signals.

Cheap terminal or a CP/M 'Bee? If you have a Microbee you can use it as a terminal for the ETI-690 Little Big Board. The Microbee with Network ROM will act as a terminal (just type 'T'), communicating at 1200 baud. That's slow by some terminals' standards, but it works well and is low cost. Then again, if you have a 'Bee and hanker after CP/M and the software world it opens up to you, the Little Big Board offers a low cost solution using you 'Bee as a terminal. What's more, you get to keep your existing software base.

The disk drive shown here is a Mitsubishi M2896, courtesy of Nexus who distribute them. The Little Big Board is mounted in an STD card cage from Pro-Log. (Somebody plugged the 50-way disk interface cable in the wrong way up — a point to watch). The Microbee plugs into Port A on the ETI-690 from the 'Bee's RS232 interface. See Table 2 for interface connections.

Power supply

The Little Big Board needs three power supply rails to STD buss specifications:

Vcc +5 V (± 5%) at 850 mA
Aux.+ +12 V (± 5%) at 60 mA
Aux.− −12 V (± 5%) at 60 mA

The ETI-166d power supply (August '83) issue, page 89) will do the job (. . . just) using the popular '6672' 30 V/1 A transformer. Three, three-terminal regulators are used, one 7805, a 7812 and a 7912. The 7805 should be mounted on a reasonably large heatsink as it will be called upon to dissipate up to 14 watts. You can mount it off the pc board but the leads should be no longer than about 50 mm.

Setup routine

For this you'll need a dc voltmeter, a frequency counter that can read to 4 MHz and a CRO that has a timebase speed reaching 100 ns/cm. If you have a CRO, it's possible to dispense with the counter. If you haven't a CRO or a counter it's possible to 'fly blind', but you'll need that dc voltmeter.

I will assume you have a 56-pin edge connector socket and a suitable power supply. Connect a momentary-action pushbutton between pins 4 and 48. This will be your reset button. The monitor EPROM (U21 — marked MP7A) should be inserted in its socket.

Your terminal (with attached VDU) needs to be set up for communications at 9600 bits/second, even parity with one stop bit. Check that pin 4 of its RS232 connector (RTS) is high. If you're using a Microbee as a terminal you'll need the appropriate monitor EPROM to suit its communications format.

Connect up the terminal and the Little Big Board's power supply and power up. Press the reset button and

--- L.B.B. MONITOR Version 7 (MP7) ---

should appear on the VDU screen. If not, check supply voltages at the board edge connector and then on various IC pins to see that power is being distributed around the board. A fault at this stage is usually caused by missed solder joints, dry joints or incorrect component orientation.

If all is well, you can carry out a memory test. The monitor will prompt you with a '*' and waits for you to enter a command. You have twelve commands at your disposal. Section 7 of the User's Manual explains them. You can perform a memory test by simply typing T followed by a start address, a comma and a finish address; like so:

TØØØØ,1ØØØ

A 'random' test pattern is stored and then verified. A period is displayed after each pass. You'll get a message if an error is detected. The test will repeat until you hit a return key.

You can test Port B using a monitor command, also. Type P1. This switches the terminal (or console) drive to Port B. Reconnect the terminal to Port B and try the memory test again to see that it's functional. To go back to Port A, either type PØ or press the reset button.

Now you can set up the floppy disk controller, if you have a disk drive. First set up your disk drive jumpers according to Section 3 of the User's Manual and referring to the documentation supplied with your drive. *Don't* plug in your disk drive yet.

With the Little Big Board powered up and the dc voltmeter connected to Test Point 3 (TP3, between U39 and U41), adjust VR3 to get a reading of +1.4 volts. This sets up the phase-locked loop lock range.

The VCO idle frequency is adjusted next. Set VR2 to the middle of its range. If you have neither a CRO or frequency counter this should be good enough as the PLL has a good lock range. If you have a CRO or counter though, connect the input to Test Point 1 (TP1, same area as TP3) and adjust VR2 so that you get 4 MHz here.

Power down and plug in the disk drive, Make *double sure* you get the 50-way cable the right way round. Power up and type B to boot the disk drive (only one drive should be selected). Insert the CP/M Systems Disk. Run the "SETTERM" program (see Section 6 of the User's Manual). When ready, run the "FORMAT" program, selecting drive A. Take out the System Disk, insert a blank disk and type N to get a menu of options. FORMAT writes to and reads back from tracks 0, 43, 44 and 70 on the disk. Connect your CRO to Test Point 2 and adjust VR1 so that you get a 150 ns pulse (this is the precompensation applied to tracks greater than 43). If you're 'flying blind' without a CRO, set VR1 to get 5.1 volts on pin 17 of U36 (the WD2143). This will put the pulse width on TP2 between 100 and 200 ns. You can then adjust it while running the FORMAT program to get no "read error" messages.

Alternatively, you could run "COPY.COM" and do these adjustments.

Setting the real-time clock

This is pretty simple. There's a program on the CP/M system disk called "CTEST.COM". Using this you can set the day/month/year and the time of day in hours, minutes and seconds.

Backup

In the unfortunate event that you cannot get your Little Big Board to perform satisfactorily, Pulsar Electronics will supply a "fixit" service. This works as follows: securely pack your Little Big Board, enclosing a cheque or money order for $50 made out to "Pulsar Electronics Pty Ltd" and send it to **Pulsar Electronics, L.B.B. Fixit, Lot 2, Melrose Drive, Tullamarine 3043 Vic**. They will get your project going and return it to you. However, they advise that they will have to charge for replacing 'dead' or incorrectly inserted components.

If you've always wanted your own 'proper' computer now there's no excuse.▶

LITERATURE

Apart from those books already mentioned in the text, the following data books provide a wealth of information on devices used in the ETI-690 Little Big Board. You will have to shop around for the data books, some are plentiful, others hard to get.

1. Zilog Data Book. Zilog Corporation. Data sheets on the Z80A and Z80A DART.

2. Mitsubishi Data Book (LSI). Mitsubishi Electric (distributed by Nexus). Data on the 4164 dynamic RAMS, 2716 EPROM and 8255 PPI chip. The Intel *8086 Family User's Manual* has data on the 8255 and 2716 also, and Fairchild's *MOS Memory Data Book* has data on the 4164s.

3. Western Digital Components Handbook. Western Digital Corporation (distributed by Daneva Australia). Data on the FD1797-02 floppy disk controller, WD1691V floppy support logic (FSL) and WD2143M-03 four-phase clock. For the BR1941 dual baud rate clock chip, get Western Digital's *Network Products Handbook*.

4. Signetics TTL Data Manual. Signetics Corporation. This contains data on the 74XX series TTL devices plus the 74S and 74LS series devices. However, Texas Instruments and Motorola also have data books covering these device series'.

5. National Semiconductor Interface Databook. National Semiconductor Corporation (distributed by N.S.D.). You'll find data in here on the 1488 and 1489 RS232 line driver ICs. Motorola has also published data on these as they, too, manufacture them.

The real time clock chip (MSM5832) is an OKI device, distributed by VSI, but data is scarce.

The following books are useful reference works for those who want to get 'right into' the system. All are available from **ETI Book Sales, P.O. Box 227, Waterloo NSW 2017.** Post and handling on any item is $2.75. Quote the book no. when ordering. They are not listed in any particular order.

6. Programming the Z80; Rodney Zaks. The legendary reference work. This 624 page tome covers the architecture, instruction set, programming and interfacing of the Z80 in six lengthy chapters with seven appendixes. K0231A $19.95.

7. Z80 Microprocessor Programming and Interfacing Book 1 and Book 2; Nichols, Nichols and Rony. These two books provide a thorough treatment of the subject, covering the Z80 architecture, instruction set and programming, including its use with the PIO and CTC. Over 20 chapters and nearly 800 pages in the two books. Book 1 J0350P $10.95, Book 2 J0351P $12.95.

8. Z80 User's Manual; Joseph J. Carr. This well-written book covers the Z80 in 17 chapters and would be a useful 'dip into' reference manual. J0331P $13.25.

9. The Z80 Microcomputer Handbook; William J. Barden. A well-known work, this book covers Z80 basics and gives some examples with hardware descriptions. 18 chapters, six appendixes, 304 pages. J0171P $19.50.

10. A Z80 Workshop Manual; E. A. Parr. This little book is exactly what it says it is. Concisely written for quick reference. Some interfacing details are also given. It has six chapters plus limited data. J0283B $8.95.

11. Microprocessor Interfacing with the 8255 PPI; Paul F. Goldsborough. This book provides a thorough coverage of the operation and use of the 8255 programmable peripheral interface device. 217 pages. J0326P $12.35.

TABLE 3 PULSAR CP/M DISTRIBUTION DISK FILES

MOVCPM.COM	Configures and leaves in memory an nK version of CP/M relocated for a specific memory size.
PIP.COM	Copies, combines and transfers files.
SUBMIT.COM	Starts execution of a file of CP/M commands.
XSUB.COM	Used with submit files to accept input from command lines.
ED.COM	CP/M line editor.
ASM.COM	Assembles assembly language statements producing an output file in Intel hexadecimal format.
DDT.COM	8080 debugger.
LOAD.COM	Produces a "COM" file from a "HEX" file.
STAT.COM	Returns information about files, disc drives and other peripheral devices.
DUMP.COM	Dumps a file in hex onto terminal memory location.
DUMP.ASM	Demonstrate, assembler.
CTEST.COM	Clock test and setup programme.
CTEST.SRC	Source of CTEST.
TERMMENU.SRC	Source, Pulsar terminal menu.
BIOS.ASM	Example BIOS.
BOOT.ASM	Example Boot.
DEBLOCK.ASM	Disk deblock algorithm.
DISKDEF.LIB	Macro library for disk table.
CPM22.DOC	CP/M documentation.
SYSGEN.COM	Copies operating system on system tracks.
SETTERM.COM	Setup of terminal for Pulsar utilities.
SETTERM.SRC	Source code.
LB28A.MAC	BIOS source.
FORMAT.COM	Drive select format program.
FORMAT.SRC	Source code.
FORMAT3.COM	Side select format program.
FORMAT3.MAC	Source code.
SETBOOT.COM	Set sign-on, rate & word length of serial ports.
SETBOOT.SRC	Source code.
GETTIM.MAC	Sample assembly language program to read clock chip.
BC.BAS	Sample BASIC program which uses GETTIM call to read clock chip.
BC.COM	Compiled sample program with GETTIM linked in.
READ.ME	User manual.
NOTES	Notes on how to recompile Pulsar BIOS.
DATE.COM	Program to read clock chip and place result in DATE .DAT file.
SYSDECS.LIB	System declarations.
COPY.COM	Disk or track copier.
COPY.SRC	Source code.
SETUP.COM	To temporarily change rate of printer port.
LBOOT6.MAC	Pulsar Boot PROM source.
AUTOBOOT.COM	Automatic execution of CP/M command line.
AUTOBOOT.SRC	Source.
LBLDRIO.MAC	Little Big Board loader.
DGEN61.SUB	Submit file for compiling Pulsar BIOS. (61K System).
DGEN62.SUB	(62K System).
VERF.COM	Disk verifier.
VERF.SRC	Source.
DCTBIOS.MAC	Direct BIOS calls.
EXBDOS.MAC	Extended BDOS calls.
DSKT1	Disk test. Writes to and reads back from tracks 0 43, 44 and 70of a disk.

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B0019B *$2.75*
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WALL CHART — RADIO, ELECTRONICS, SEMI-CONDUCTORS AND LOGIC SYMBOLS
B0020B *$1.95*
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B0021B *$1.75*
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amateur radio, dx communications

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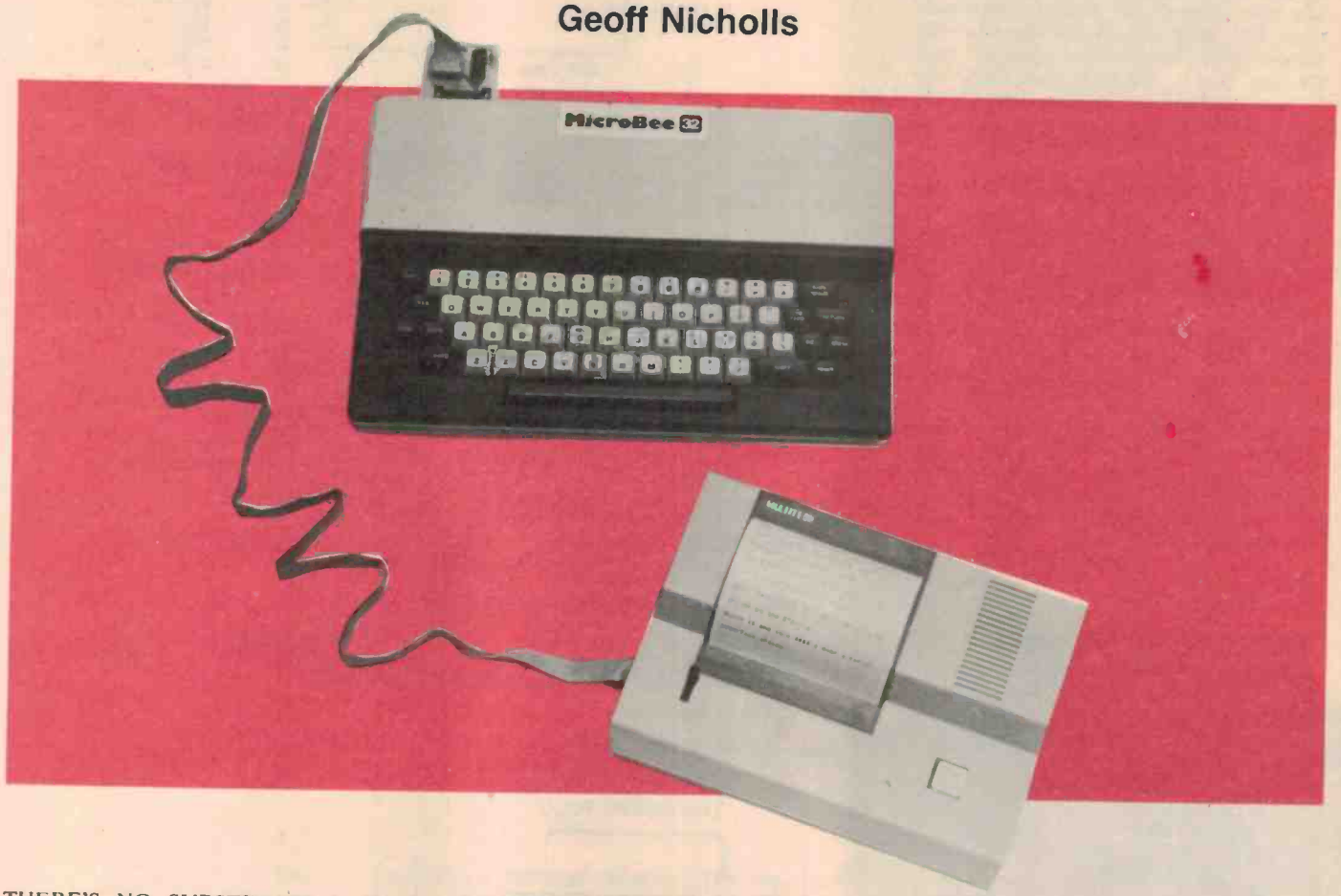
BS0132

Parallel printer interface for the Microbee

Nick-named "the 'Bee pee interface", this project allows you to connect your Microbee to a printer having a 'parallel' or 'Centronics' input. It's simple to build and low in cost.

Geoff Nicholls



THERE'S NO SUBSTITUTE for hard copy from a computer in a myriad of situations and applications, but I don't really have to tell you that. There's no doubt that the most cost-effective way to provide hard copy from your Microbee is to buy an old teletype, rig up an interface for it and do some software jiggery-pokery to convert the 'Bee's ASCII output to Baudot. But that's all explained in Project 672 elsewhere in this issue! However, if your desires and budget stretch to a 'real' printer, then here's how to do it.

The Microbee's parallel port won't drive a parallel interface printer directly. The 'Bee's parallel port is 'driven' by a Z80 PIO. To signal a peripheral attached to the port that the data's ready and waiting, the PIO puts a 'strobe' signal on pin 2. Trouble is, the STROBE pulse is generally too short. Simple solution? — stretch it! In addition, most parallel interface printers generate an 'acknowledge' signal to let your computer know that it's "busy". The 'Bee's PIO needs an appropriate-length pulse to know that, so I've taken care of that, too.

Next problem is the price of printers. Good quality 80-column dot-matrix printers have recently plummeted in price and can now be obtained for under $500. If that's what you're after, fine, shop around. If, like quite a few readers, you like to (or is that *have to*?) watch your spare cash but really want a dot matrix printer, then finding something gets a little harder.

Back in May we reviewed the Multitech MPF-II computer. With it came a 40-column dot matrix printer. I looked closely at the price and its capabilities. Apart from a comprehensive character set, it included graphics capabilities. Hmmm. At around $230 retail (inc. tax), it represents very good value for money. While 80-column printout is desirable, I found 40-column printout is no real drawback, especially at that sort of price. The MPF-II Printer is imported and distributed by Emona Enterprises, Suite 204/661 George St, Sydney NSW 2000. (02)212-4815. They have distributors in all states.

While the construction here specifically relates to this printer, the interface will work equally well with 80-column printers.

(*Note:* The MPF-II printer input circuitry is CMOS and the usual care should be taken to avoid damage.) ▶

Project 671

Construction

There's not much to building this one. Start with the right-angle plug, mounting it on the component side as in the photo. It is better to drill the mounting holes and screw the plug to the board before soldering, to relieve stress on the pins.

I used a socket for the IC, and recommend that you do too. The resistors and capacitors are not polarised and may be assembled in any order.

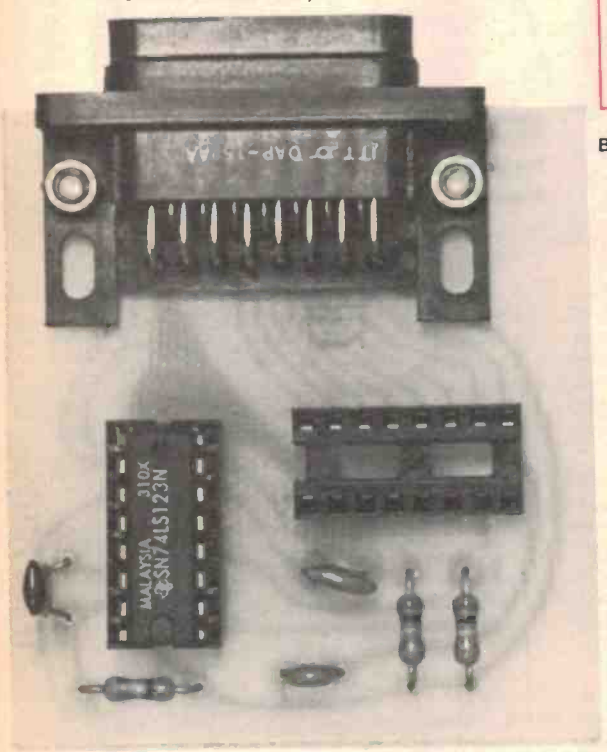
Connecting the printer

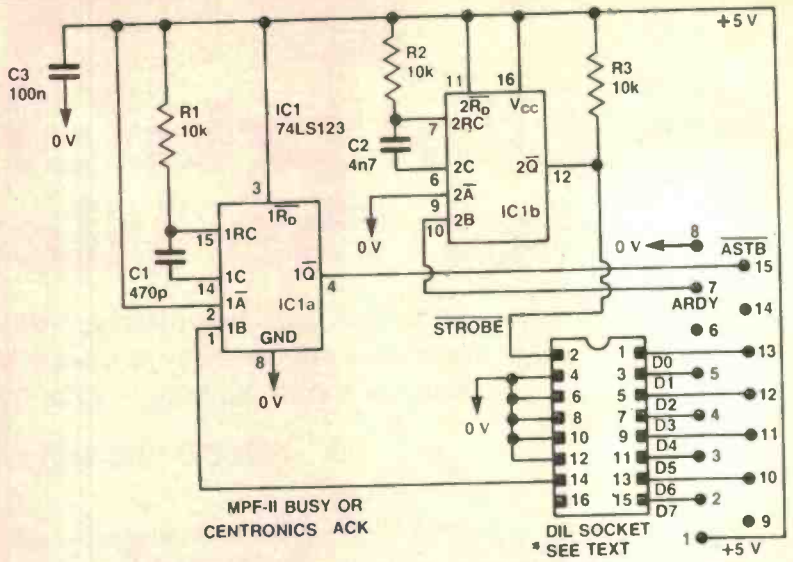
If you are using a MPF-II printer, then you should use 16-way ribbon cable supplied with the printer. An insulation displacement DIL plug will fit directly onto the ribbon. *Note:* I have utilised a 'reverse' type ID plug, that is, the first conductor in the cable connects to pin 16 of the DIL socket. The plug type I used was an Ansley 609-M165H. Check carefully that the plug you use has the same pinout.

The circuit diagram shows how the cable conductors connect to the DIL socket. The numbers shown refer to the cable, starting at the end with the blue stripe as No. 1. The socket is shown as viewed from above. For example, the No. 1 conductor connects to pin 16 of the socket, the No. 2 conductor connects to pin 1 of the socket, etc.

If you are using a Centronics printer, you cannot simply attach an ID plug to the Centronics' cable. The most straightforward solution would be to use a DIL header plug, and strip and solder the wires one by one. The accompanying table shows the relation between the DIL pinouts, the MPF-II cable and the Centronics signals.

(*Note:* The MPF-II BUSY signal corresponds to the Centronics ACKNOWLEDGE.) ▶





Circuit. Simple, huh? The numbers shown in the DIL socket refer to the wire numbers in the MPF II printer ribbon cable, viewed looking down on the DIL socket. The DB15 plug numbering refers to the pins when viewed from the front of the plug (pin 1 uppermost).

HOW IT WORKS ETI-671

The circuit interfaces a Z-80 PIO port to a MPF-II printer. It is also suitable for use with a Centronics style printer.

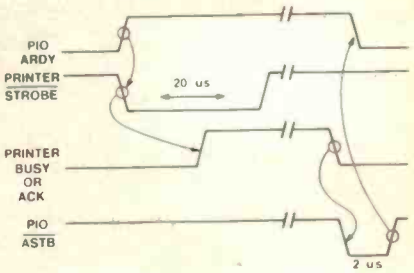
The timing diagram for the interface is shown in Figure 1.

The PIO ARDY line goes high to signify that a byte is available at the port lines D0-D7 of port A. This triggers Monostable 2 to generate an active low pulse of about 20 µs which signals the printer to accept the byte. The printer will raise the BUSY line while it is processing the byte, or printing a line.

Note that BUSY on the MPF-II is ACKNOWLEDGE for a Centronics printer.

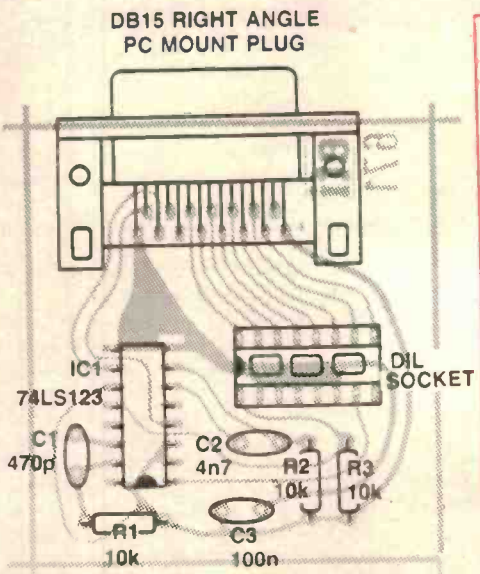
When the printer is ready for more data it lowers the BUSY line thus triggering Monostable 1 and generating an active low pulse of about 2 µs, the rising edge of which terminates the ARDY signal.

These pulse lengths are for the MPF-II. If your printer requires other pulse lengths, change C1 and/or C2 according to the formula $t = 4000 \times C$ where t is in seconds, C is in Farads.



This is only an approximate formula, but should be within 20% or so of the actual pulse length.

Below. Full size pc board artwork.



PARTS LIST — ETI-671

Resistors ..... all ¼ W, 5% unless noted

R1, R2, R3 ..... 10k

Capacitors

C1 ..... 470p ceramic
C2 ..... 4n7 greencap
C3 ..... 100n ceramic bypass

Semiconductors

IC1 ..... 74LS123

Miscellaneous

ETI-671 pc board; 16-pin IC socket; either an Ansley 609-M165H insulation displacement plug or a 16-pin DIL header; DB15 right angle pc mounting plug; two 6BA ¼" screws and nuts; cable to suit printer.

Estimated cost: $10-$12

(not inc. printer plug & cable)

bankcard

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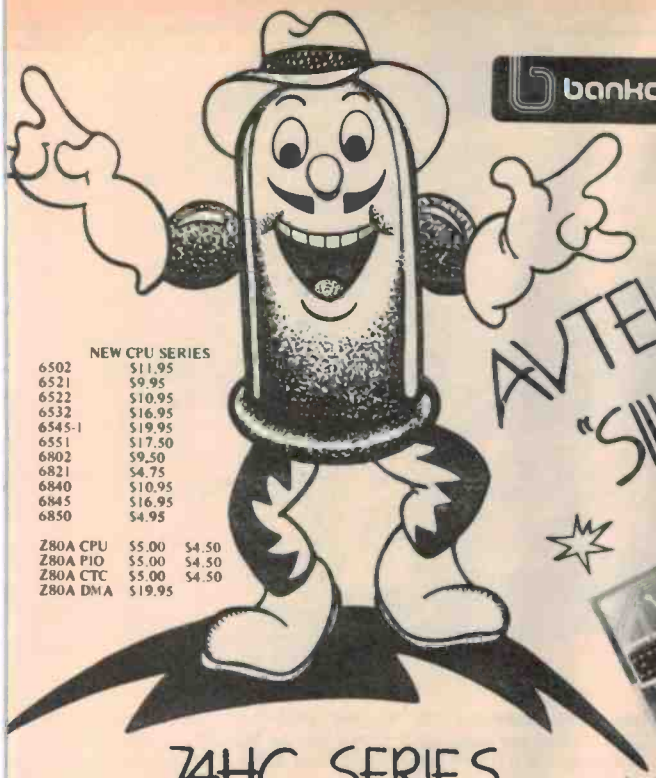

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A NEW KIT MICROBEE

MULTIPROM INTERFACE BOARD ONLY $99

The Multiprom board is an extension of the Microbees memory in ROM. It simply plugs into the fifty way bus expansion port on the core board. It fits either neatly inside the Microbee or behind it, using the Microbee's own power supply.

The board takes the EDASM and NET eprom normally residing inside the Microbee, but allows several different sets to fit in: Editor-Assembler, Wordbee, Logo, MiniPascal, Networkrom, Bemon or your own program. It has room for 4 sets of eproms in the EDASM location and 3 sets of eproms in the NET location, a total of 44K of eprom. The board can be simply daisy chained with up to 6 slave boards (using an outside power supply in this case), allowing a maximum total of 308K in ROM. The EDASM locations accept either type 2532 or 2764 eproms and they can be mixed. Another powerful feature of the board is the Input/output system. 11 outputs, open collector transistor driven. Each can turn ON or OFF a relay under program control. 8 inputs, buffered and protected can read 8 switch status – ideal for computer controlling of model trains, alarm systems, tape recorders, machinery etc.

The Avtek kit includes a plated through board plus all components to make this exciting project. There is also provision on the board to change the address of the ports used for eprom selection and input/output.

74HC SERIES

WHAT IS THE 74HC CMOS SERIES?

74HC CMOS is a family of High Speed SSI MSI logic components. High speed logic circuits have historically been the domain of bipolar circuits, namely TTL and ECL. However due to improved processing, CMOS technology is now capable of speeds similar to low power Schottky TTL logic, whilst still retaining the advantages of the CD 4000B and MM74C series circuits. The MM74C family characteristics have been standardized to ensure compatibility within the family and ease designing with these devices. The overall family concept has been to provide a series of CMOS circuits which retain the input noise immunity and low power consumption of metal gate CMOS, but offer a *ten fold increase in speed*. The MM 74C series logic is intended to be a "self sufficient" family. That is, an entire set of logic functions are provided such that the designer can develop his family entirely of "HC" components. These devices are *pin out and functionally compatible to LS-TTL circuits*, which enables the TTL designer to easily make the transition to CMOS.

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74HC139	$1.99	$1.85
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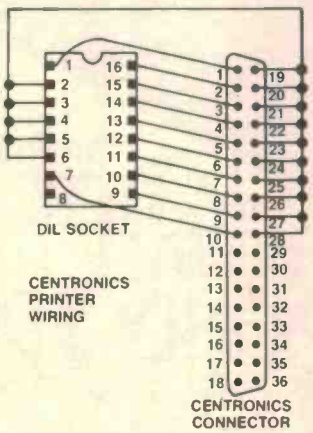
Using the printer

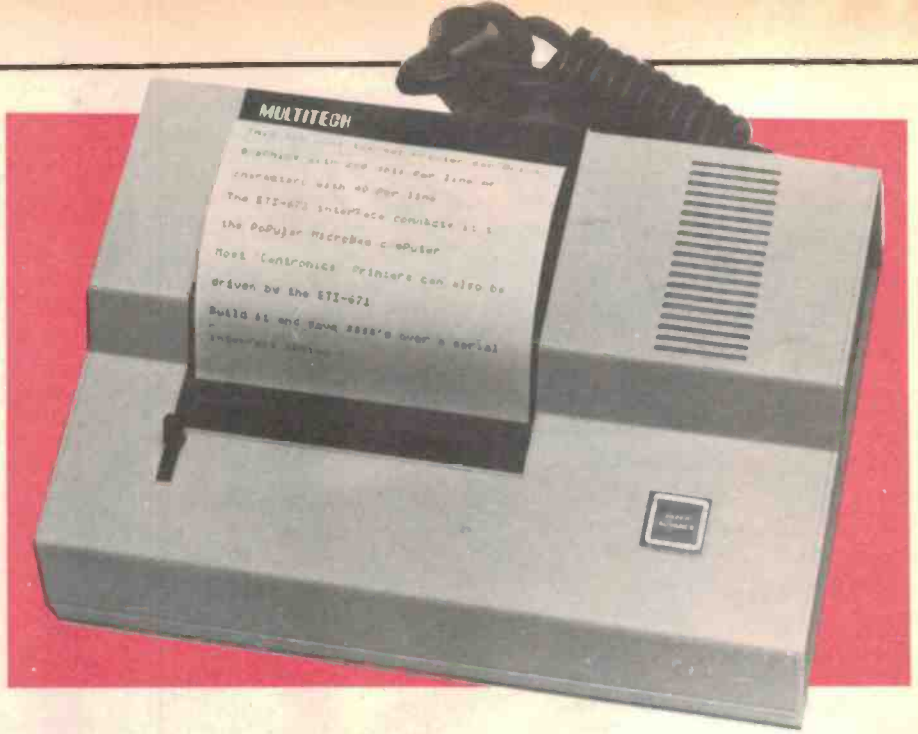
To call the printer from BASIC, it is first necessary to use the output redirection command to tell the Microbee that a parallel printer is connected. There are two ways to do this. The printer can be the *list* device or the *output* device (or both). To set up the printer as the list device, which means any program LLIST commands will output to the printer, type the following:

OUTL#1.

To make the printer an output device, which means it will print anything that normally appears on the VDU screen, type the following:

OUT#1 ON.



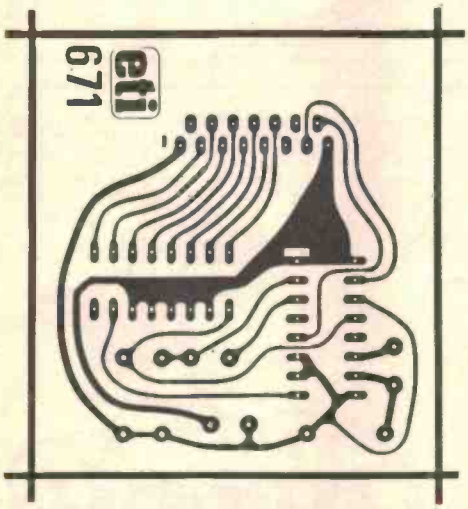


Fine print. The message reads: "This low cost thermal printer can print graphics with 280 dots per line or characters with 40 per line. The ETI-671 interface connects it to the popular MicroBee computer. Most "Centronics" printers can also be driven by the ETI-671. Build it and save $$$$s over a serial interface option!"

The printer will not begin printing until it either receives a carriage return code or fills up the 40-character line buffer. To send a carriage return to the printer when it is an output device, insert the following:

PRINT " " or PRINT CHR(13);.

Most parallel printers automatically carry out a line feed upon receiving a carriage return. The Microbee normally sends both a carriage return and line feed, so double spacing will result in program listing, etc. Applied Technology has supplied a program to overcome this problem; it is reproduced elsewhere in this article. The program needs to be run everytime a cold start is executed, but may be deleted once it is run. ●



Pin connection table

DIL socket pin Nos	MPF-II printer cable Nos	Centronics connector Nos	Signal name
1	2	1	STROBE
2	4	19,20	GND
3	6	21,22	GND
4	8	23,24	GND
5	10	25,26	GND
6	12	27,28	GND
7	14	10	BUSY(MPF-II), ACK (CENTRONICS)
8	16	N/C	not used
9	15	9	D7
10	13	8	D6
11	11	7	D5
12	9	6	D4
13	7	5	D3
14	5	4	D2
15	3	3	D1
16	1	2	D0

```
00100 REM- Program to Print the MPF-II
00110 REM- standard character set
00120 REM
00130 REM- OutPut device=Parallel Port
00140 OUT#1
00150 FOR N=32 TO 255
00160 PRINT CHR(N);
00170 NEXT N
00180 PRINT CHR(13)
00190 REM- OutPut device=VDU
00200 OUT#0
```

```
00100 REM- MicroBee Program to remove
00110 REM- LineFeed character from the
00120 REM- list outPut stream.
00130 DATA 254,10,200,195,248,181
00140 RESTORE 130
00150 FOR I=328 TO 333
00160 READ A : POKE I,A
00170 NEXT I
00180 POKE 180,72:POKE 181,1
 !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFG
HIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmno
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```

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Y 1012	4.0000 mHz	Parallel	5.00	4.50
Y 1015	4.1940 mHz	Parallel	5.00	4.50
Y 1017	5.0000 mHz	Parallel	5.00	4.50
Y 1018	6.0000 mHz	Series	5.00	4.50
Y 1019	8.0000 mHz	Series	5.00	4.50
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Sensitivity	5mV/div to 5V/div (1-2-5 sequence), 10 calibrated steps; 1mV/div to 1V/div (-6%) (When using ×5 amplifier); Uncalibrated continuous control between steps 1 and 2.5 (provided with click positioning function)
Bandwidth	DC to 15MHz, -3dB (at 4div); DC to 7MHz, -3dB (at 4div) (When using ×5 amplifier)
Rise time	24ns. (for ×5) 70ns typ.
Signal delay line	
Max. input voltage	600Vp-p or 300V (DC + AC peak) at 1kHz
Input Coupling	AC, GND, DC
Input impedance	Direct 1M ohm, approx. 30pF
Operating modes	CH1, CH2, DUAL, ADD, DIFF
X-Y operation	CH1 X axis, CH2 Y axis
Sensitivity	5mV/div to 5V/div (when using ×5 amplifier, 1mV/div)
Phase difference	DC to 10kHz within 3°
X bandwidth	DC to 500kHz, -3dB
Dynamic range	4div or more
CH1 output	
Output voltage	20mV/div or more (terminated into 50Ω)
Band width	50Hz to 5MHz, -3dB
Output impedance	Approx. 50Ω

• Horizontal deflection	
Trigger modes	AUTO, NORM, TV (-2, TV (-)
Trigger source	CH1, CH2, LINE, EXT
Trigger coupling	AC
TV sync	TV sync-separation circuit
Internal	1div or more (V sync-signal)
External	1Vp-p or more (V sync-signal)
Trigger sensitivity	Frequency / Internal / External: 20Hz to 2MHz / 0.5div / 200mV; 2 to 15MHz / 1.5div / 600mV
AUTO low bandwidth	30Hz
Trigger slope	+ -
External trigger input	Input impedance approx. 1M ohm, 30pF or less; Max. input voltage 100V (DC + AC peak, at 1kHz)
Sweep time	0.2us/div to 0.2s/div ±5%, 19 calibrated steps; Uncalibrated continuous control between steps 1 and 2.5 (provided with click positioning function)
Sweep time magnifier	10 times (±7%)
Max. sweep time	100ns/div (20ns/div and 50ns/div, not calibrated)
• Amplitude calibrator	
Waveform	Approx. 1kHz ±10% (typ), square wave
Voltage	0.5V ±5%
• Power requirements	100/120/220/240V ±10% 50 to 60Hz, approx. 40W
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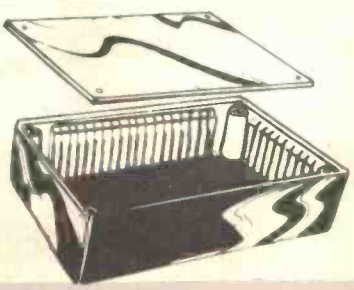
H 0105	83 x 54 x 28	50	47	**$1.20**



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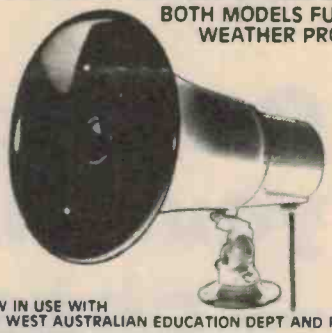

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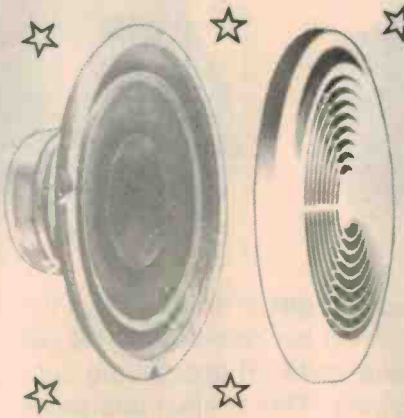

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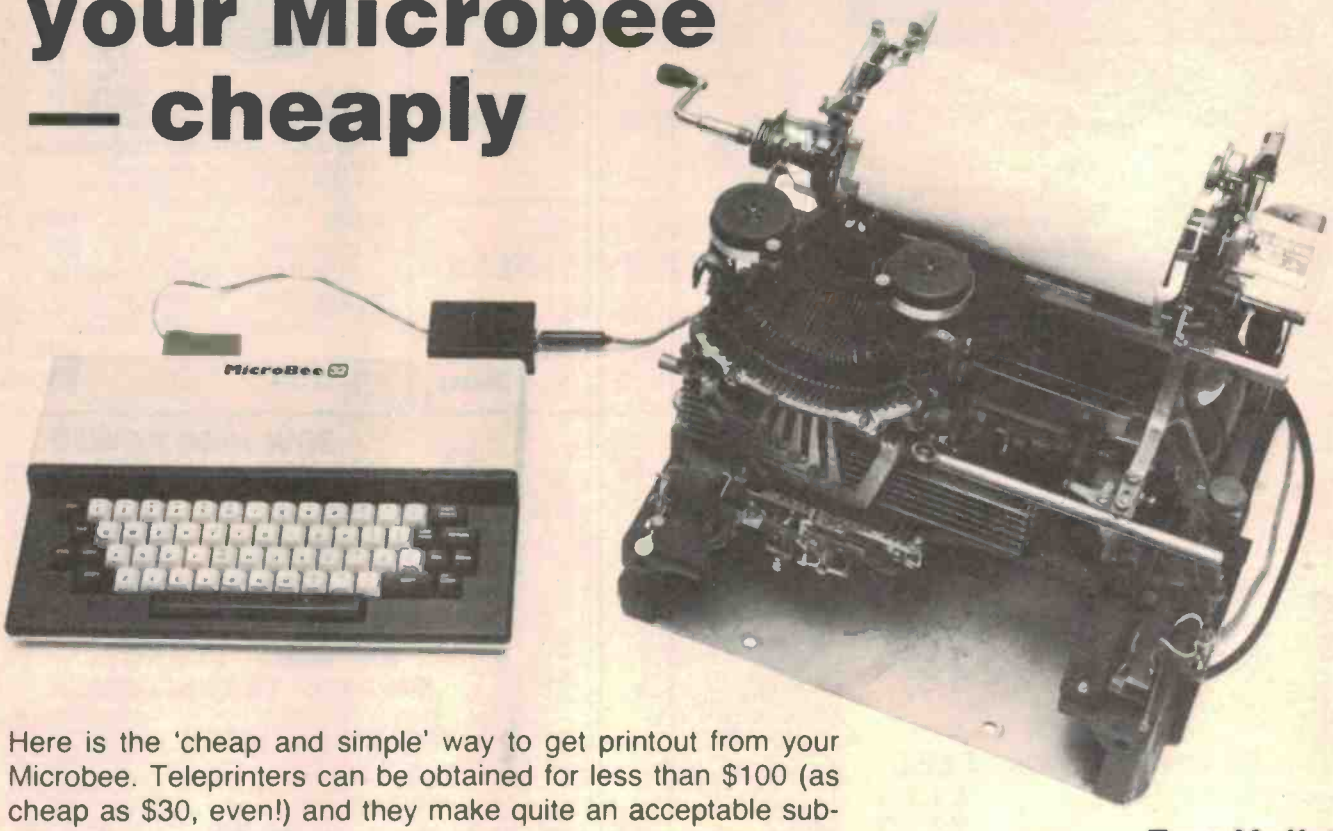
Getting hard copy from your Microbee — cheaply



Here is the 'cheap and simple' way to get printout from your Microbee. Teleprinters can be obtained for less than $100 (as cheap as $30, even!) and they make quite an acceptable substitute if you can't afford a 'real' printer. This project interfaces your Microbee to a teleprinter.

Tom Moffat
39 Pillinger Drive, Fern Tree, Tas. 7101

YOU MAY RECALL that some of the early Microbee programs in ETI were originally printed out on an old 50 baud teleprinter. This worked well for assembly langauge programs, but there were a few problems when BASIC was being printed. One program even had to be published a second time with a proper ASCII printout because people couldn't make much sense of the first version. The trouble is the Baudot character set . . . some of those special characters such as "*" and "#" just don't exist. But even with all the troubles, I still keep getting letters and phone calls asking "how'd you do it?"

I did it, originally, with a second computer, a small 6800-based machine. The machine code program took in ASCII material at 1200 bauds and translated it to Baudot code which was sent to the printer at 50 bauds. The data was transferred a line at a time, and then the Microbee was forced to wait while the other computer drove the teleprinter. The system looked like any 1200 baud printer to the 'Bee, and the signals came out of the second computer as audio tones which were decoded with an ETI-730 radioteletype converter (August '79). Nothing had to be modified, everything just plugged together, but it was messy. Now, due to all that popular demand, here's a teletype machine driver system that's internal to the Microbee.

Using the 50-baud printing system described here is simplicity itself. All you do is play a tape into the 'Bee and from then on anything that would have come out the RS232 port as 1200 baud ASCII comes out as 50 baud Baudot instead. A small interface circuit then converts the RS232 data levels to high voltage drive for the teleprinter. Because of the Microbee's battery backup system, the 50 baud routine remains in force until you cold-start the BASIC. That re-initializes the 1200 baud routine, which stays in force until you re-load the tape. By the way, a tape of the software (reproduced later) is available from the author, post paid, for $12 if you're too lazy, ham-fisted or lacking in confidence to key it in yourself.

How I did it

The signals at the 'Bee's RS232 port are 0 V for mark and +10 V or thereabouts for space. Not quite RS232 standard, but it seems to drive printers all right. The signals are upside-down for teletype, and of the wrong voltage. The circuit shown in Figure 1 will take care of this. I built a prototype to fit inside a standard RS232 (25-pin) plug shell of the Cannon variety (the big black one). The circuit board for this was 709.68 millimetres square (or just over one square inch, to be less metric about it). As this would provide some difficulties for the aver-

age constructor, the final prototype was built on a somewhat larger board and housed in a small jiffy box.

You may notice that the design is very similar to the rear end of the ETI-730 teletype converter. If fact, if you have one of these converters you can use it instead by removing the link between R26 and R27 and feeding signals from the 'Bee's RS232 port into the driver transistor (Q2) for the loop switch at the 'free' end of R27.

Once again, the loop circuit is a direct pinch from the ETI-730 project, and if you have a loop power supply already, use it. Otherwise, you can build one up from a disused transformer, some diodes, and a filter capacitor. Perhaps you can fit it in the teleprinter's case.

Software

The first part of the program, up to line 200, fools the Microbee into thinking it's got a 1200 baud printer connected. This is the only part of the program that actually runs; it substitutes a jump address to "TTYPRT" for the jump address to the 1200 baud routine stored in ROM. The 1200 baud routine is the one the Microbee always defaults to. It's what you get when you use LPRINT or specify OUT#5. It's also the routine the editor/assembler calls for any printing operations.

The rest of the TTYPRT program, from line 230 onwards, is just one big subroutine. The character to be printed is in the Z80's accumulator when the print routine is called. The character is first inspected to see if it's a carriage return, a line feed, or a form feed. Carriage return and line feed are translated directly, as is, but form feed causes 10 line feeds to be generated. The editor/assembler sends form feeds to break up its output into pages.

Any control codes other than the ones mentioned above are thrown away. Lower case characters are converted to upper case and the character, now with a value between 0 and 3F (hex), specifies a certain entry within the look-up table starting at line 800. Each byte in the table contains the five bits of a Baudot character in its five left-most bits. The right-most bit is an indicator ▶

TELEPRINTERS

Frederick George Creed (1871-1957), a native of Nova Scotia, is credited with being the pioneer of the teleprinter which he adapted from a Barlock typewriter, producing his first prototype in a shed he rented for 5s in Glasgow in 1897. He retained this as a mascot for the rest of his life. Creed's first instruments actually put Morse Code on a punched paper tape but this new technology was not accepted as it was much quicker than existing Morse-encoding machines and threatened to replace the many trained operators of the day.

One Charles Krumm produced a 'teletype' machine in 1907, but it was the UK Morkrum Company who successfully developed one independently and introduced it in the early 1920s. The German Siemens-Halske company also developed a machine at this time. These machines employed a then-new encoding system developed by Jean Maurice Baudot and Donald Murray (a New Zealand farmer). The 'Baudot' code, as it is now known, is a five-unit code and requires synchronous transmission and reception (See ETI, April, '83, RTTY-Computer Decoder, Figure 1, page 80).

Creed was a strongly religious man and resigned the chairmanship of his own company in 1930 at the age of 59 because his employees insisted on playing sport on the Sabbath. He continued his interest in inventions, however, a more 'colourful' one being his permanent hair dye, only ever applied once, on his own beard, which turned an indelible rainbow pattern!

Secondhand ex-government and commercial service teleprinters of various makes can be had for quite cheap prices in most Australian states. The most common ones available are the Teletype Corp. Model 15 and Siemens Model 100, although Creed Model 7s can still be found. Scanning through Mini-Mart in recent issues of ETI shows you can pick up model 15s for $50 or less and Siemens Model 100s for between $50 and $100. Both these machines can come with or without a keyboard, the latter being the cheaper. For computer printout purposes, a keyboard is not necessary.

They can also be found in 'surplus' electronics shops. Shop around, advertise in Mini-Mart *(it's free!)*, you should not have too much difficulty finding one.

```
ADDR    CODE      LINE   LABEL   MNEM    OPERAND

                  00100 ,MICROBEE TO 50 BAUD TELETYPE PRINT ROUTINE...
                  00110 ,REPLACES 1200 BAUD SERIAL ROUTINE (OUTL@5).
                  00120 ,       - TOM MOFFAT, 31/7/83
                  00130
0400              00140         DEFR    16
014D              00150         ORG     014DH
014D 215701       00160         LD      HL,TTYPRT
0150 22BC00       00170         LD      (0BCH),HL,SUBSTITUTE JUMP ADDRESS
0153 2AA200       00180         LD      HL,(0A2)
0156 E9           00190         JP      (HL)
                  00200
                  00210 ,START OF ASCII TO BAUDOT CONVERSION, ASCII IN A.
                  00220
0157 0601         00230 TTYPRT  LD      B,1       ,PRINT ONCE
0159 0E10         00240         LD      C,10      ,TTY (CR) CHARACTER
015B FE0D         00250         CP      0DH       ,ASCII RETURN
015D 280C         00260         JR      Z,REPT
015F 0E40         00270         LD      C,40      ,TTY (LF) CHARACTER
0161 FE0A         00280         CP      0AH       ,ASCII LINE FEED
0163 282F         00290         JR      Z,PRINT
0165 060A         00300         LD      B,0AH     ,TEN LINE FEEDS
0167 FE0C         00310         CP      0CH       ,ASCII FORM FEED
0169 2005         00320         JR      NZ,KILL
016B CD9401       00330 REPT    CALL    PRINT
016E 10FB         00340         DJNZ    REPT
0170 D620         00350 KILL    SUB     20        ,KILL CONTROL CODES
0172 D8           00360         RET     C
0173 FE40         00370         CP      40        ,LOWER CASE?
0175 30F9         00380         JR      NC,KILL   ,THEN SUBTRACT 20 AGAIN
0177 21BF01       00390         LD      HL,TABLE
017A 85           00400         ADD     A,L
017B 6F           00410         LD      L,A
017C 3AFF01       00420         LD      A,(FLAG),FIGS/LTRS FLAG
017F 4F           00430         LD      C,A
0180 7E           00440         LD      A,(HL)    ,TTY CHARACTER
0181 E601         00450         AND     1         ,ISOLATE F/L FLAG BIT
0183 B9           00460         CP      C         ,COMPARE PREVIOUS FLAG
0184 280D         00470         JR      Z,PRINT-1
0186 32FF01       00480         LD      (FLAG),A
0189 B7           00490         OR      A         ,FIGS OR LTRS NEEDED?
018A 0EDB         00500         LD      C,0DBH    ,TTY (FIGS)
018C 2002         00510         JR      NZ,$+4
018E 0EFB         00520         LD      C,0FBH    ,TTY (LTRS)
0190 CD9401       00530         CALL    PRINT
0193 4E           00540         LD      C,(HL)
0194 B7           00550 PRINT   OR      A         ,CLEAR CARRY
0195 CDAC01       00560         CALL    PULSE     ,START BIT
0198 C5           00570         PUSH    BC
0199 0605         00580         LD      B,5
019B CB11         00590 PRT1    RL      C
019D CDAC01       00600         CALL    PULSE     ,5 DATA BITS...
01A0 10F9         00610         DJNZ    PRT1
01A2 C1           00620         POP     BC
01A3 37           00630         SCF               ,SET CARRY
01A4 CDAC01       00640         CALL    PULSE     ,ONE STOP BIT..
01A7 11F002       00650         LD      DE,2F0
01AA 180D         00660         JR      DELAY     ,AND A HALF.
                  00670
01AC DB02         00680 PULSE   IN      A,(2)     ,READ PIO
01AE CBAF         00690         RES     5,A       ,IF LOW BIT
01B0 3002         00700         JR      NC,$+4
01B2 CBEF         00710         SET     5,A       ,IF HIGH BIT
01B4 D302         00720         OUT     (2),A     ,SEND BACK TO PIO
01B6 11E005       00730         LD      DE,5E0    ,20 MS TIME DELAY
01B9 1B           00740 DELAY   DEC     DE
01BA 7A           00750         LD      A,D
01BB B3           00760         OR      E
01BC 20FB         00770         JR      NZ,DELAY
01BE C9           00780         RET
                  00790
                  00800 ,BAUDOT CHARACTER TABLE, ARRANGED BY ASCII VALUE
                  00810
01BF 2039         00820 TABLE   DEFW    3920      ,(SPC) .
01C1 A129         00830         DEFW    29A1      ,' £
01C3 59B1         00840         DEFW    0B159     ,$ $
01C5 D1A1         00850         DEFW    0A1D1     ,% '
01C7 F149         00860         DEFW    49F1      ,( )
01C9 B889         00870         DEFW    89B8      ,X +
01CB 31C1         00880         DEFW    0C131     ,, -
01CD 3989         00890         DEFW    0B939     ,. /
01CF 69E9         00900         DEFW    0E969     ,0 1
01D1 C9A1         00910         DEFW    81C9      ,2 3
01D3 5109         00920         DEFW    0951      ,4 5
01D5 A9E1         00930         DEFW    0E1A9     ,6 7
01D7 6119         00940         DEFW    1961      ,8 9
01D9 7131         00950         DEFW    3171      ,: ;
01DB F179         00960         DEFW    79F1      ,< =
01DD 4999         00970         DEFW    9949      ,> ?
01DF D1C0         00980         DEFW    0C0D1     ,@ A
01E1 9870         00990         DEFW    7098      ,B C
01E3 9080         01000         DEFW    8090      ,D E
01E5 B058         01010         DEFW    58B0      ,F G
01E7 2860         01020         DEFW    602A      ,H I
01E9 D0F0         01030         DEFW    0F0D0     ,J K
01EB 483A         01040         DEFW    3A48      ,L M
01ED 3018         01050         DEFW    1830      ,N O
01EF 68EA         01060         DEFW    0EA68     ,P Q
01F1 50A0         01070         DEFW    0A050     ,R S
01F3 08E0         01080         DEFW    0E008     ,T U
01F5 78CA         01090         DEFW    0CA78     ,V W
01F7 B84A         01100         DEFW    0A4B8     ,X Y
01F9 88F1         01110         DEFW    0F188     ,Z [
01FB B949         01120         DEFW    49B9      ,/ ]
01FD D1D1         01130         DEFW    0D1D1     ,(UP-ARROW) (LEFT-ARROW)
                  01140
01FF 00           01150 FLAG    DEFB    0
                  01160
0000              01170         END
00000 TOTAL ERRORS

DELAY   01B9    PRT1    019B    PULSE   01AC    FLAG    01FF
TABLE   01BF    KILL    0170    PRINT   0194    REPT    016B
TTYPRT  0157
```

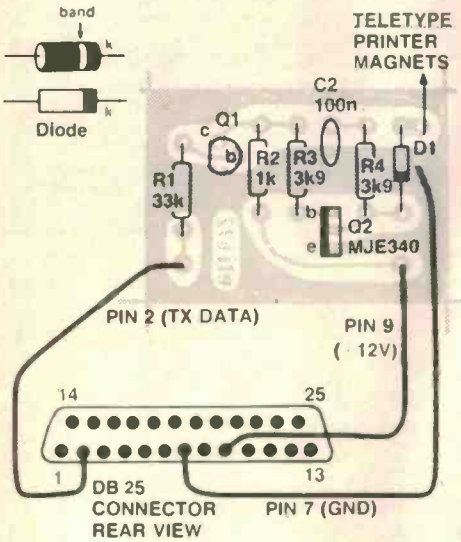
HOW IT WORKS — ETI-672

It's really quite simple. The modified-to-Baudot data signals on pin 2 of the Microbee's RS232 port drive the base of Q1 via R1, turning it on and off. The collector load for Q1 is provided by R2, the collector supply being derived from pin 9 of the RS232 port (±12 V). The signal at the collector of Q1 is thus an inverted version of the signal at pin 2 of the RS232 port, swinging from about +12 V for 'mark' to less than 1 V for 'space'.

The collector signal of Q1 drives the base of Q2 via R3. This transistor is connected in series with the teletype printer magnets via D1, thus operating the printer in accordance with the code sent.

Diode D1 and the RC network of R4-C2 smooth out inductive 'kicks' from the printer magnets.

The loop supply comprises a 110 V transformer, a diode bridge rectifier and a smoothing capacitor, C1. Resistor R_x is set to limit the current through the printer magnets to about 60 mA.



PARTS LIST — ETI-672

Resistors ..... all ¼W, 5%
- R1 ..... 33k
- R2 ..... 1k
- R3, R4 ..... 3k9

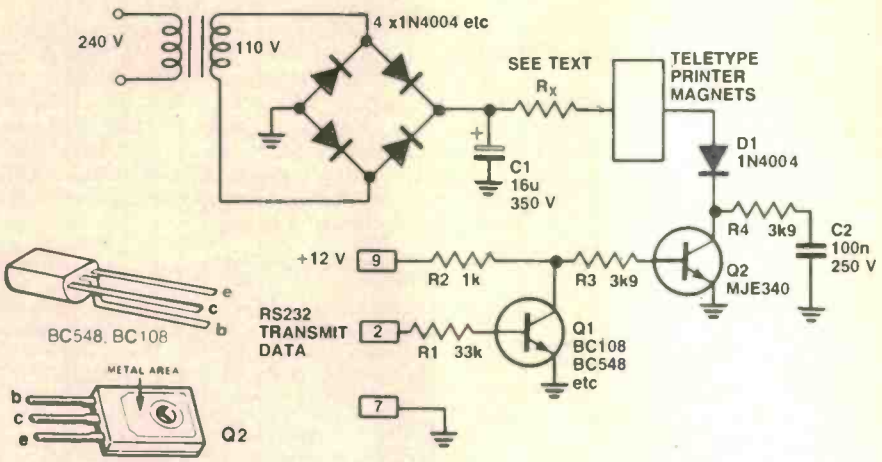
Capacitors
- C1 ..... 16µ/350 V electro.
- C2 ..... 100n/250 V greencap or ceramic.

Semiconductors
- D1 ..... 1N4004
- Q1 ..... BC108, BC548 etc
- Q2 ..... MJE340

Miscellaneous

ETI-672 pc board; UB5 jiffy box (28x54x83 mm); DB25 connector (for Microbee RS232 port); jack plug for teleprinter; teleprinter (see panel in text); loop supply components — transformer with 110 Vac or 125 Vac secondary rated at 100 mA, 4 x 1N4004, 25 W resistor (see text); hookup wire, etc.

Estimated cost: $14-$16
(less loop supply)



that tells whether the character should be figures- or letters-shifted. The bit is compared with a figures/letters flag that tells whether the previous character was in figures or letters case. If different, figures or letters is sent to the printer, and the new flag condition is stored. If the bit and the flag were the same, this part is skipped over.

The Baudot character to be printed is now copied into register C, where it's rotated out the left hand end bit by bit, with 20 millisecond time delays inserted in between. A start bit (always low) is sent before the first rotation and a stop bit (always high) is sent for 30 ms after the last data bit. With the character complete the TTYPRT subroutine returns to the calling program.

The times specified are for a 50 baud printer, but other speeds can be used as well, by changing the data in some memory locations. The Microbee IC model, with its higher speed clock frequency, is also catered for. See Table 1.

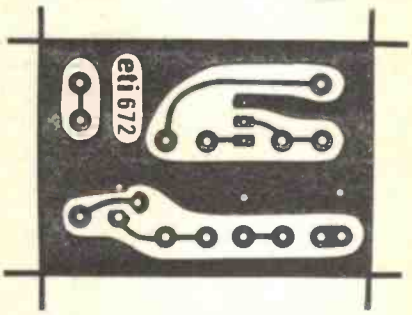
Table 1.

BAUDS	CLOCK	01A8	01A9	01B7	01B8
75	2 MHZ	F5	01	EA	03
50	2 MHZ	F0	02	E0	05
45	2 MHZ	3B	03	76	06
75	3.375	4E	03	9C	06
50	3.375	F5	04	EA	09
45	3.375	74	05	E8	0A

Construction

Construction is quite straightforward. First check the pc board has no problems — no broken tracks or tiny copper 'bridges, all holes drilled correctly, etc. If all's well, insert all the resistors and the one capacitor according to the overlay shown in Figure 2. Next insert the diode, making sure you get it the right way round (otherwise your teleprinter won't operate at all), followed by the two transistors, also making sure you get those the right way round.

The DB25 plug can then be wired up with a short cable to run to the pc board, plus a two-wire cable to a jack plug for the teleprinter. Don't wire them to the pc board yet. Drill two holes, in either end of a small jiffy box (a 'UB2' does nicely, it measures just 28 x 54 x 83 mm) and pass the two cables through, tying a knot to prevent them pulling out and leaving enough wire to



solder to the pc board. Solder the wires to the pc board. If you like, the board can be left loose in the jiffy box or, taped down with a piece of double-sided sticky pad under the Q1 end of the board. Screw the lid on and you're ready to go.

Before you start printing, however, you may need to adjust the value of R_x for correct operation of the printer magnets. Connect a milliammeter of 100 mA full scale, or a multimeter set to read 100 mA, between the anode of D1 and ground then power up the printer loop supply. Adjust R_x to get a reading of around 60 mA. An old wirewound 'slider' resistor of about 2000 or 2500 ohms, rated at 20 W or 25 W, is just right for this job, otherwise you'll have to do it by substitution. *Don't adjust the resistor with the power on and remember to discharge C1 after you switch the power off and before you adjust R_x.*

Be happy, print cheaply

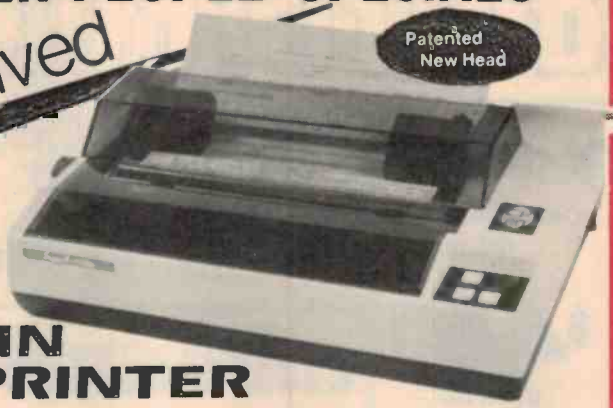
This whole system has been under test for quite a few weeks and it hasn't missed a beat (so far). The memory area for the program was chosen to keep it out of harm's way from other programs that may be in the computer. After all, it's meant to be an accessory, not the star attraction.

If you can lay your hands on an old teleprinter, this system is a good, clean solution to the high cost of 'proper' printers. The program listing with this article was printed by an old Siemens Model 100 teleprinter. Not bad, huh? ●

AFTER STOCKTAKE SALE — BE QUICK AND YOU WILL REAP THE BARGAINS

THE PRINTER PEOPLE SPECIALS

Just Arrived



A NEW PRINTER NOW!

CP-80/I, 80-COLUMN IMPACT PRINTER

SPECIFICATIONS

Functional Specifications
Printing method — Serial impact dot matrix
Printing format — Alpha-numeric — 7 x 8 in 8 x 9 dot matrix field. Semi-graphic (character graphic) — 7 x 8 dot matrix. Bit image graphic — Vertical 8 dots parallel horizontal. 640 dots serial/line
Character size — 2.1mm (0.083")-W x 2.4mm (0.09")-H. 7 x 8 dot matrix
Character set — 228 ASCII characters. Normal and italic alpha-numeric fonts, symbols and semi-graphics
Printing speed — 80 CPS 640 dots/line per second
Line feed time — Approximately 200 msec at 4.23mm (1/6") line feed.
Printing direction — Normal — Bidirectional, logic seeking. Superscript and bit image graphics — Unidirectional, left to right
Dot graphics intensity — Normal — 640 dots 190.5mm (7.5") line horizontal. Compressed characters — 1280 dots/190mm (7.5") line horizontal
Line spacing — Normal — 4.23mm (1/6") Programmable in increments of 0.35mm (1/72") and 0.118mm (1/216")
Columns/line — Normal size — 80 columns. Double width — 40 columns. Compressed print — 142 columns. Compressed/double width — 71 columns. The aboves can be mixed in a line
Paper feed — Adjustable sprocket feed and friction feed
Paper type — Fanfold. Single sheet. Thickness — 0.05mm (0.002") to 0.25mm (0.01"). Paper width — 101.6mm (4") to 254mm (10").
Number of copies — Original plus 3 copies by normal thickness paper

Mechanical Specifications
Ribbon — Cartridge ribbon (exclusive use). black
MTBF — 5 million lines (excluding print head life)
Print head life — Approximately 30 million characters (replaceable)
Dimensions — 377mm (14.8")-W x 295mm (11.6")-D x 125mm (4.9")-H incl. sprocket cover

Parallel CP80 $495 **Serial CP80 $595**

PRINTER SPECIALISTS

MPI DISC DRIVES

to suit Tandy & System 80 computers)
with Box & Power supplies

	1 DRIVE	2 DRIVES
B 51	$259 + tax	$520 + tax
B 52	$389 + tax	$620 + tax
B 91	$460 + tax	P.O.A.
B 92	$559 + tax	P.O.A.

DISCOUNT DISKETTES WELL KNOWN BRAND 12 MONTH WARRANTY (CONTROL DATA)

5¼ SOFT SECTORED
—S—Side Double Density $27.50/10
—D—Side Double Density $47.50/10

8" SOFT SECTORED
—S—Sided Single Density $32.00/10
—D—Sided Double Density $49.00/10

ALL PRICES PLUS 20% SALES TAX

CHECK THE PRICES THIS MONTH ONLY
THE MITSUBISHI RANGE OF DISK DRIVES

M2896-63
Slimline 8" Disk Drive, Double Sided, Double Density, No AC Power Required, 3ms track to track, 1.6 mbytes unformatted, 77 track/side, 10^9 bit soft error rate.
$485 + tax Box & Power Supply to Suit $95 + tax
5 or more $450 + tax

M2894
Standard size 8" drive, Double Sided, Double Density, 3ms track to track access, 1.6 mbytes unformatted, 77 track/side, 10^8 bit soft error rate.
$485 + tax Box & Power Supply $95 + tax

M4854
Slimline 5¼" disk drive, Double Sided, Double Density, 96 track/inch, 9621 bits/inch, 1.6 mbytes unformatted, 3ms track to track access, 77 track/side.
$355 + tax Box & Power Supply $65 + tax

M4853
Slimline 5¼" disk drive, Double Sided, Double Density, 1 mbyte unformatted, 3ms track to track, 80 track/side, 5922 bits/inch, Steel band drive system.
$335 + tax Box & Power Supply $65 + tax

ALL VERBATIM DISCS 10% OFF LISTED PRICE THIS MONTH

VERBATIM DISCS 5 YEAR DATALIFE GUARANTEE		Per Box of 10
MD525-01	Single Sided, Double Density	44.00
MD525-10	SSDD 10 Sectors 40 Tracks	45.00
MD525-16	SSDD 16 Sectors 40 Tracks	45.10
MD550-01	Double Sided, Double Density	47.50
MD550-01	DSDD 10 Sectors 40 Tracks	49.50
MD550-16	DSDD 16 Sectors 40 Tracks	49.50
MD557-01	SSDD Soft Sect 80 Tracks	49.50
MD577-10	SSDD 10 Sectors 80 Tracks	57.00
MD577-16	SSDD 16 Sectors 80 Tracks	57.00
MD557-01	DSDD Soft Sect 80 Tracks	59.00
MD557-16	DSDD 16 Sectors 80 Tracks	59.00

8" VERBATIM		
FD32-1000	Single Sided, Single Density	45.00
FD32-8000	Single Sided, Double Density	54.00
FD32-9000	SSDD Critically Certified	51.00
FD34-1000	Single Sided, Single Density	45.00
FD34-8000	Single Sided, Double Density	51.00
FD10-4008	Double Sided, Single Density	59.00
FD10-4015	Double Sided, Single Density	59.00
FD10-4026	Double Sided, Single Density	59.00
FF32-2000	SD FLIPPY FLOPPY	62.00
FF34-2000	SD FLIPPY FLOPPY	62.00
DD32-4000	Double Sided, Double Density	54.00
DD34-4001	Double Sided, Double Density	49.00
DD34-4008	Double Sided, Double Density	51.00
DD34-4015	Double Sided, Double Density	53.00
DD34-4026	Double Sided, Double Density	55.00

ALL PRICES PLUS 20% SALES TAX
WE WILL NOT BE BEATEN ON DISC PRICES

CPM SYSTEMS

VIC 20 IS HERE

Twin 8"
4MHz Double Density
Big Board (2) $2950.00 + tax
Twin 5" Drives
4MHz Double Density
Big Board (2) $2250 + tax

HARD DISC DRIVES ARE HERE!

5 Megabyte	$1000 + tax
10 Megabyte	$1250 + tax
Controller to suit	$450 + tax
Box and Power Supply	$225 + tax

BIG BOARD (1) NEWS

Double Density add on.
$195 + tax (incl. Software & Hardware)
Hard Disc Interface $195 + tax

PROWRITER PRINTERS

	Tax Exempt	Tax Paid
8510P	$775	$895
8510S	$990	$1095
1550P	$1025	$1195
1550S	$1125	$1295
1101P	$1700	$2095
1101S	$1850	$2195

TERMINALS

Come in and see them working

1—5	$995 + tax
6—24	$850 + tax
24—99	$750 + tax
100 +	$695 + tax

HI TECHNOLOGY PRODUCTS AND EXPERIENCE

VIC 20, VIC 64 TAX EXEMPT ASK OUR PRICE

RITRONICS WHOLESALE PTY LTD

48 - 50 A'BECKETT STREET, MELBOURNE 3001. Telephone: (03) 347 9251
425 HIGH STREET, NORTHCOTE, VICTORIA 3070. Telephone: (03) 489 7099

MAIL ORDERS TO P.O. BOX 235 NORTHCOTE 3070. P&P MINIMUM $3.00

JAYCAR & ELECTRONIC AG

Digital Delay Line

The Digital Delay Line is designed to produce a huge variety of electronic effects. It works very well but the amazing thing is the low low price! The effects depend on the time delay selected and some of those included are: Phasing, Flanging, Chorous, ADT (Automatic Double Tracking), Echo, and Vibrato. The delay time can be varied from 0.32ms to 1.6 seconds! Because the signal is stored in digital form there is, unlike analog systems, no degeneration of the signal with time and unlimited repetition is provided by use of the freeze control.

All the controls mount directly upon PCB's to eliminate wiring and to further simplify construction the main board is 'plated through' i.e. there are no wire links or link-through pins. The whole of the memory whether for the basic 400ms machine or the fully expanded 1.6 second model all fits on the main board. The cabinet which is free standing but also suitable for 19" rack mounting, is fully finished to a very high standard. The panel is deep blue whilst the cover is prayed with a durable black enamel. The kit is available for only $449 — compare that with inferior uints that can cost over $2,000!!

400ms VERSION ONLY

$449 COMPLETE KIT

Cat. KJ-6621 $449.00

Video Amplifier/-Buffer

Ref: EA Aug 1983

The answer to a maidens prayer!
This device can be made to fit inside a TV set (or in a separate box if necessary). It basically enables you to connect straight into the video drive of your TV, turning it into a colour monitor. This means that the video signal from your computer, VCR, TV game etc., does not need to be converted to RF and go through the TV IF strip. You will be amazed by the clearer, sharper signal that has less interference! Notes on how to fit to various TV sets are included.
Cat. KA-1527 $14.95

Jiffy Box to suit HB-6003 $2.20

minitune

Specification

Function	F.S.D.	Resolution	Accuracy
Voltage (d.c.)	20V	10mV	0.5% ± 1 digit
	200V	100mV	0.5% ± 1 digit
Resistance	2000Ω	100mΩ	0.5% ± 1 digit
	20kΩ	10Ω	0.5% ± 1 digit
R.P.M	20,000 r.p.m	10 r.p.m	1% ± 3 digits
Dwell	90°	0.1	2% ± 3 digits

FAR CHEAPER THAN DPM SEPARATELY

$42.95

Ref: EA June 1983

Following the spectacular success of the DP2010 Digital Multimeter kit, we now have an ENGINE ANALYSER KIT! But the spectacular thing is the price! It is ACTUALLY CHEAPER than the DPM-05 Display and Case!! The Minitune will measure voltage, resistance (down to a very low range), RPM and Dwell Angle.
Cat. KJ-7012 $42.95

TEST LEADS TO SUIT ONLY $2.95

0-30V 1amp power supply

ETI 162

Cat. KE4570

Ref: ETI December 1982

- Fully protected
- Output variable from 0-30V DC
- Selectable current limit
- Both voltage and current metering
- After a multimeter & soldering iron an absolute must for the enthusiast.

You will never own a more useful piece of gear.

$49.50

Touch Lamp Timer

Ref: EA Aug 1983

This project is very similar to the EA touch dimmer which has been very popular. Basically, you touch the wallplate and the light stays on for a predetermined amount of time. The same wallplate is used as the dimmer.
As usual the Jaycar kit contains quality components as originally specified, including a quality HPM wallplate.
Cat. KA-1525 $21.00

LOW COST DIGITAL MULTIMETER KIT

Ref: EA March 1983 (This month)
Almost everyday we are asked for a multimeter kit. Up until now we thought that it was just not worth it considering the fine low cost built-up units available. The DP2010 changed all that.
This kit, fully imported from the UK uses the famous DPM-05 custom LCD/Voltmeter to achieve phenomenal accuracy at very modest cost!
All parts are included to complete the meter including an attractive and colourful front panel. (a 9V battery is required)

Set of test probes to suit $2.95
Probe to suit Cat. WT5312 ONLY $2.50
Eveready 216 (red) 9V Battery Cat. SB2370 ONLY $1.40

"LEARN ELECTRONICS AND END UP WITH A USEFUL PIECE OF TEST GEAR IN THE END"

DP2010 kit Cat. KJ7010 ONLY $45

SPECIFICATIONS

Function	f.s.d.	Resolution	Accuracy	Protection
Volts (d.c.)	2V	1mV	1% ± 1 digit	500V for
	20V	10mV	1% ± 1 digit	one minute
	200V	100mV	1% ± 1 digit	
	500V	1V	1% ± 1 digit	
Current (d.c.)	2mA	1uA	1% ± 1 digit	1A/250V
	20mA	10uA	1% ± 1 digit	
	200mA	100uA	3% ± 1 digit	
	2000mA	1mA	5% ± 1 digit	
Volts (a.c.)	2V	1mV	2% ± 5 digit	500V for
	20V	10mV	2% ± 5 digit	one minute
	200V	100mV	2% ± 5 digit	
	500V	1V	2% ± 5 digit	
Current (a.c.)	2mA	1uA	2% ± 5 digit	1A/250V
	20mA	10uA	2% ± 5 digit	
	200mA	100uA	4% ± 5 digit	
	2000mA	1mA	7% ± 5 digit	
Resistance	2K	1	1% ± 1 digit	260V
	20K	10	1% ± 1 digit	r.m.s.
	200K	100	1% ± 1 digit	
	2000K	1K	1% ± 1 digit	
Diode Test	2V	1mV	1% ± 1 digit	260V r.m.s.

AC VOLTAGE AND CURRENT RANGES
When S3a selects a.c. functions the output from either the voltage attenuator or current shunts is fed through C1 to remove any d.c. component.

SAVE A FORTUNE!

BBD EFFECTS BOX

Fantastic low-cost instrument using the versatile MN3001 Bucket-Brigade Delay Line to achieve brilliant sonic effects. Now you can emulate the commercial rock groups with Phasing, Flanging' Reverb and Echo. The Jaycar kit includes all components INCLUDING IC sockets and the TU-04 box. (Not cut down but this is easily done). Jaycar has a specially built cabinet for this kit with all holes pre-punched etc., at only $10 extra but only if you buy the original kit from us. Available as a separate item for $29.50. WHEN THE KIT IS PURCHASED WITH THE DE-LUXE CASE THE TU-04 CASE WILL NOT BE SUPPLIED.

Special cabinet to suit $10.00 Cat. HB6445

COMPLETE KIT

Cat. KE1522 $79.00

TRANSISTOR ASSISTED IGNITION

Ref: EA Jan '83. Latest version of this popular kit. The Jaycar kit has a genuine die cast box - as used in the EA prototype. Beware of others that use flimsy sheet metal.
Cat. KA1506 $35

"Fluoro Starter"

$5

Ref: EA Oct 1982
One of our most popular kits. Enables you to replace the electromechanical starter with an electronic one! The Fluoro starts up instantly without a flicker!
All electronic components supplied including high quality mains cap. (Fluoro starter case required)

Cat. KA-1480

MICRON 30 WATT SOLDERING IRON

Cat. TS-1450

LIGHT WEIGHT
FULLY S.E.C. TESTED & APPROVED

$9.95

ENCIES — NO.1 FOR KITS

EA Wideband AM Tuner

FANTASTIC VALUE AT ONLY $249

Ref: EA Dec-Jan 82-83

OUTSTANDING VALUE

FREE ALIGNMENT KIT AND STEREO SIMULATOR WORTH ALMOST $20

Australia is one of the few countries in the world where wideband AM is transmitted. In fact a good quality AM signal can be much better than its FM counterpart!! Anyone who has suffered from FM multipath distortion will know what we mean. The Playmaster AM tuner is a true broad-bandwidth superhet design. See the frequency response graph in November E.A. 1982.
Once again, the Jaycar kit is a high quality approach. Jaycar supplies an exclusive front panel design that differs from the original E.A. design. The Jaycar kit provides all components to complete the project INCLUDING a completely pre-punched cabinet.

KA-1498

"Blueprint" 5000 preamp

Cat. KE4202

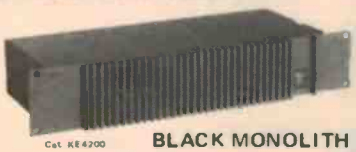
FUNCTIONS
- MOVING COIL INPUT
- MOVING MAGNET (DYNAMIC CART)
- INPUTS (2 OFF)
- TUNER INPUT
- AUX INPUTS (2 OFF)
- TAPE INPUTS (2 OFF)
- INPUT LEVEL CONTROL
- TAPE OUTPUTS (2 OFF)
- 400Hz CALIBRATION OSCILLATOR
- LED AVERAGE (VU) & PEAK
- LEVEL METERS –48dB TO +9dB
- MODE SWITCH, STEREO BALANCE CONTROL LINE OUT, MONITOR OUT, MONITOR VOLUME CONTROL

FEATURES
- EXTREMELY CLOSE TRACKING TO RIAA PHONO EQ.
- GOLD PLATED CONNECTORS ON ALL INPUTS
- ENGLISH 'LORLIN' LOW NOISE SELECTOR SWITCHES
- LOW NOISE 1% 50ppm METAL FILM RESISTORS USED
- TINNED FIBREGLASS PCB's
- LOW CAPACITANCE SCREENED CABLE USED THROUGHOUT
- QUALITY I.C. SOCKETS
- SPECIAL REAR PANEL
- MULTICOLOURED RECTANGULAR LEDs USED

$299

5000 POWER AMPLIFIER

REF: ETI JAN/MARCH 1981



Cat. KE4200

BLACK MONOLITH
unbeatable value
ONLY $319

5000 SERIES GRAPHIC EQUALISERS

ALL IC SOCKETS PROVIDED

SPECIFICATIONS:
Signal-to-Noise: –102dB with respect to 1 Volt
Frequency Response: 12Hz – 105kHz to –1dB
Boost/Cut: 14dB (28dB total)
Distortion: 100Hz-0.007% 1kHz-0.003% 10kHz-0.008% (essentially, irrespective of cut or boost)
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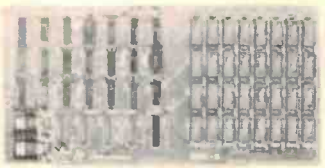

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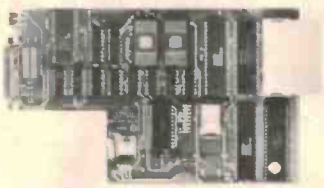

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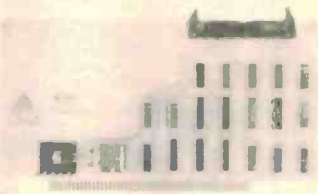

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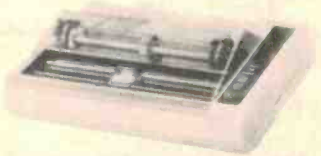

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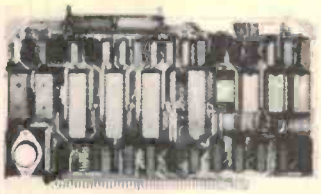

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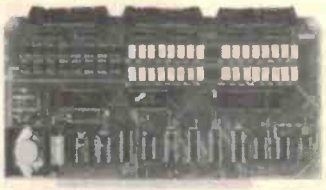

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- Approx 4 times faster than Winchester.
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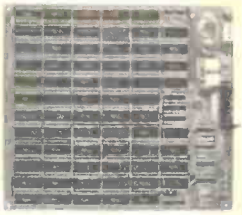

SOLID STATE FLOPPY - CRC-128. Port addressed 128K CMOS RAM boards, high security data protection with battery back up. Chain together up to 1Mb.

- Suitable for extreme enviromental conditions.
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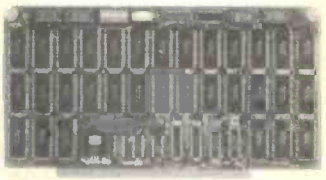

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DEALER ENQUIRIES WELCOME.

Artificial intelligence for the Learner's microcomputer

Frank Rees
27 King St, Boort Vic. 3537

Owners of the ETI-660 Learner's Microcomputer or any other machine running Chip 8 are introduced to the real world of artificial intelligence. A beast paces up and down in its enclosure, then changes its 'mind' and sets off in a new direction. You can restructure the beast's environment, then see how it reacts.

TODAY'S COMPUTERS can not do much more than print out 'no compute' when the problem gets sticky or to indicate an error.

However, computers are now being designed that will enable us to have a two-way conversation with them. This suggests that one day we will be able to communicate with computers on a different level so that we can study a problem in greater depth than is now possible.

This all sounds as if the computer has an 'intelligence'. How real is this intelligence? Is it artificial as the title suggests or is it a real creation of man (and woman)?

Just what is intelligence? Are you sure that it is a product of your own mind? Stop and think about it. Look at the list of words in Table 1. Remove or add words to the list, so that they fit in with your definition of intelligence. The list should only contain words that you consider essential to the definition of intelligence. Think about it.

To illustrate my thoughts; we have a short-haired German Pointer dog, Emma. She responds to many commands but is a bit slow to come when her name is called if she hears her bath rattling in the shed. However, she is very quick off the mark if the call is 'dinner'. Does that mean that she is intelligent?

Table 1.

recall	write
knowledge	learn
spell	speech
voice	memory
think	beast
read	man
creature	

Does it require intelligence to play board games like Iago or Reversi? Would you still consider one of the players to be intelligent if it was a computer?

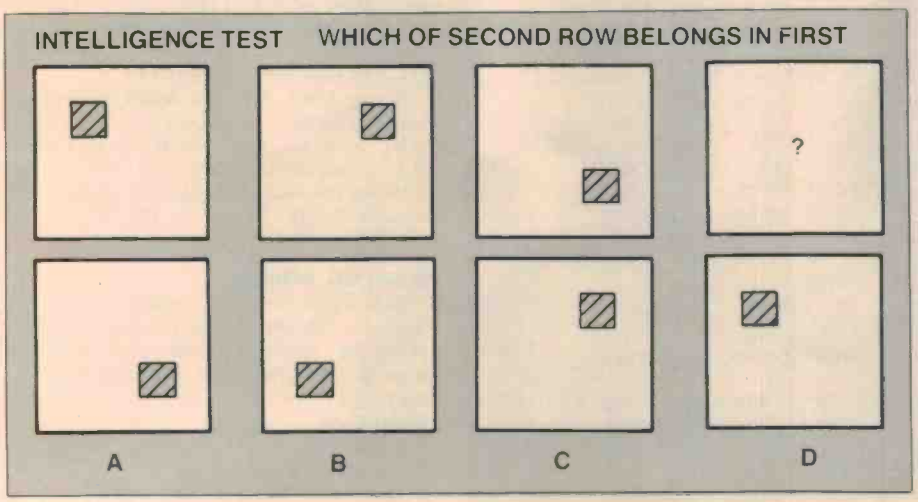
Is a calculator intelligent because it can do complicated mathematics very quickly? Maths is generally based on logical steps which do not necessarily require intelligence but a set of rules for the 'memory' to recall and use.

Verbal and written tests are the usual means of assessing intelligence. However, speech and writing are not a pre-requisite of intelligence; they are used only for the convenience of determining the degree of intelligence.

If it is accepted that intelligence can also apply to non-humans, does that recognition extend to machines? And is a machine's intelligence real or artificial?

We all enjoy listening to music. How long is it since you heard the 'real thing'? Do you receive less pleasure from listening to recorded music? Is the recorded music you hear real or artificial?

These seemingly random thoughts on intelligence have occured to me after reading a few chapters of David L. Heiserman's book, "Projects in machine intelligence for your home computer" (published by Tab). In fact, David Heiserman says, "If this book did not get you thinking then you have missed the point of it all".



'Alpha plus demo' program

There are several programs written on artificial intelligence but not many of them are very informative as to how they work. The 'Alpha plus demo' program is based on the 'Alpha — demo of artificial intelligence' program written in BASIC by David Heiserman.

The original 'Alpha demo' program releases a beast inside a four-sided fenced enclosure. The only obstruction to the beast is the fence. The beast wanders around in this environment, only changing direction when it has to.

Two features have been added to the original program to create the 'Alpha plus demo' program. One new feature is that the beast is faster and chatters to itself when it is confronted with an obstacle and has to change direction.

The other 'plus' is that it is now possible to escape from the 'main line' program to change the environment. You can observe how the beast responds to these changes.

As the purpose of this article is to learn something about the concepts of artificial intelligence, the program has not been re- ▶

Program subdivision

0600	no operation
0602	jump to 'Alpha Plus Demo' at 0694
0604	'Search Ahead' routine
0694	Main Line start, jump to 'Border' routine
0696	Main Line continues
06DE	'Border' routine
0706	'Change' routine

MAIN LINE program

0694	'Border' routine
0696	random start within ±2 of middle
06AE	get Motion Code for new X, Y or X and Y
06BE	sound when Motion Code called for
06C0	call 'Search Ahead' routine
06C2	no operation
06C4	check if contact, if so get new Motion Code
06CC	remove beast, get new X, Y and redraw
06D4	escape Main Line
06D8	or continue Main Line
06DA	remove beast
06DC	and go to 'Change'

MAIN LINE

0694	16DE	GO TO 06DE	go to Border routine
0696	6A20	VA = 20	use as X co-ordinate
0698	6B18	VB = 18 (6B10)	use as Y co-ordinate
069A	267E	DO SUB 067E	get rnd. no. −2 to +2
069C	8A04	VA = VA + V0	add to X screen horz. centre
069E	267E	DO SUB 067E	get rnd. no. −2 to +2
06A0	8B04	VB = VB + V0	add to Y screen vert. centre
06A2	A682	1 = 0682	point to dot data 80
06A4	DAB1	SHOW 1 AT VA, VB	display dot at X, Y.
06A6	4F00	SKF VF NE 00	VF = 1 if dot was already there
06A8	16AE	GO TO 06AE	if not continue
06AA	DAB1	SHOW 1 AT VA, VB	otherwise return dot
06AC	1696	GO TO 0696	and go get new position
06AE	267E	DO SUB 067E	get rnd. no. −2 to +2
06B0	8400	V4 = V0	Motion Code X co-ordinate
06B2	267E	DO SUB 067E	get rnd. no. −2 to +2
06B4	8500	V5 = V0	Motion Code Y co-ordinate
06B6	3400	SKF V4 = 00	if Motion Code X = 0
06B8	16BE	GO TO 06BE	
06BA	4500	SKF V5 NE 00	If Motion Code Y = 0
06BC	16AE	GO TO 06AE	go get another Motion Code X & Y
06BE	F618	TONE = V6	beep with each new Motion Code call
06C0	2604	DO SUB 0604	call Search Ahead routine
06C2	16C4	GO TO 06C4	no operation
06C4	3600	SKF V6 = 00	if no X contact
06C6	16AE	GO TO 06AE	otherwise get new M/Code
06C8	3700	SKF V7 = 00	if no Y contact
06CA	16AE	GO TO 06AE	otherwise get new M/Code
06CC	DAB1	SHOW 1 at VA, VB	erase beast old position
06CE	8AC0	VA = VC	get new X co-ord
06D0	8BD0	VB = VD	get new Y co-ord
06D2	DAB1	SHOW 1 AT VA, VB	display beast in new position
06D4	6E0E	VE = 0E	make VE = E so that
06D6	EE9E	SKF VE = KEY	pressing 'E' is escape key
06D8	16C0	GO TO 06C0	normally continue Search Ahead
06DA	DAB1	SHOW 1 AT VA, VB	erase beast last position
06DC	1706	GO TO 0706	and go to Change routine

Artificial intelligence
Alpha plus demo — Chip 8 — D3

0600	1602	1694	8CA0	8DB0	6600	6700	8840	8950
0610	4800	163E	48FE	1626	48FF	1626	4801	1622
0620	4802	78FF	1628	7801	4802	7C01	4801	7C01
0630	48FF	7CFF	48FE	7CFF	DCD1	86F0	DCD1	4900
0640	166C	49FE	1654	49FF	1654	4901	1650	4902
0650	79FF	1656	7901	4902	7D01	4901	7D01	49FF
0660	7DFF	49FE	7DFF	DCD1	87F0	DCD1	3600	1674
0670	4700	00EE	3800	167C	4900	00EE	1610	C0FF
0680	6107	8012	4007	167E	4006	167E	4000	167E
0690	70FD	00EE	16DE	6A20	6B18	267E	8A04	267E
06A0	8B04	A682	DAB1	4F00	16AE	DAB1	1696	267E
06B0	8400	267E	8500	3400	16BE	4500	16AE	F618
06C0	2604	16C4	3600	16AE	3700	16AE	DAB1	8AC0
06D0	8BD0	DAB1	6E0E	EE9E	16C0	DAB1	1706	6A00
06E0	6B00	A682	DAB1	7A01	3A3F	16E4	DAB1	7B01
06F0	3B2F	16EC	DAB1	7AFF	3A00	16F4	DAB1	7BFF
0700	3B00	16FC	1696	F00A	400C	00E0	400C	1706
0710	400A	1696	400B	16C0	400F	16DE	171E	400D
0720	1724	1706	F00A	8004	8004	8004	8004	CA3F
0730	CB1F	A726	DAB1	70FF	3000	172E	1696	

duced to its shortest form unless this makes an idea easier to understand.

Note that the JUMP statement has been used instead of the CALL statement. For example, there are JUMPs at 071A and 0694 to the 'border' routine. A JUMP at 0704 returns this routine to the 'main line'. However, the disadvantage of this method is that if you want to call this routine from somewhere else then 0704 would have to be a RETURN instead of a JUMP. Some operating systems use this technique with the result that many useful routines in ROM can not be called by user programs in RAM.

I'd like to know how you enjoy this program and whether you have any problems with getting it to work properly. Letters to me are welcome, just enclose a S.S.A.E.

Now if we could only teach this beast to make rational decisions based on its experiences, then it could learn from its mistakes.

Draw Border

This is, without doubt, the most straightforward way there is of drawing a border. You should not have any problems understanding it.

Just remember how the DXYN instruction retains the pointer to the data, and calculates from X and Y the pointer for where the data is to go to. 'N' makes sure that only one byte of the DXYN store of 16 bytes of data is displayed.

The following changes can be made to this routine, showing how useful and adaptable it can be.

Go either to the instruction for width at 06E8 (02E8) or to the instruction for height at 06F0 (02F0) and add one to it. In case you are not used to hex numbers, 3F + 1 = 40, as F + 1 = 10 in hex. Now try adding ten to either instruction.

By making these simple changes you can create many different types of barriers or bordered areas.

Remember, if your Chip 8 starts at 0200 then the 06F0 (02F0) instruction is 3B1F to give the correct height of the bordered area.

Random number −2 to +2

This is an interesting routine to study. You may like to try to simplify it by using C007 at 067E (027E) and substituting the 0680, 0682 (0280, 0282) instructions with 'NO OP', 'GO TO' NEXT.

But don't use C005 at 067E and jump from 0680 (0280) to 0690 (0290). The random function in Chip 8 is a 'logical AND' of constant K in the CXKK instruction, and a random number from 00 to FF.

Using C005 does not result in a proper random number from zero to five as 'logical AND' with five only selects bits 0, 1 and 4. Bit 2 is not in the bit makeup of five. As bit 2 is filtered out, as is any bit greater than five, both bits 2 and 3 are lost. More about the random function later.

Search ahead

This is the main routine which has been designed to be used again in other programs involving artificial intelligence. It could have been written in a shorter form, however, this would not have made it so easy to understand.

Even this longer version has 70 key strokes less to enter than the BASIC program, not including BASIC remarks and all

spaces. More importantly, this longer version is faster, making it ideal for using in 'cat after mouse' or 'mouse in maze' type games.

The 'search ahead' routine tests for any obstacles in the path of the beast. If there are no obstacles to its movement in its present direction it continues to use the same co-ordinates of motion code plus its current position. If there is an obstacle this routine selects a new motion code.

As 'search ahead' is such an important routine, a description of its operation is given in BASIC terminology within the same framework of the Chip 8 program.

In addition, variables used in the Chip 8 program are referenced against the BASIC variables with a description. ▶

DRAW BORDER

06DE	6A00	VA = 00	use as X co-ordinate
06E0	6B00	VB = 00	use as Y co-ordinate
06E2	A682	1 = 0682	point to dot data 80
06E4	DAB1	SHOW 1 AT VA, VB	draw dot at X, Y top line
06E6	7A01	VA = VA + 01	add one to X
06E8	3A3F	SKF VA = 3F	when top line done
06EA	16E4	GO TO 06E4	otherwise continue
06EC	DAB1	SHOW 1 AT VA, VB	draw dot at X, Y RHS
06EE	7B01	VB = VB + 01	add one to Y
06F0	3B2F	SKF VB = 2F (3BIF)	when RHS done
06F2	16EC	GO TO 06EC	otherwise continue
06F4	DAB1	SHOW 1 AT VA, VB	draw dot at X, Y bottom
06F6	7AFF	VA = VA + FF	take one off X
06F8	3A00	SKF VA = 00	when bottom done
06FA	16F4	GO TO 06F4	otherwise continue
06FC	DAB1	SHOW 1 AT VA, VB	draw dot at X, Y LHS
06FE	7BFF	VB = VB + FF	take one off Y
0700	3B00	SKF VB = 00	when LHS done
0702	16FC	GO TO 06FC	otherwise continue
0704	1696	GO TO 0696	jump to Main Line

RANDOM NUMBER −2 TO +2

067E	C0FF	V0 = RND. FF	random number 0-FF
0680	6107	V1 = 07	mask for bits 0,1,2*
0682	8012	V0 = V0 AND V1	random number 0-7
0684	4007	SKF V0 NE 07	if seven
0686	167E	GO TO 067E	get another number
0688	4006	SKF V0 NE 06	if six
068A	167E	GO TO 067E	get another number
068C	4000	SKF V0 NE 00	if zero
068E	167E	GO TO 067E	get another number
0690	70FD	V0 = V0 + FD	random number (1 to 5) −3
0692	00EE	RETURN	with V0 = −2 to +2

* bit numbers 2,1;0 have hex. values 4,2,1 req. for 1 to 5

SEARCH AHEAD — a BASIC listing

```
0604  NX = PX new & present X co-ord
0606  NY = PY new & present Y co-ord

0608  CX = 0 initial contact code for X
060A  CY = 0 initial contact code for Y

060C  Motion Code X SGN (signum) and ABS (absolute) value
060E  Motion Code Y SGN (signum) and ABS (absolute) value

0610  IF AT = 0
0612  then GO TO 063E (as X the same) otherwise
0614  AI = AI − 1 (ABS) (X towards centre)
0628  IF SI>0 (pos.) then NX = NX + 1 and GO TO 0638 otherwise
0630  NX = NX − 1
0638  CX = SCREEN (NX, NY)

063E  IF AJ = 0
0640  then GO TO 066C (as Y the same) otherwise
0642  AJ = AJ − 1 (ABS) (Y towards centre)
0656  IF SJ>0 (pos) then NY = NY + 1 and GO TO 0666 otherwise
065E  NY = NY − 1
0666  CY = SCREEN (NX, NY)

066C  if not (CX = 0 and CY = 0) if a contact
0672  then RETURN (to get new motion code)
0674  IF AT = 0 and AJ = 0 (in centre) then RETURN (to move if no
      contact) (or get new motion code) otherwise
067C  GO TO 0610 continue 'Search Ahead'
```

SEARCH AHEAD

0604	8CA0	VC = VA	copy present X into new X
0606	8DB0	VD = VB	copy present Y into new Y
0608	6600	V6 = 00	initial contact code for X
060A	6700	V7 = 00	initial contact code for Y
060C	8840	V8 = V4	Motion Code X copy
060E	8950	V9 = V5	Motion Code Y copy
0610	4800	SKF V8 NE 00	if X component of Motion Code = 0
0612	163E	GO TO 063E	go to check Y test
0614	48FE	SKF V8 NE FE	If X code = −2
0616	1626	GO TO 0626	go to X + 1
0618	48FF	SKF V8 NE FF	if X code = −1
061A	1626	GO TO 0626	go to X + 1
061C	4801	SKF V8 NE 01	if X code + 1
061E	1622	GO TO 0622	go to X − 1
0620	4802	SKF V8 NE 02	if X code + 2
0622	78FF	V8 = V8 + FF	X − 1
0624	1628	GO TO 0628	go to next routine
0626	7801	V8 = V8 + 01	X + 1
0628	4802	SKF V8 NE 02	if signum X positive
062A	7C01	VC = VC + 01	add one to new X
062C	4801	SKF V8 NE 01	check for +1 as +2 above
062E	7C01	VC = VC + 01	
0630	48FF	SKF V8 NE FF	If signum X negative
0632	7CFF	VC = VC + FF	subtract one from new X
0634	48FE	SKF V8 NE FE	check for −2 as −1 above
0636	7CFF	VC = VC + FF	
0638	DCD1	SHOW 1 AT VC, VD	display dot at new X
063A	86F0	V 6 = VF	if a contact VF = 1 copy into X contact
063C	DCD1	SHOW 1 AT VC, VD	display dot again to erase
063E	4900	SKF V9 NE 00	if Y component of motion Code = 0
0640	166C	GO TO 066C	go to check contact test
0642	49FE	SKF V9 NE FE	if Y code = −2
0644	1654	GO TO 0654	go to Y + 1
0646	49FF	SKF V9 NE FF	If Y code = −1
0648	1654	GO TO 0654	go to Y + 1
064A	4901	SKF V9 NE 01	if Y code = +1
064C	1650	GO TO 0650	go to Y − 1
064E	4902	SKF V9 NE 02	if Y code = +2
0650	79FF	V9 = V9 + FF	Y − 1
0652	1656	GO TO 0656	go to next routine
0654	7901	V9 = V9 + 01	Y + 1
0656	4902	SKF V9 NE 02	if signum Y positive
0658	7D01	VD = VD + 01	add one to new Y
065A	4901	SKF V9 NE 01	check for +1 as +2 above
065C	7D01	VD = VD + 01	
065E	49FF	SKF V9 NE FF	if signum Y negative
0660	7DFF	VD = VD + FF	subtract one from new Y
0662	49FE	SKF V9 NE FE	check for −2 as −1 above
0664	7DFF	VD = VD + FF	
0666	DCD1	SHOW 1 AT VC, VD	display dot at new Y
0668	87F0	V7 = VF	If contact VF = 1, copy into Y contact
066A	DCD1	SHOW 1 AT VC, VD	display dot again to erase
066C	3600	SKF V6 = 00	If no X contact
066E	1674	GO TO 0674	
0670	4700	SKF V7 NE 00	If no Y contact
0672	00EE	RETURN	then return
0674	3800	SKF V8 = 00	If X Motion Code = 0
0676	167C	GO TO 067C	
0678	4900	SKF V9 NE 00	if Y Motion Code = 0
067A	00EE	RETURN	then return
067C	1610	GO TO 0610	check X or Y, or X & Y Motion Code again

Motion code

This routine produces a code which, when added to the current position co-ordinates, can result in a movement of up to two steps in any direction.

Every time the beast runs into anything the 'search ahead' routine calls 'motion code'. The motion generated by 'motion code' is entirely random and it can leave you thinking about the response of a creature to many situations.

The accompanying diagram illustrates 'motion code', however, the pattern can also be seen by changing the location 06C0 (02C0) to 1696 (1296) and running the program.

Changing the environment

You can spend a lot of time watching and contemplating the actions of the beast in this simple four-sided enclosure. However, the time will come to try other things.

The discussion of the 'border' routine mentioned that the size and shape of the border can be easily altered by changing one or two instructions. In addition, the plus of 'Alpha plus' can be used to change the environment with simple key strokes. The keys that can be used and their functions will now be described.

Key 'E' is the escape key. It gets out of the 'main line' program so that changes can be made. The beast is removed from the enclosure.

Key 'D' draws dot barriers. The number of these dots is determined by the next key pressed and is approximately the number of the pressed key multiplied by 10 hex. The beast is returned.

Key 'C' clears the screen and waits.

Key 'F' redraws the fenced area. If the fence was already there it will be erased first. The beast is returned.

Key 'A' releases the beast again at the point where it was removed by key 'E'. It leaves a barrier on the present course.

Additional pointers

To start the beast off at a corner change 0696 (0296) to 6A01, 6B01, 16AE (12AE).

To leave a trail change 06CC (02CC) to 16CE (12CE). To mute the beast for quicker decisions you can change 06BE (02BE) to 16C0 (12C0).

Observations

'At' or 'contact at' is an important instruction. This routine enables you to find what is 'at' or if 'contact at' particular X, Y co-ordinates on the screen.

It was known that the Chip 8 variable VF was affected by the DXYN instruction. To study it more fully a favourite test routine (see test routine one) was used.

This test routine normally shows a changing pattern of random dots. The screen never fills to white as one dot on an existing dot causes 'selective erase' (as I call it) of the last dot. The idea was to detect this erasure and replace an erased dot by rewriting it. The result was a second test routine which is a variation of the first (see test routine two).

Test routine two showed that if the first DAB1 display of a dot took place on an existing dot then VF = 01 and the second DAB1 display of a dot at the same co-ordinates restored 'selective erased' dot almost immediately.

The 'contact at' routine which resulted was a simple DXYN, 8ZF0, DXYN. The contact flag VZ is set (=1) if the first display which is removed by the second takes place on the existing display. When the 'N' in DXYN is equal to one, a proposed new X is tried with the existing Y, and a proposed new Y is tried with the existing X. A routine can be devised to check a particular course of movement on the screen.

Test routines

Test routine one 0MMM CAFF CBFF AMMM DAB1 1MMM 80.

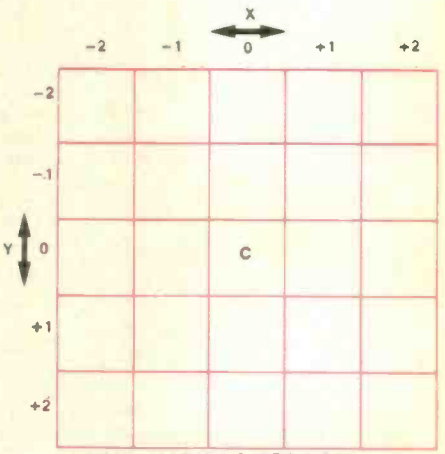
Test routine two 0MMM CAFF CBFF AMMM DAB1 3F00 DAB1 1MMM 80.

Note: AMMM points to the location of the dot 80. 1MMM is to go to the start again at 0MMM.

Test routine two should fill the screen with white dots providing your source of random numbers does not dry up.

Chip 8 D1, D2 should run as is. Chip 8 D1, D2 with 0600-0800, add 1600 at location 0200.

Relocate the others as described in the article, 'Hints for Chip 8 programmers', which is in ETI, December 1982, page 110.



MOTION CODE X,Y COORDINATES
C = CURRENT BEAST POSITION

CHANGES

0706	F00A	V0 = KEY	input key wait
0708	400C	SKF V0 NE 0C	if key = C
070A	00E0	ERASE	clear screen
070C	400C	SKF V0 NE 0C	and
070E	1706	GO TO 0706	go wait for another key
0710	400A	SKF V0 NE 0A	if key = A
0712	1696	GO TO 0696	go start again in centre
0714	400B	SKF V0 NE 0B	If key = B
0716	16C0	GO TO 06C0	start from last position – leave barrier
0718	400F	SKF V0 NE 0F	if key = F
071A	16DE	GO TO 06DE	re-do border to erase or redraw
071C	171E	GO TO 071E	no op. use to go to user routine
071E	400D	SKF V0 NE 0D	if key = D
0720	1724	GO TO 0724	go get no. dots to draw at random
0722	1706	GO TO 0706	any other key go to key wait
0724	F00A	V0 = KEY	input no. of dots
0726	8004	V0 = V0 + V0	
0728	8004	V0 = V0 + V0	multiply by 10H
072A	8004	V0 = V0 + V0	
072C	8004	V0 = V0 + V0	
072E	CA3F	VA = RND.3F	random X co-ord
0730	CB2E	VB = RND.2F(CB1F)	random Y co-ord
0732	A726	1 = 0726	point to dot data 80
0734	DAB1	SHOW 1 AT VA, VB	show dot at X, Y
0736	70FF	V0 = V0 + FF	take one off dot count
0738	3000	SKF V0 = 00	when all done
073A	172E	GO TO 072E	otherwise do another
073C	1696	GO TO 0696	jump to Main Line

BASIC, Chip 8 comparison

```
FN R (O) FUNCTION FOR GENERATING A MOTION
         CODE PARAMETER (BETWEEN-2 AND +2)
         CALL SUBROUTINE AT 067E.
VA=PX    HORZ. COMPONENT OF PRESENT POSITION
VB=PY    VERT. COMPONENT OF PRESENT POSITION

VC=NX    HORZ. COMPONENT OF NEW POSITION
VD=NY    VERT. COMPONENT OF NEW POSITION

V4=CI    HORZ. COMPONENT OF MOTION CODE
V5=CJ    VERT. COMPONENT OF MOTION CODE

V6=CX    HORZ. COMPONENT OF CONTACT CODE
V7=CY    VERT. COMPONENT OF CONTACT CODE

V8=SI    SIGNUM VALUE OF CI
(V4) AI  ABSOLUTE VALUE OF CI

V9=SJ    SIGNUM VALUE OF CJ
(V5) AJ  ABSOLUTE VALUE OF CJ
```

THE VIC-20 COLUMN

✶ENCOURAGEMENT✶

Ozi-Soft, in conjunction with Computer Technics, is offering to donate a VIC-20 expansion board for the best software item submitted to this column every month.

The board is Australian-designed and manufactured and simply plugs into the VIC-20's expansion slot. It features three sockets that can be independently switch-selected, plus an on-board reset switch. With it you can plug in up to three separate expansion units to your VIC-20 and avoid the hassle of plugging things in and out and turning the computer on and off each time.

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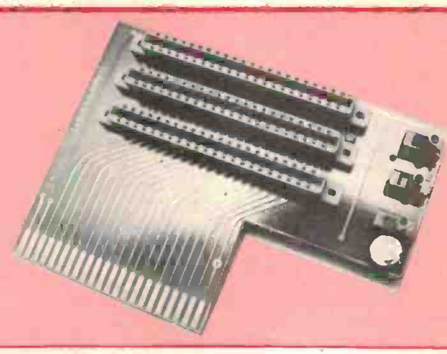
All submissions must be accompanied by a signed letter from you stating that it's your original work. The winning submission will be judged by the Editor and no correspondence will be entered into. All published submissions will be paid for.

Send entries to: **The Editor, VIC-20 Column, ETI Magazine, P.O. Box 227, Waterloo NSW 2017.**



September's winner of the expansion board is Phil Campbell of Bondi Junction NSW who wrote the program 'Times Square Display'.

TIMES SQUARE DISPLAY

Phil Campbell, Bondi Junction NSW

The program allows a message of up to 88 characters to be entered, then scrolls the message across the screen in double size characters.

The double sized characters are created in lines 60 to 110 by copying character data from memory locations 32768 to 33032 into RAM. This RAM has been reserved in line 40 by opening a 'dummy' RS232 file.

Each data value is copied twice into adjacent RAM locations (lines 60-70), then a simple POKE to location 36867 in line 80 sets the VIC character matrix size to 8 by 16 mode.

As each character now fills 16 memory locations in RAM, we are only able to squeeze 32 characters into the 512 bytes we have allocated. The 'space' character just misses out. As it is probably more useful to us than the 'back-arrow', line 110 replaces the arrow character with a blank. This means that the input message must contain an arrow character everywhere a space is required in the output display.

Almost all punctuation characters are lost too. The OPEN and CMD statements in line 100 suppress the '?' which would normally prompt the user's input. Try leaving them out, and look at the random character which appears in place of the usual prompt.

Screen width, height, horizontal and vertical origins are set in lines 120 to 160.

The display scrolling routine in lines 180 to 240 simply over-prints sequential segments of the message string, each one character longer than the previous one. The delay in line 230 can be varied to provide the desired reading speed.

TIMES SQUARE DISPLAY

```
40 CLR:OPEN2,2,2:PRINT"[illegible]":POKE36879,25
50 PA=32768:CO=7168
60 FORPA=32768TO33032:POKECO,PEEK(PA)
70 POKECO+1,PEEK(PA):CO=CO+2:NEXTPA
80 POKE36869,255:POKE36867,PEEK(36867)OR1
90 PRINT" ENTER MESSAGE USING    ← FOR SPACE
100 OPEN1,3:CMD1:INPUT"[illegible]MESSAGE[illegible]";M$
110 FORCO=7664TO7679:POKECO,0:NEXT
120 REM*******SET SCREEN PARAMETERS*******
130 POKE36867,PEEK(36867)AND129OR3
140 POKE36865,65
150 POKE36866,PEEK(36866)AND128OR27
160 POKE36864,PEEK(36864)AND128OR7
165 POKE36879,28
170 REM*************MOVING DISPLAY************
180 X=LEN(M$)
190 DIMA$(X+1)
200 FORI=1TOX:A$(I)=RIGHT$(M$,I):NEXT
210 FORG=X+1TO0STEP-1
220 PRINT"[illegible]"A$(G);
230 FORDELAY=1TO150:NEXTDELAY:GOSUB300:NEXTG
240 GOTO210
300 REM***********SOUND SUBROUTINE***********
310 V=36878:N=36877:S3=36876
320 POKEN,220:FORI=15TO0STEP-3:POKEV,I
330 POKES3,225:FORD=1TO10:NEXTD,I:RETURN
READY.
```

ENGLAND

David Alram, Banksia Park SA

This program has been created by using the graphics and sound capabilities of the VIC.

The first part of the program, up to line 135, draws the English flag. The second part is a simple music routine which plays 'God Save the Queen', while the flag is being displayed on the screen.

When the tune has finished the program goes into a never-ending loop. All you have to do to get back to the normal mode is to hit the STOP and RESTORE keys together, or just hit STOP to get the cursor on the screen.

ENGLAND

```
2 S3=36876
3 V=36878
5 POKE V,15
10 PRINT"[illegible]";
15 POKE36879,107
20 PRINT"[illegible]";
25 PRINT"[illegible]";
30 PRINT"[illegible]";
35 PRINT"[illegible]";
40 PRINT"[illegible]";
45 PRINT"[illegible]";
50 PRINT"[illegible]";
55 PRINT"[illegible]";
60 PRINT"[illegible]";
65 PRINT"[illegible]";
70 PRINT"[illegible]";
80 PRINT"[illegible]";
85 PRINT"[illegible]";
90 PRINT"[illegible]";
95 PRINT"[illegible]";
100 PRINT"[illegible]";
105 PRINT"[illegible]";
110 PRINT"[illegible]";
115 PRINT"[illegible]";
120 PRINT"[illegible]";
125 PRINT"[illegible]";
130 PRINT"[illegible]";
135 PRINT"[illegible]";
140 GOSUB 150
145 GOTO 145
150 READ P
155 IF P=-1 THEN 190
160 READ D
165 POKES3,P
170 FOR N=1 TO D:NEXT N
175 POKES3,0
180 FOR N=1 TO 20:NEXT N
185 GOTO 150
190 POKEV,0
195 RETURN
300 DATA175,500,175,500,183,500,167,750,175,250,183,500,191,500,191,500,195,500
310 DATA191,750,183,250,175,500,183,500,175,500,167,500,175,1500,201,500
320 DATA201,500,201,500,201,750,195,250,191,500,195,500,195,500,195,500,195,750
191,250
330 DATA183,500,191,500,195,250,191,250,183,250,175,250,191,750,195,250,201,500
340 DATA207,250,201,125,195,125,191,500,183,375,175,125,175,1500
350 DATA -1

READY.
```

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Minimum of 32 characters

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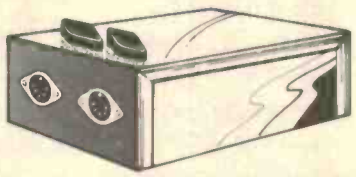

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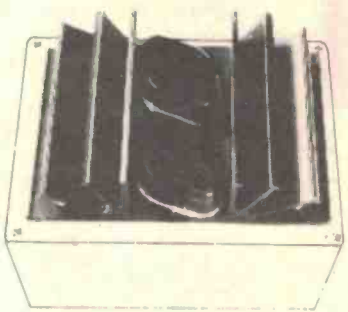

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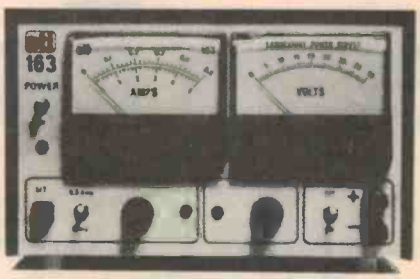

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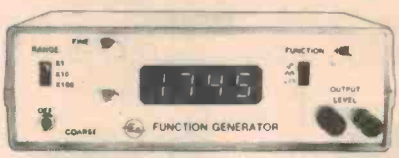

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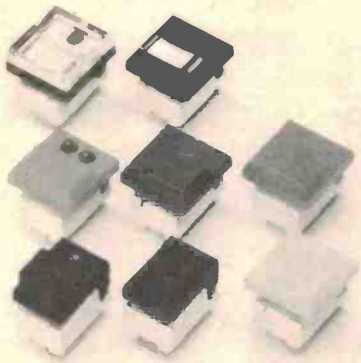

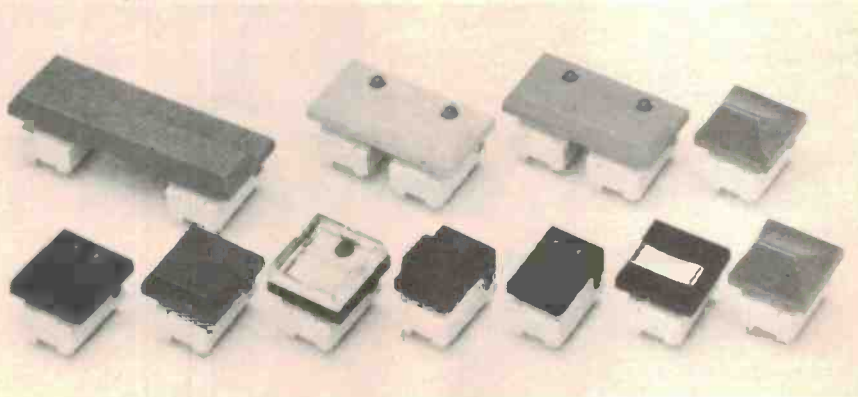

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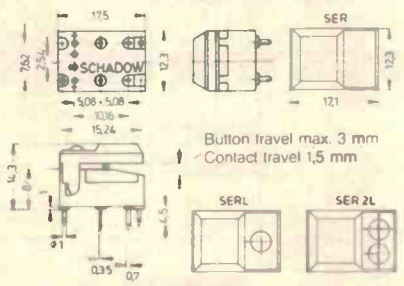
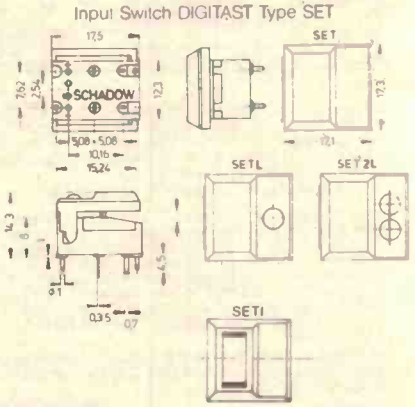


Input Switch DIGITAST Type SET



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LEXICON 1865

THREE-IN-ONE DIGITAL SCOPE MULTIMETER

Kent Instruments has released a digital scope multimeter which combines the functions of a full-feature digital multimeter, an oscilloscope and a transient recorder in one compact, battery-powered unit.

The instrument, the Metrawatt M2050, represents another advance in miniaturisation.

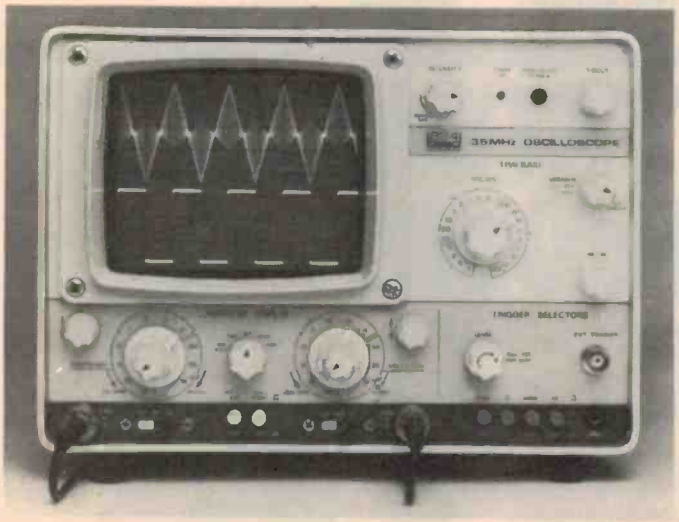
The digital multimeter has 32 ranges, covering current, voltage and resistance. The LCD display features 3½-digit resolution, and ac measurements may be made as average value or true RMS.

The flat-screen LCD oscilloscope provides a high-contrast graphic image with a resolution of 128 x 64 dot matrix. There are 30 input sensitivities for voltage and current, plus eight time deflections, each expandable by four. Trigger capabilities include EXT/INT and AUTO, with trigger level being continuously variable. The instrument can also display a true RMS curve.

Configured in its transient recorder mode, the M2050 uses two separate memories to store random transient events. The maximum sampling rate is 500 kHz.

Completely battery-powered (an ac adaptor is included), the MC2050 will operate for up to eight hours on a single charge. Saved data will be retained for about six months with the instrument off and the batteries charged.

For further information, contact **Kent Instruments, 70/78 Box Road, Caringbah NSW 2229. (02)525-2811.**



BWD's 824 OSCILLOSCOPE

BWD Instruments has released the Model BWD 824 oscilloscope, featuring an internal graticule CRT with 6 kV EHT.

The screen presents crisp, high-intensity displays, even of fast low-repetition signals. The CRT geometry is accurate and signals are sharply focussed to the graticule edge.

The vertical amplifiers can be displayed independently, alternatively, chopped or added. Channel 2 can be inverted to provide a differential display with Channel 1, and 2.5:1 vernier control is provided between each attenuator step.

The BWD is backed by a comprehensive range of accessories.

For further information, contact **BWD Instruments, P.O. Box 325, Springvale Vic. 3171. (03)561-2888.**

LOW-CURRENT LINEAR POWER SUPPLIES

Electronic Technologies has released the LN-1000 series of low-current dc power supplies and the LN-2000 series of linear dc power supplies.

Presented in an open-frame format, each supply in the LN-1000 range is rated to deliver about 3 W of well-regulated dc power from the ac mains.

Standard LN-1000 single-output versions include 5 V at 650 mA, 9 V at 300 mA, 12 V at 250 mA, 15 V at 200 mA and 24 V at 150 mA. The dual-output range includes ±9 V at 150 mA, ±12 V at 150 mA and ±15 V at 100 mA.

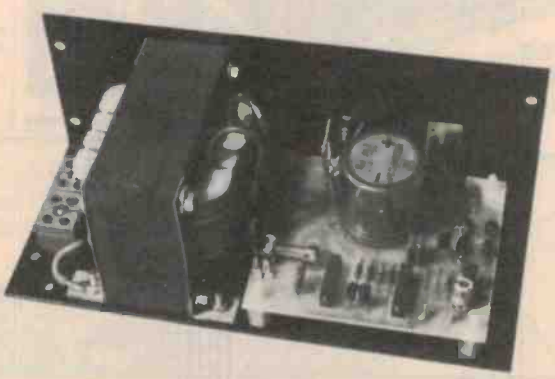
All supplies feature output indicator LEDs, current limiting and input transient suppression. The LN-1000 power transformer meets ASC 3126. Input and output connections are via screw terminal blocks, with inbuilt wire protectors.

Typical applications for the LN-1000 include isolation amplifiers, panel instruments or indicators, alarm circuits, extra floation power rails, preamp supplies, digital line drivers and OEM applications.

The LN-2000 series is available in either open-frame or bench-mount format. Each supply in the range features adjustable output voltage, good regulation, short-circuit protection, low ripple and output indicator LEDs. The transformer is in accordance with ASC 3126.

The single-output versions, which are equipped with crowbar overvoltage protection, include 5 V at 3 A, adjustable 4 V to 6 V, and 15 V at 2 A, adjustable 6 V to 16 V. The dual-output version is ±15 V at 1 A, adjustable ±6 V to ±16 V, with each output separately adjustable.

For further details, contact **Electronic Technologies, PO Box 1518, Macquarie Centre, North Ryde NSW 2113. (02) 816-1498.**



SOLDERLESS BREADBOARDING

Electronic Development Sales is now stocking the redesigned and improved SK-10 solderless breadboarding socket from E&L Instruments, of Connecticut.

The SK-10 is now made from noryl, a plastic material with less capacitance and which permits higher frequency operation and more sophisticated and diversified breadboarding. A new mould, a new forming die and a permanent moulded-in tie-point numbering system are other benefits of the SK-10.

A lifetime guarantee is offered on the socket — any socket which does not perform to specifications can be returned for replacement.

For further information, contact **Electronic Development Sales, 92 Chandos Street, St Leonard's NSW 2065. (02)438-2500.**

DIGITAL-TO-ANALOG CONVERTER CHIP

The Fairchild UA565 chip is a fast 12-bit digital-to-analog converter combined with a high-stability voltage reference on a single monolithic chip. The UA565 chip uses 12-precision, high-speed bipolar current steering switches, control amplifier, laser-trimmed thin-film resistor network and buried zener voltage reference to produce a high-accuracy analog output current.

The internal buried zener reference is laser-trimmed to 10.00 V with ±1% maximum error. The reference voltage is available externally and can supply up to 1.5 mA beyond that required for the reference and bipolar offset resistors.

The UA565 is available in four performance grades. The UA565J and K are specified for use over the 0 to 70°C temperature range and the UA565S and T grades are specified for the −55 to +125°C range.

For more information, contact **Fairchild Australia, 366 Whitehorse Road, Nunawading Vic. 3131. (03)877-5444.**

WELLER'S POSTER

Cooper Tools, the manufacturer of Weller soldering equipment, has published a colour poster of its Weller soldering and desoldering tips.

The poster depicts — by number, temperature and range — all Weller tips available.

For a complimentary copy of the poster, contact the **Cooper Tool Group, P.O. Box 366, Albury NSW 2460. (060) 21-5511.**

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For further information phone:

Philips Electronic Components and Materials,
P.O. Box 50, Lane Cove, 2066. Phone: **Sydney** 427 0888.
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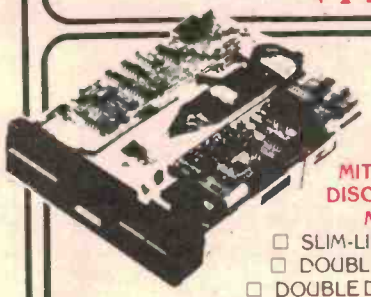

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4013	30c	7410	23c	7490	45c	74LS85	30c
4015	55c	7411	30c	7493	45c	74LS90	30c
4042	45c	7413	45c	74121	45c	74LS93	30c
		7414	45c	74LS11	23c	74LS123	30c
7400	23c	7420	23c	74LS12	23c	74LS157	30c
7402	23c	7430	23c	74LS14	55c	74LS174	30c
7403	23c	7432	23c	74LS15	23c	74LS240	75c
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Ideal for both home and industry, the Bosch Digitimer DT201 can be used for:

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RAM RIP-OFF: MOTOROLA WARNS ITS CUSTOMERS

Motorola's Semiconductor Products Sector has revealed that memory devices stolen from one of the company's assembly plants are showing up in the marketplace. The memory devices include a quantity of 64K dynamic random access memories (DRAMs) and a smaller number of 16K DRAMs taken from "raw stock" at one of the company's plants.

When they were stolen, these parts were packaged in plastic, only partially tested, and were not marked with the company's name. Motorola now believes its own logo and possibly competitors' logos are being used on these parts.

"We want to alert our worldwide customers to buy only from authorised distributors or Motorola sales people," said Gary Johnson, general manager of Motorola's Texas-based MOS Integrated Circuits Group.

"Because these devices were not fully tested and some may even be rejects, Motorola cannot verify that they meet our high performance and reliability standards."

Mr Johnson said the company is making every effort to recover the stolen parts, and that some of the persons implicated in the theft have been apprehended.

For further information, contact **Asia Pacific Marketing Headquarters, Motorola Inc, P.O. Box 89064, Kowloon City, Hong Kong.**

TEXAS ACROSS THE TASMAN

Texas Instruments has appointed Standard Telephones and Cables as a New Zealand distributor for its semiconductor product range.

"The franchise agreement will substantially boost product support and availability for Texas Instruments semiconductors and components in New Zealand," said Ian Hawkins, marketing manager for Texas Instruments' Semiconductor Division.

As well as integrated circuits components, STC will carry a range of Texas Instruments ic sockets and will support the wide range of adds-on-memory board products.

For further information, contact **Standard Telephones and Cables, P.O. Box 26-064, Auckland, New Zealand.**

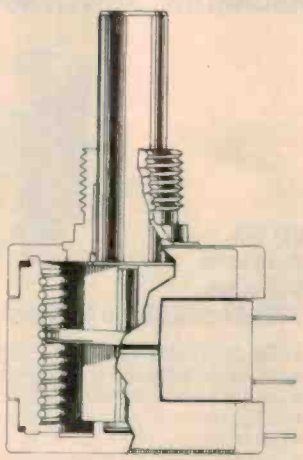
LOW-COST PRECISION POT

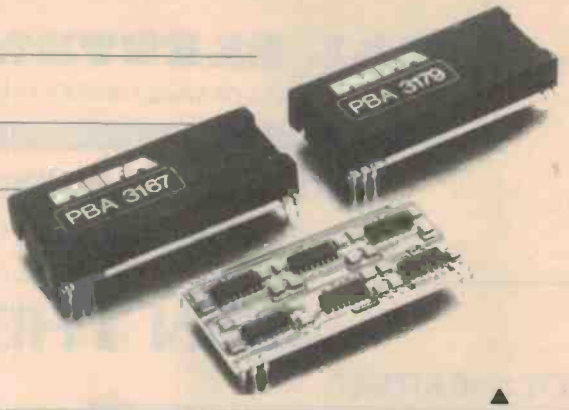
Designed to meet industrial standards, the new Bourns 3590 10-turn precision potentiometer is available with O-ring seals for board washing.

The Bourns pot has a resistance range of 200R-100k and an operating temperature range of −55°C to +125°C.

Made for long-life application, the unit offers a load life of 1000 hours and rotational life of one million revs. It has a body diameter of 22 mm and a length of 19 mm.

For further information, contact **Rifa, 202 Bell Street, Preston Vic. 3072. (03)480-1211.**





ANTI-ALIASING FILTERS WITH FLAT RESPONSE

Rifa's new PBA 3167 and PBA 3179 are low-pass filters intended for use as anti-aliasing filters in digital audio systems.

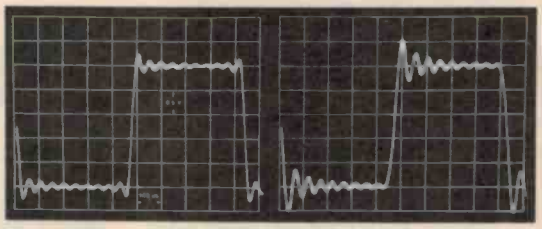
Constructed in thick-film hybrid technology, the units feature flat amplitude response within ±0.2 dB from dc to 20 kHz (PBA 3167) and to 15 kHz (PBA 3179) respectively.

The stop-band attenuation is typically 80 dB for the PBA 3167, while the PBA 3179 is specified at 60 dB. The dynamic range of 110 dB at 1 kHz exceeds that of a 16-bit digital system, keeping the filter-induced noise at a sufficiently low level.

The filters also contain a phase equaliser that keeps the phase-shift almost linear up to near the pass-band edge.

This results in a group delay that is constant within ±10 µs up to 19 kHz for the PBA 3167 and ±15 µs for frequencies up to 13 kHz for the PBA 3179.

For further information, contact **Rifa, 202 Bell Street, Preston Vic. 3072. (03)480-1211.**



RIFA PBA 3167 with built-in phase-correcting delay-equaliser gives a symmetrical squarewave response with minimum ringing.

Ordinary 20 kHz low-pass filter with non-linear phase-response.

PRICE REDUCTION FOR LED LIGHT-BAR SERIES

A price reduction of up to 25% has been announced for Hewlett-Packard's LED light bars.

Light-bar products eligible for this price reduction include the high-efficiency red HLMP-2600 and HLMP-23X0, the yellow HLMP-2700 and HLMP-24X0, and the green HLMP-2800 and HLMP-25X0 series.

Designed for use as backlighting sources for annunciator messages in front-panel displays, these light bars provide bright, uniform light-emitting surfaces. Common applications include illuminating legends and symbols in business machines, medical instrumentation, telecommunications equipment and automotive dashboards.

For pricing and availability, contact **Hewlett-Packard Australia, 31-41 Joseph Street, Blackburn Vic. 3130. (03) 890-6351.**

A laboratory standard function and pulse generator

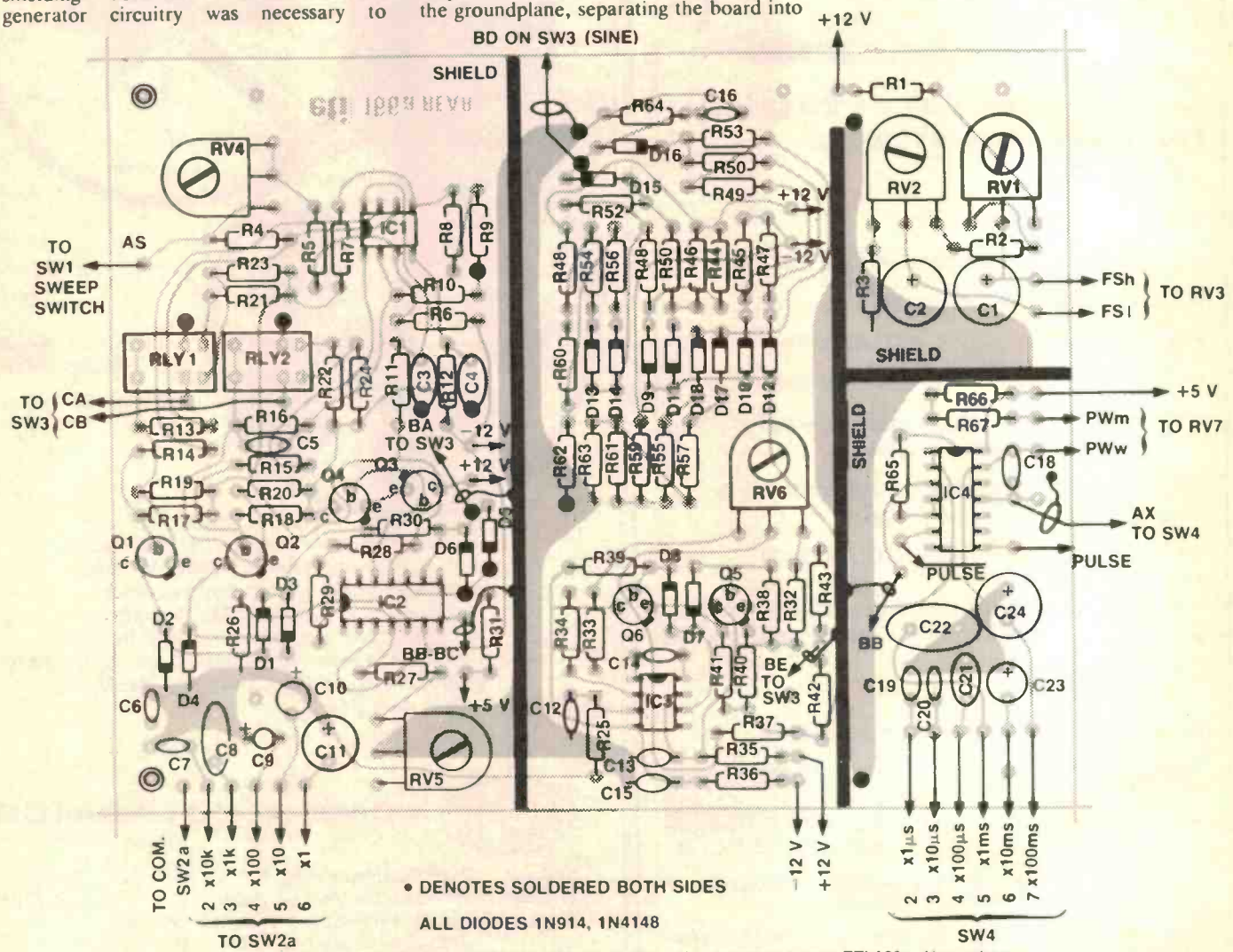
Part 4

David Tilbrook

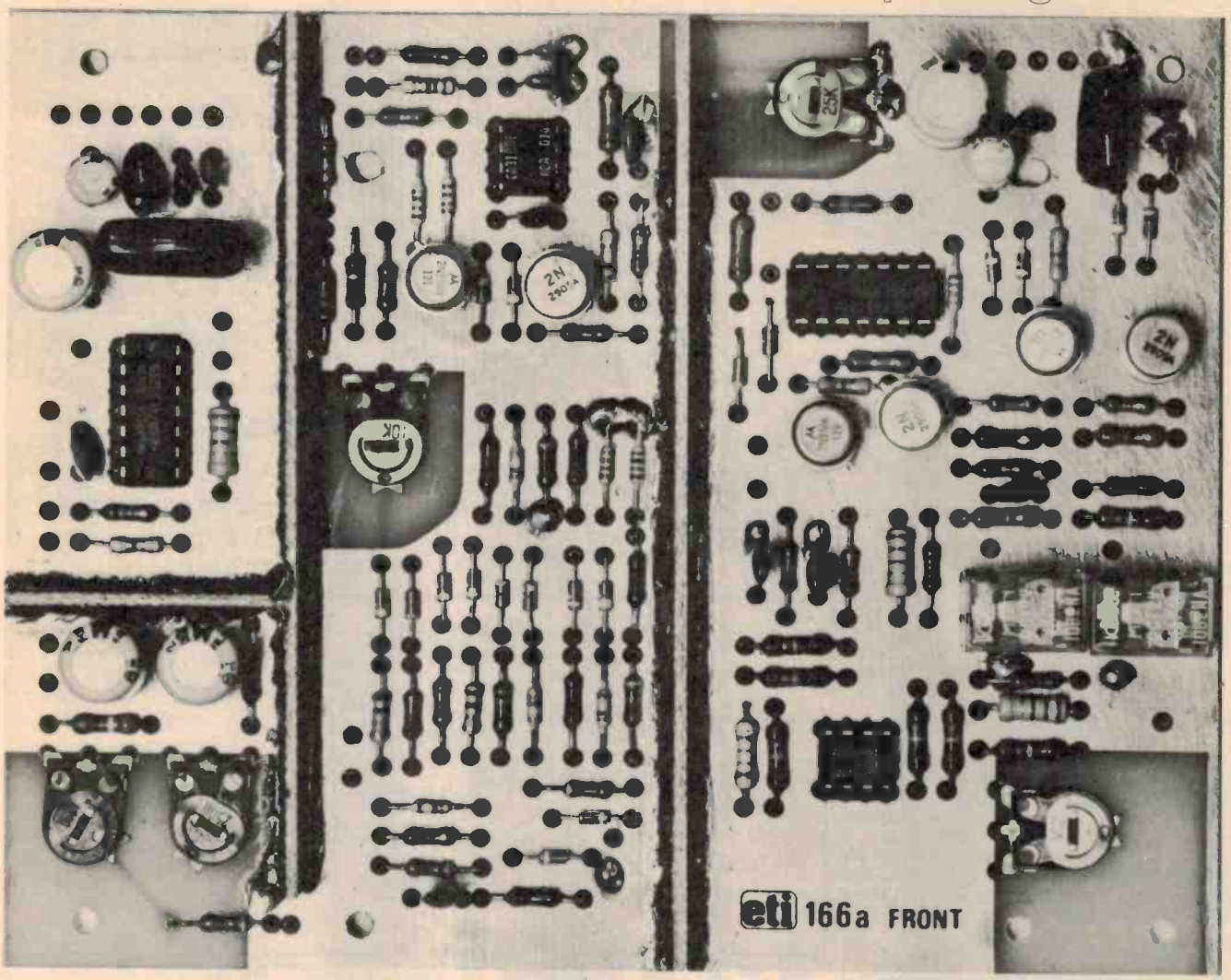
THIS INSTALMENT covers construction of the main generator board plus final assembly and setting up. I had to employ RF construction techniques on the main generator board as high speed signals are generated, pc tracks start to behave like transmission lines and 'reflections' cause ringing at certain portions of the waveform, spoiling the purity of the generated signal. Also, because high speed switching transients are generated by portions of the circuit, I found that shielding between sections of the generator circuitry was necessary to prevent these transients being coupled from one section to another and upsetting the operation.

The accompanying photograph of the main generator board (ETI-166a), illustrates the general construction. A large 'groundplane' is on the component side of the board. Etched-out holes permit component leads to pass through to the track side. Some components have leads 'earthed' to the topside groundplane. The three shields are made from 15 mm wide strips of double-sided pc board soldered to the groundplane, separating the board into four sections. That on the far right contains the main oscillator (Circuit A) while the centre section contains the sine shaper (Circuit B). The section at the upper left contains the pulse generator (on Circuit D) while the small section at lower left contains two set trimpots and two bypass capacitors.

The frequency counter board (ETI-166b) is mounted above this board with long bolts and nuts to position it. All trimpots on the main generator board are still accessible, however. ▶



Component overlay. Showing general assembly of the main generator board, ETI-166a. Note where shielded cable is used. Don't forget to link pin 7 of IC2 (BB-BC) to pin 3 of IC4 (BB). Use shielded cable. Pin 7 of IC2 also goes to the input of the Frequency Meter board (BC) — again, used shielded cable. Note the points soldered on both sides of the board. Some are linked by component leads, some by a tinned copper wire link.



Main generator board. View of the completed ETI-166a main generator board. note the size and positioning of the shields. A number of top-to-bottom side links have to be installed before the shields are soldered in place (see text). To terminate the flying leads from this board, either pc stakes or short lengths of tinned copper wire are soldered in place in the appropriate positions.

PARTS LIST — ETI-166a

Resistors ..... all ¼W, 5%
- R1, 58, 59 ..... 470R
- R2, R71 ..... 390R
- R3, 35, 36, 56, 57, 60, 61 ..... 10R
- R4, 5, 6, 7, 8, 10, 13, 16 ..... 820k
- R9, 26, 30, 66, 73 ..... 4k7
- R11, 12 ..... 100R
- R14, 15 ..... 22k
- R17, 18 ..... 8k2
- R19, 20 ..... 820R
- R21, 22, 34, 37 ..... 1k
- R23, 24, 65 ..... 220R
- R25, 28, 31, 72 ..... 1k2
- R27 ..... 12k
- R29 ..... 56k
- R32, 33 ..... 47k
- R38, 39, 44, 45 ..... 2k2
- R40, 41 ..... 2R7
- R42, 46, 47, 70 ..... 10k
- R43 ..... 6k8
- R48, 49, 54, 55 ..... 39R
- R50, 51, 67 ..... 330R
- R52, 53 ..... 47R
- R62, 63 ..... 22R
- R64 ..... 270R
- R68 ..... 120k
- R69 ..... 39k
- R74 ..... 2k7
- R75 ..... 3k3
- R76, 77, 78 ..... 47R
- RV1, RV2 ..... 100R min. trimpot.
- RV3, RV9 ..... 1k/A pot.
- RV4, RV5 ..... 25k min. trimpot.
- RV6 ..... 10k min. trimpot.
- RV7 ..... 50k/A pot.
- RV8 ..... 10k/A pot.

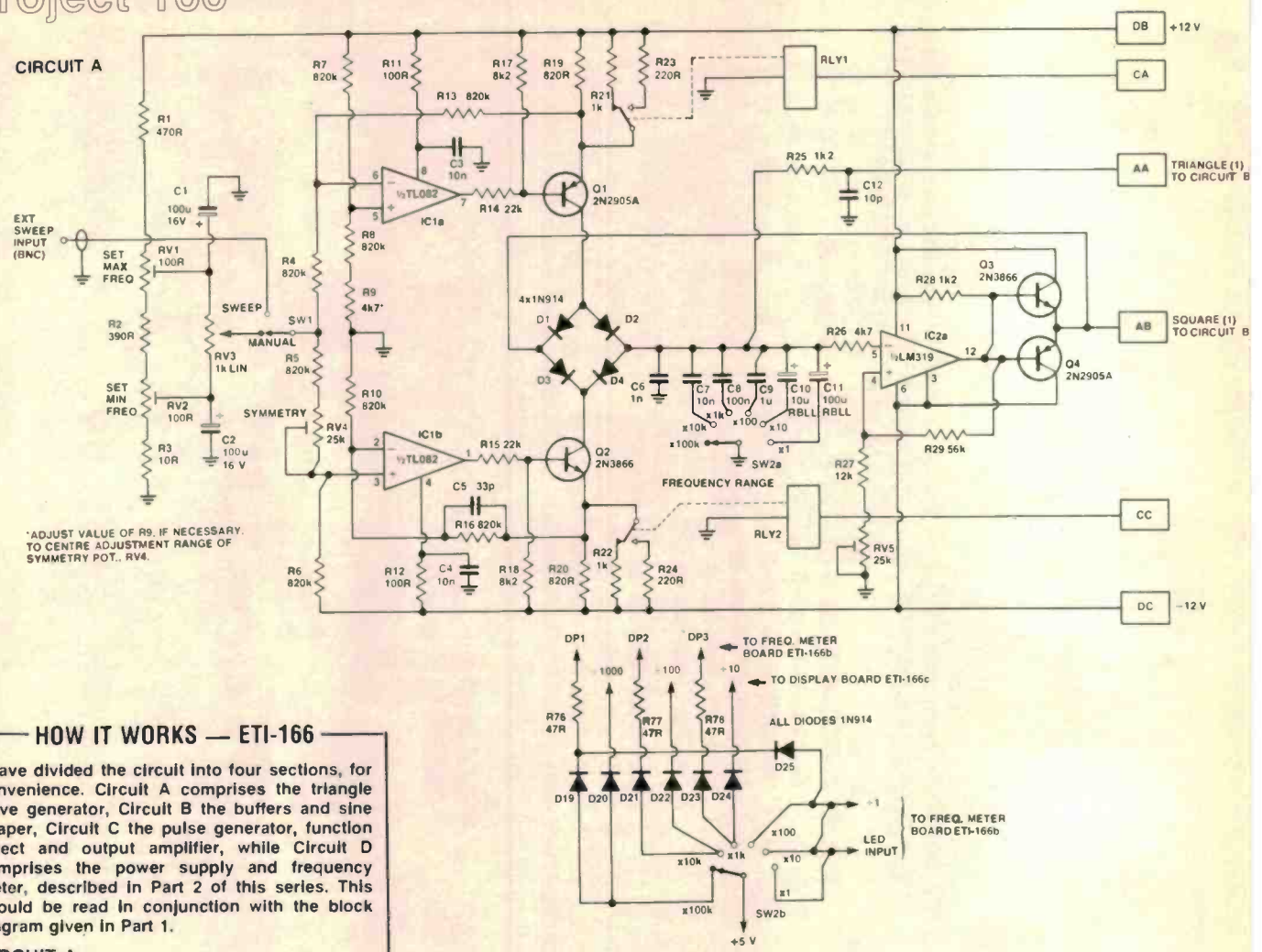
Capacitors
- C1, 2, 11 ..... 100µ/16 V RBLL
- C3, 4 ..... 10n 'bluechip' ceramic
- C5 ..... 33p ceramic
- C6 ..... 1n greencap
- C7 ..... 10n greencap
- C8 ..... 100n greencap
- C9 ..... 1µ/16 V tant.
- C10 ..... 10µ/16 V RBLL
- C12, 14 ..... 10p ceramic
- C16 ..... 2n2 greencap
- C17 ..... 27p ceramic
- C18 ..... 470p ceramic
- C19 ..... 5n6 greencap
- C20 ..... 56n greencap
- C21 ..... 560n greencap
- C22 ..... 5µ6/16 V RBLL
- C23 ..... 56u/16 V RBLL
- C24, 13, 15 ..... 100n 'bluechip' ceramic

Semiconductors
- D1-D25 ..... 1N914, 1N4148
- IC1 ..... TL082, TL072, µA772
- IC2 ..... LM319, µA319
- IC3 ..... CA3100
- IC4 ..... 74122 (see text)
- Q1, Q4, Q6 ..... 2N2905A
- Q2, Q3, Q5 ..... 2N3866

Miscellaneous
- SW1 ..... SPDT min. toggle switch
- SW2, SW5 ..... two-pole, six-pos. rotary switch
- SW3 ..... two-pole, five-pos. rotary switch
- SW4 ..... one-pole, seven-pos. rotary switch
- RLY1, RLY2 ..... SPDT min. pc mount relays (e.g: D.S.E. S-7120)

ETI-166a pc board; ETI-166b, c and d modules; ETI-1520 module; shielded cable; hookup wire, nuts, bolts etc.

Price estimate: $175-$185
(complete project)



HOW IT WORKS — ETI-166

I have divided the circuit into four sections, for convenience. Circuit A comprises the triangle wave generator, Circuit B the buffers and sine shaper, Circuit C the pulse generator, function select and output amplifier, while Circuit D comprises the power supply and frequency meter, described in Part 2 of this series. This should be read in conjunction with the block diagram given in Part 1.

CIRCUIT A

The triangle wave generator is built around a TL082 dual op-amp, IC1, a comparator from IC2 (an LM319) and a diode switching network, D1 to D4, plus associated components.

Two constant-current sources are used to charge and discharge a capacitor selected by the FREQUENCY RANGE switch, SW2a. The positive current source consists of IC1a, Q1 and associated components, while the negative current source consists of IC1b, Q2 and associated components. The inverting input of IC1a is tied to the non-inverting input of IC1b via R4, R5 and RV4. A voltage applied to the junction of R4 and R5 will vary current through the collectors of Q1 and Q2.

Now, the positive current source provides charging current for the capacitor selected by SW2a, while the negative current source provides discharging current for the capacitor. The rate of charge or discharge is determined by the current set to flow through the collectors of Q1 and Q2.

The capacitor selected by SW2a will charge via D2 until the voltage across it exceeds the upper threshold of the inverting input of IC2. Its output will then go low, turning Q4 on, its emitter 'pulling down' the cathode of D1, reverse-biasing D2 and preventing the capacitor charging current from flowing. The capacitor will then discharge via D4, at a rate determined by the current allowed to flow in the collector of Q2.

When the voltage across the capacitor reaches the lower threshold of IC2a's inverting input, IC2a's output goes high, turning Q4 off and Q3 on. This forward-biases D3 and reverse-biases D4, preventing the capacitor discharge current flowing any more. Charging current can begin to flow once again and the whole cycle is repeated as D1 is now reverse-biased, allowing D2 to permit current to flow into the capacitor from the positive current source.

As a voltage at the junction of R4 and R5 varies the current delivered by the current sources, varying this voltage will vary the frequency of oscillation. Hence, a resistive network can be used to provide frequency variations by a potentiometer, RV3 here, and setting of the maximum and minimum frequency limits.

The network R1, RV1, R2, RV2 and R3 form a simple voltage divider from the +12 V supply rail. RV3, the FREQUENCY SET control, is connected between the wipers of RV1 and RV2. Capacitors C1 and C2 are bypasses to keep hum and noise from modulating the current sources' input voltage and thus modulating the output frequency.

For a symmetrical triangle wave, the two current sources are virtually identical, the charge and discharge currents being the same. To produce a sawtooth wave, the charge and discharge currents are made unequal by means of a relay switching different value resistors in parallel with the emitter resistors of Q1 and Q2 accordingly. For a sawtooth that 'ramps up' then drops quickly to the start point, the discharge current is increased by the relay RLY2 switching from R22 to R24. Likewise, for a sawtooth that jumps up then ramps down, RLY1 switches from R21 to R23 to increase the charging current.

The triangle output is taken to Circuit B through a low pass filter, R25-C12, which removes high frequency switching 'rubbish'.

As you may have already realised, the waveform at the emitters of Q3 and Q4 is a square wave, this too, being passed to Circuit B.

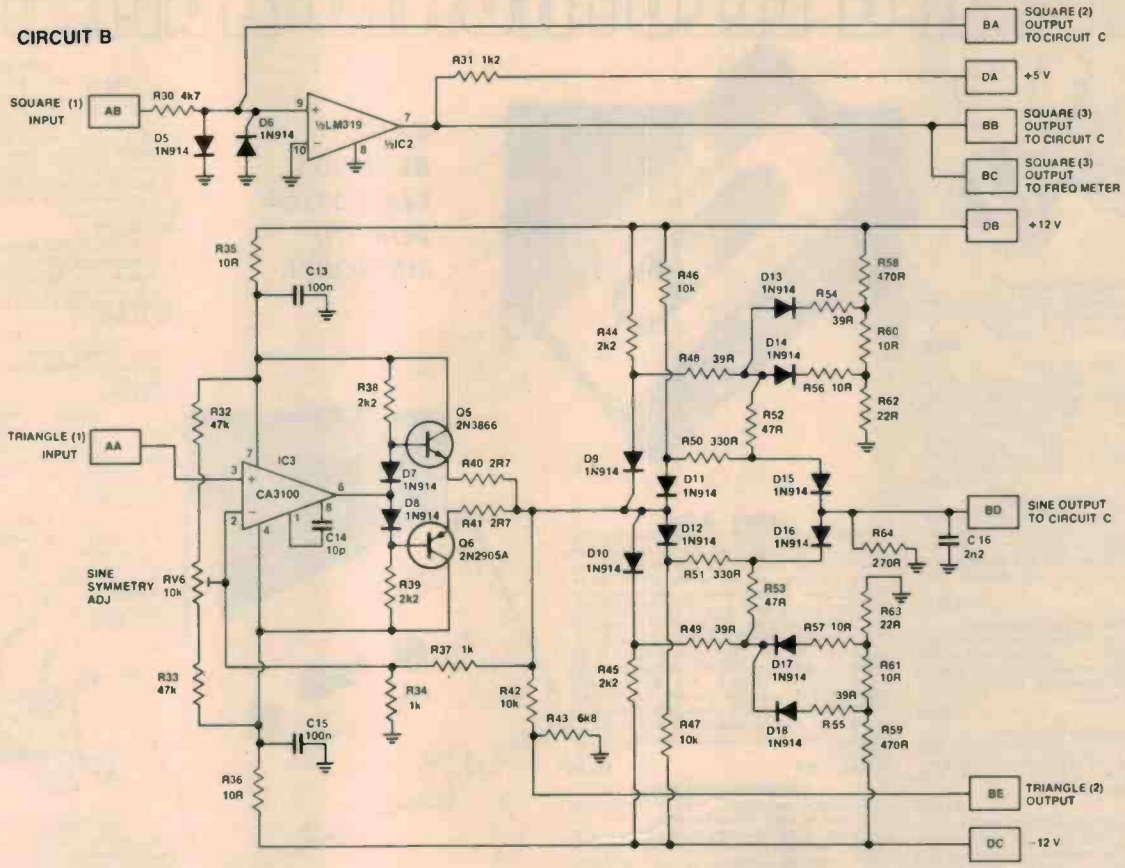
Note that the x100k frequency range capacitor is always in circuit, SW2a simply connecting the selected range capacitor in parallel. This cuts down on external wiring and reduces problems that might arise with stray inductance and capacitance at the high frequency end of the range.

The second half of SW2 is employed to switch the division ratios in the frequency meter and the decimal points in the display.

To make provision for external sweep, SW1 switches the current sources' input (junction of R4-R5) from the wiper of RV3 to the EXT. SWEEP input socket. Note that the external sweep control voltage can range from positive to negative owing to the symmetry of the current source circuits.

CIRCUIT B

There are two buffers in this section, and the sine shaper circuitry. The square input at AB is clipped by two back-to-back diodes, D5 and D6, producing a square wave with an amplitude of about 1.2 volts peak-to-peak. This is passed to the FUNCTION switch in Circuit C. It is also



Printed circuit artwork. We have not reproduced artwork for the ETI-166a pc board owing to lack of space. However, you can obtain a print, free of charge, by sending us a stamped, self-addressed envelope (A4-size) and requesting "ETI-166a Artwork". Film transparencies can also be obtained — see Shoparound in this issue.

applied to the non-inverting input of IC2b, the other half of the LM319, here acting as a squarewave buffer. As this has an open-collector output stage it can be used to drive TTL circuitry by using a pullup resistor from the +5 V rail, and that's the function of R31 here. The output of IC2 goes to the pulse generator input in Circuit C and also to the frequency meter input.

The triangle output from Circuit A is buffered by a stage similar to the output amplifier (ETI-1520 — Part 1). IC3, Q5 and Q6, plus associated components, provide a low impedance output, wideband buffer amp having a gain of two (determined by feedback resistors R34 and R37). The output of this buffer stage, at the junction of R40-R41, drives the sine shaper input. The sine shaper is a diode-resistor network that progressively changes the slope of the incoming waveform as it increases in amplitude, 'rounding off' the waveform to approximate a sinewave. It's too complex to fully describe here, but it works very well indeed.

The sine shaper output is taken from the junction of D25 and D26. A load is provided by R64 and the nominal output amplitude is 1.2 Vp-p. Capacitor C15 provides a little high frequency bypassing to remove high frequency switching rubbish. The sinewave output at BD is passed to the FUNCTION switch in Circuit C.

The triangle waveform at the buffer (junction of R40-R41) is attenuated to 1.2 Vp-p amplitude and also passed to the FUNCTION switch in Circuit C.

Construction

First do a visual check of the ETI-166a board. See that there are no broken tracks, holes incorrectly drilled or not drilled at all and that there are no tiny copper bridges between closely-spaced tracks.

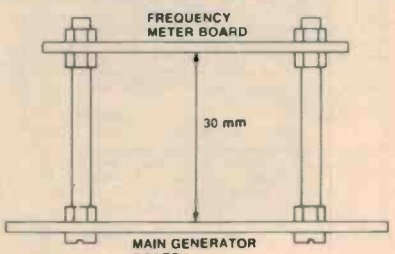
There are three top-to-bottom links to be soldered in. Identify these from the diagram and solder them in place first. Then, cut three shields to size and solder them in place, starting with the longest one. Hold the shield in position and 'tack' it in two places — on either side at each end. When it's in position, run a generous bead of solder down the joint along both sides. Use a hot iron with a large, wedge-shaped tip of about 4 mm width. A temperature-controlled iron is best for this sort of job. Don't overheat the board though or you'll risk lifting the copper. Do the next longest shield followed by the short one last of all.

The components can be soldered in place next, commencing with the resistors. Follow with the capacitors, making sure you get the electrolytics the right way round as shown on the component overlay. Take note of those components that have a lead soldered on the top side.

All the diodes can be soldered in place next, taking care that you correctly orientate them. Follow with the trimpots, then the transistors and ICs. If you wish, IC sockets may be used. Ensure that all the ICs and transistors are placed in the correct orientation. The transistors should be positioned such that the bottom of their cases sit only two millimetres or so off the board. Finish off by soldering the two pc mount relays in place.

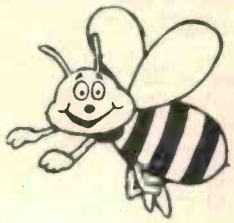
Having finished the board, carefully check *everything*.

Before proceeding, the four bolts that secure the frequency counter board (ETI-166b) should be assembled according to the accompanying diagram. ▶



Piggyback. The ETI-166b Frequency Meter pc board rides 'piggyback' on the main generator board, about 30 mm above it, using 40 mm long 6 BA bolts and nuts. the 16-pin DIL socket for the ETI-166c Display Board mounts toward the front panel.

JAYCAR & ELECTRONIC AGENCIES



KEPLERS LAWS
A simulation of planetary orbits, producing data for analysis by students of the laws of Periods, Ellipses and Areas. Year 11/12 Physics.
Cat. XE-6900 $14.95

GRAPHIC LIFE
Life is "played" on a two dimesional grid of squares, so that every square has eight neighbouring squares or cells. Each cell is either alive or dead and each cell lives or dies depending on its neighbour cells. A dead cell with three live neighbours will be brought to life in the next generation. A very intrigueing experimenters tool kit.
Cat. XE-6905 $14.95

MILLIKAN'S EXPERIMENT
In 1910 Millikan deduced the charge of an electron. Side A is a simulation in HIRES graphics of the experiment. Side B contains a tutorial on Millikan and his experiment and students must answer questions as they work through. Year 11/12 Physics.
Cat. XE-6910 $14.95

DISASSEMBLER By Dreamcards
Some may say "Not another Disassembler". But this one has a difference. It allows you to set out where the data fields are so the computer is saving time, not rying to disassemble data. A program you shouldn't be without.
Cat. XE-6915 $15.00

CHEAPIE By Dreamcards
Two top quality programs for the price of one. The best Hangman we've seen yet on side A and a superb version of Battleship on side B. Both have excellent graphics.
Cat. XE-6920 $15.00

CANNIBALS AND MISSIONARIES
The old logic problem game of transferring 3 Cannibals and 3 Missionaries from one side of a river to the other in a boat that holds two. If there are more Cannibals than Missionaries on either side at any time the Cannibals revert to their favourite form of feeding.
Cat. XE-6925 $14.95

COMPOSER BEE
This is a very well written program for music. This program allows you to compose, play, edit, transpose as well as being able to load and save your music. A program that has been a long time in the writing and well worth buying.
Cat. XE-6930 $22.50

WORD ADVENTURE
A program with very good graphics using little characters to entice the user to think what word is either a synonym, antonym or homonym of the word they are showing. Everytime you get it wrong you are given more clues. After the clues run out you must face the Dragon when you must spell the word he is holding correctly before you.
Cat. XE-6935 $14.95

PONTOON
A quality fast moving card game where up to 6 players can play against the computer who is banker.
Cat. XE-6940 $14.95

WORD PROCESSOR – MYTEK
Mytek Wordprocessor comes with a quality ring binder and features most of the commands of the highly acclaimed SPELLBINDER. Mytek Wordprocessor is screen orientated and re-formats the screen to 32 lines, allowing twice the amount of text to be displayed at once. Commands, which are all single keystrokes, included APPEND BACK, CLOSE, DELETE, EDIT, FORWARD, HOLD, INSERT, KILL, LINE LENGTH, MEMORY, OPEN, PRINT, READ,SEARCH/REPLACE TOP, UNHOLD, VERIFY, WRITE and EXIT.
Mytek Wordprocessor is not a plaything. Although simple to use, it is one of the most powerful cassette based wordprocessors currently available on any microcomputer.
Cat. XE-7015 $35.00

MUSIC – 8 – MYTEK
Music8 is a music Composer/Editor that lets-you create and save music and sound effects with a flexibility that makes chopsticks of the Basic PLAY command. Music8 is a great way to learn and play music! Comprehensive instructions are included.
Cat. XE-7010 $20.00

STOCK SUPERVISOR
This program is the means of creating a stock or product data base which provides an on-line information system. This system is then capable of being continuously and easily updated to reflect all the inventory and accounting aspects of stock on hand.
Cat. XE-6865 $15.95

GAMES
BUSINESS
EDUCATION
FOR THE
MICROBEE

TRSBEE – MYTEK
TRSBEE is a package of three programs that loads TRS-80 Model 1 and 3 program tapes into the MicroBee without any additional hardware. Although some program editing will still be required prior to their running, the majority of program typing time is saved by TRSBEE. The first program loads TRS-80 BASIC programs into MicroWorld BASIC. Most prgrams may then be edited and run. The second program in the package loads any TRS-80 machine code file into MicroBee memory. The third program loads TRS-80 assembler files into the MicroBee EDITOR/ASSEMBLER. Any TRS-80 Model 1 or 3 tape may be loaded. TRSBEE opens up a whole new world of possible software on your MicroBee!
Cat. XE-7005 $30.00

HOUSEHOLD REGISTER
This program will simplify the task of determing the value of your home's contents for insurance purposes, as well as providing descriptions of all listed items in the event of their loss or destruction. Effects are catalogued by name, description and value. Nine separate rooms are provided, and up to 28 items may be listed in each.
Cat. XE-7000 $15.95

STAT PACK – STATISTICS
This program is a general purpose graph plotting, linear regression, line of best fit and correlation program. It features a t-test of significance for the correlation coefficient and, if no evidence of correlation is found, a determination of minimum sample size is performed.
Cat. XE-6999 $14.95

LOG – GENERAL PURPOSE INDEX
This program is designed to suit a wide range of records where indexing (and later searching) can be on one or two words, or on a string of up to 15 characters. Each record consists of its index heading, plus up to 12 lines of text. Each line can contain up to 41 characters.
Cat. XE-6890 $15.95

PROGRAMMING HINTS
Consists of a collection of modules which you may use to improve your own BASIC programs. They are all linked together under a menu driven display which allows you to RUN or LIST each module to see how they work.
Cat. XE-6895 $14.95

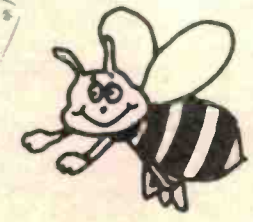
PROSPECTOR
Arcade game in which you are the prospector attempting to get gold and diamonds which are scattered around the field, and at the same time avoid two drunken bandits who are chasing you.
Cat. XE-6885 $14.95

BASIC TUTORIAL
Is a super teaching aid for any classroom. Basic Tutorial is a set of 9 interactive exercises designed for teaching Basic to the computer novice. No previous knowledge is assumed. Basic Tutorial uses a unique double screen technique to display both the normal computer output and the tutorial exercises at the one time. This allows the student to use the MicroBee in the normal way, while the tutorial instructions appear in the lower half of the screen.
Cat. XE-6860 $20.00

MACHINE CODE TUTORIAL – MYTEK
Consists of 8 interactive exercises designed for teaching machine code programming and related topics as they apply to the MicroBee computer. Only a general knowledge of the BASIC language is assumed. Machine Code Tutorial is designed to bridge the gap bewteen BASIC programming and being able to understand and use typical Z80 manuals.
Cat. XE-6855 $25.00

BUDGET – SPREADSHEET
This program is designed to speed up and simplify the task of framing a usable financial budget. Applications range from personal or household to small business finances. A quality program.
Cat. XE-6850 $15.95

SEADOG
Seadog a war game between two ships from the days of Nelson. You may play against a friend, or against the computer. The game features limited resolution graphics for the war battle sequences. As well as the enemy fleet, you must survive hazzards such as hurricanes, diseases, and your own gun aimers who do not always shoot straight!
Cat. XE-6845 $14.95



DECODE
Basic decoder and listing formatter
This programme will be an invaluable aid to any one taking first steps in understanding machine code or wants to expand their library of proven machine code routines. Decode will (a) print imbedded machine code routines fully and accurately (b) print all unprintable characters (c) provide a clearer, easier to read listing and send all output to a printer if so required. ED ASM is not required.
Cat. XE-6765 $15.95

CARDEX – CARD INDEX SYSTEM
This program simulates the card index systems of yesteryear in that it neatly files a series of records, and the user can leaf through the file inspecting each record one by one.
Cat. XE-6755 $9.95

FILEX
Filex is a larger version of Cardex, but handles larger amounts of data, and also is easier to find "the cards".
Cat. XE-6760 $14.95

FINANCIAL MANAGER
Provides an accurate and clearly formatted record of any financial account, and a cost analysis stated in money amounts and percentages – Personal Account Monitor and Business Account Analyst.
Cat. XE-6750 $15.95

TEXTED
This program helps to produce a neatly formatted document of word processor appearance, with an absolute minimum of fuss on the user's part. It is the logical alternative when a high powered (and high priced) word processor is not warranted and/or not justified.
Cat. XE-6745 $14.95

ASTEROIDS PLUS – MYTEK
Asteroids Plus is one of the finest high resolution graphic arcade games available for the MicroBee computer. It features 3-D point by point resolution graphics, shields, sound effects, intelligent objects, guided missiles, black holes and a score board. If you enjoy playing computer games, you will be captivated by Asteroids Plus.
Cat. XE-6297 $22.50

BEEZ 80 – MYTEK
This secret code disassembler will disassemble any code sequence. Nothing is illegal. It will allow you to program with codes that no other disassembler can decipher!
Cat. XE-6298 $20.00

SPACE INVADERS
One of the most popular programmes ever released. This version was written especially for the MicroBee.
Cat. XE-6030 $14.95

SCREEN DUMP
This tape comes with two programmes and can be used on both parallel and serial printers such as Star, FX80, Epson and other compatible types.
Side A - Horizontal Dump - executed from net command.
Side B - Vertical Dump - executed from CTRL P command.
Cat. XE-6970 $14.95

FORTH
A new language for the MicroBee. Comes complete with interpreter on one side of the tape and supporting programs on the other side. As well as this it includes a very well written, bound manual.
Cat. XE-6965 $45.00

MINE DROP
You are a tank running around a maze gathering all the supplies you can. It sounds easy, but you have a guided missile hot on your trail. Your only defence is a remote controlled mine which you drop and explode at will. A very fast joystick or key controlled game.
Cat. XE-6960 $14.95

PENETRATOR
A low resolution graphic version of the popular game "Scrambler". You must defeat the rockets and bomb the radars in an effort to get to the next stage which is even harder. This game can be either controlled by a Joystick or by keys. Being in Lores graphics it is a very fast game. If you are bored with the same land pattern you can devise your own.
Cat. XE-6955 $19.95

SPACE PATROL
A lot like Penetrator but in high resolution graphics. You must battle your way through the various stages where at the last stage you have four chances of blowing up a neutron bomb shelter. If you are successful, the next round is a lot harder.
Cat. XE-6950 $16.95

NO.1 FOR MICROBEE SOFTWARE!

DATABEE
This program is a well written data base management system that utilised the MicroBee to its fullest to provide a Data Management System similar to those found on larger and more expensive systems. This comes complete with large bound manual.
Cat. XE-6945 $19.95

TEACHERS MASTER TAPE
This tape allows the user to enter 20 words for a spelling list. These words are then at a later stage displayed back on the screen in clear graphics with four options of speed and display time. It makes a very useful program.
Cat. XE-6985 $21.50

FRACTIONS AND DECIMALS
Side one of the tape goes through a graphic tutorial of what fractions are and what they look like. Side two explains what equivalent fractions are and also introduces decimals to two decimal places. A well written tape which uses graphics to its fullest to teach the principles.
Cat. XE-6980 $16.95

NUMBER HANGMAN
A graphic game which helps improve times in solving mathematical questions. You must answer the question before the hangman has time to hang himself. Optional times and difficulty are available making it suitable for everyone.
Cat. XE-6990 $13.50

MEASUREMENT
This tape starts from scratch and defines the unit of measurement and what its other equivalents are. It gives exercises converting, measures small and large to the standard metre. It continues on to show perimeters, length and area and giving various exercises on the way. Another program that uses graphics to prove a point.
Cat. XE-6998 $13.50

MULTIPLICATION TABLES
This program is directed more at operation rather than age or grade. It uses graphics to enhance the display and optional time limits and difficulty to bring anyones multiplication tables up to scratch.
Cat. XE-6975 $10.95

ALGEBRA 1
This program introduces the uses of pronumerals as theoretical numbers with simple problems. Simple algebraic equations are treated showing collection of like terms, etc. It then gives exercises to try to further push the principles of algebra.
Cat. XE-6995 $13.50

METEOR RESCUE – MYTEK
Your mission is to rescue stranded astronauts. You are the commander of the Landing Module docked in space with the mother ship. It is your responsibility to guide the landing module through a meteor field, down to the surface of the planet, to land safely on a landing pad. An astronaut will then run to your landing module and you will blast off. You must use your lasers if necessary and dock with the mother ship again. A total of six astronauts must be shuffled to the mother ship.
Cat. XE-7020 $17.50

CORVILLE CASTLE
Corville Castle is an adventure which will take you to a far away place of mystic castles, fierce monsters and evil warlocks. You must enter the warlocks castle and find some dark secret which will help you to destroy the warlock. But remember, you only have until dusk.
Cat. XE-6285 $16.95

CARACE
A fast exciting graphic game for the MicroBee. You must weave your way through a field of cars and oil slicks to produce the highest score. If you're too good at one speed then try the next (10 speeds to choose from!)
Cat. XE-6700 $11.95

EYE OF MIN (32K)
An adventure game with a difference in that it gives you a picture of where you are. Once you enter the castle you are given a floor plan making it easier than moving in the dark. A very thrilling adventure game.
Cat. XE-7025 $14.95

MORSE CODE TUTOR
Perfect for all you budding young amateurs. Quality program which covers the full alphabet, random letters, and allows you to enter a sentence in English and plays it back in morse, plus more.
Cat. XE-6880 $14.95

PSYCHOTEC By Dreamcards
Psychotec provides a striking example of artificial intelligence, allowing a dialogue in English between computer and operator, the computer playing the role of psychiatrist and the operator being a "patient" on the couch. Leaves other "similar" types for dead.
Cat. XE-6875 $15.95

MERLIN By Dreamcards
Merlin is a 32K adventure set in England during the dark ages. Your task is to search through the dark forest inhabited by robbers, outlaws and creatures with awesome magic powers to find a legendary sword. An excellent adventure.
Cat. XE-6870 $25.00

YAHTZE
The famous old addictive dice game. Try to beat your own best score. Up to 3 players.
Cat. XE-6866 $14.95

UNDERWORLD OF KYN
Underworld of Kyn is an advanced adventure, average playing time to complete the game is about 10 to 12 hours for this reason it is recommended for experienced adventurers.
Cat. XE-6840 $14.95

BACUP
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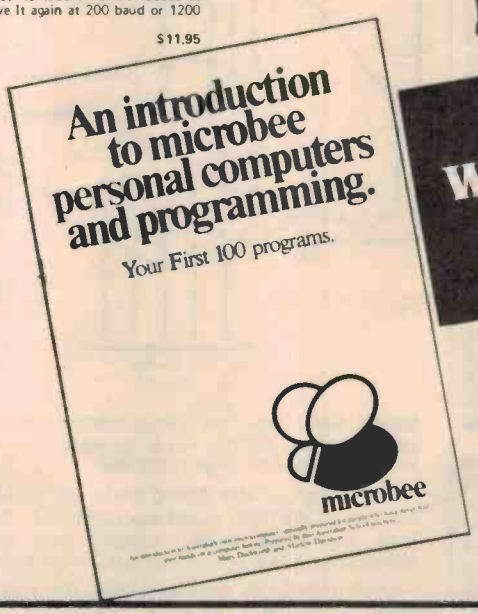

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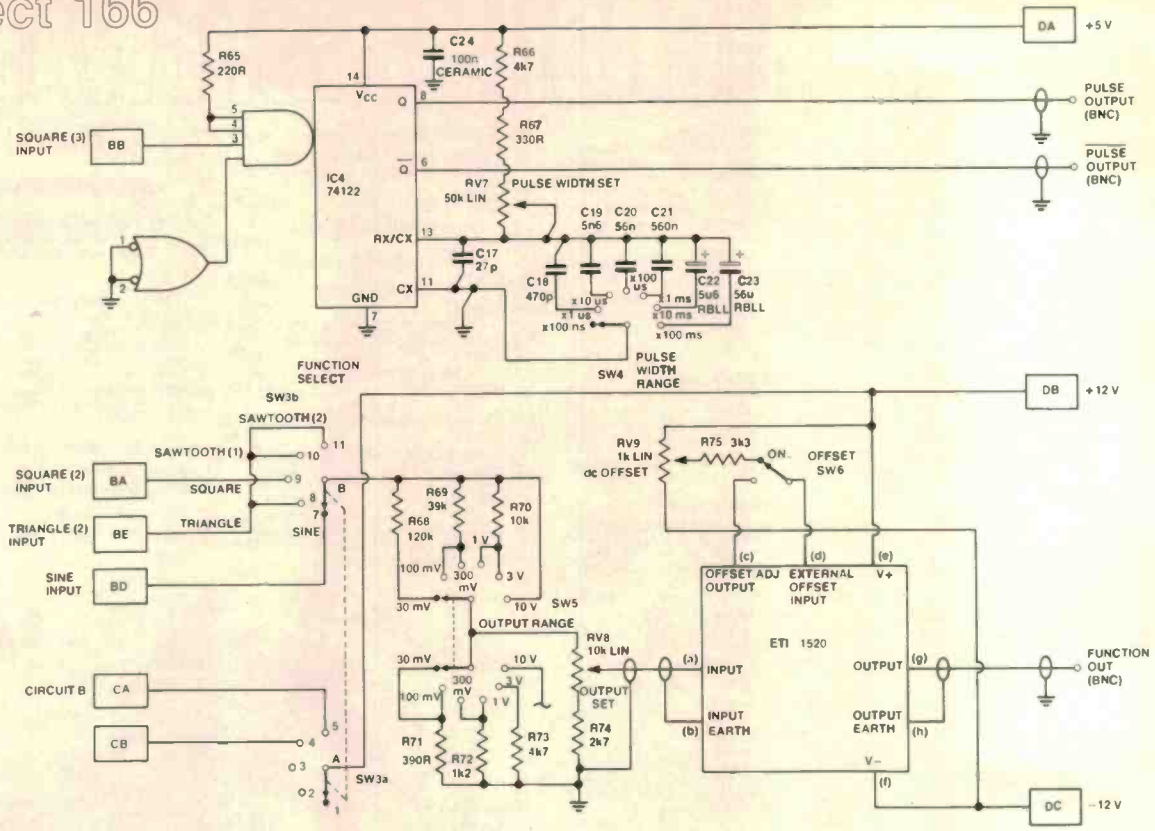
CIRCUIT C



HOW IT WORKS — ETI-166

CIRCUIT C

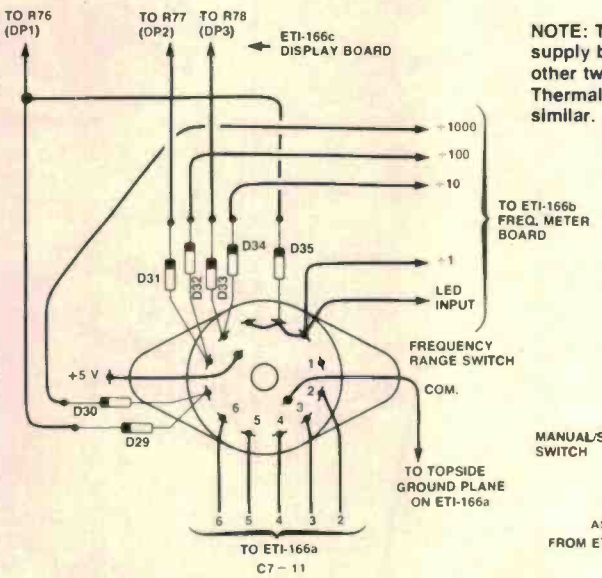
This section comprises the pulse generator, the FUNCTION switch, the OUTPUT RANGE controls and the output amplifier.

The pulse generator employs a 74122 dual monostable (IC4). Note that the 74S122 and 74LS122 can also be used here. The Q and Q outputs of IC4 go direct to the two PULSE output connectors. The PULSE WIDTH RANGE switch selects capacitors for the RC network that determines the output pulse widths. The resistance network R66-R67 and potentiometer RV7 provides the variation range for the pulse widths. Note that the x100ns range capacitor, C16, is always in circuit, the others being switched in parallel, the same as on the FREQUENCY RANGE switch. Some 74122s have to have pin 1 grounded, others do not. If pulse width 'jumping' occurs at some width settings, ground pin 1 of IC4.

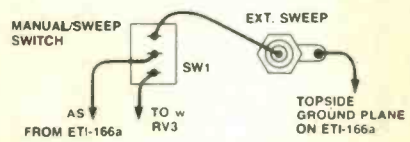
The FUNCTION switch, SW3, has two sections. SW3a selects the output required, while SW3b operates the two relays in Circuit A to provide the appropriate sawtooth output. Hence, the triangle input to SW3a is connected to three contacts.

All the signals at SW3a have a nominal amplitude of 1.2 Vp-p. The signal selected is passed to the OUTPUT RANGE attenuator, SW5. This is a straightforward voltage divider giving 1-3-10 step ratios. The OUTPUT SET potentiometer, RV8 provides continuous variation of the output down to a set low level, but not zero, as R74 is in series with RV8 to ground.

The output stage, described in Part 1, provides a gain of 20 dB, delivering a maximum output of 10 Vp-p. An OFFSET switch is provided, along with a DC OFFSET control (RV9).



Wiring SW2. How the FREQUENCY RANGE switch is wired up. The top of the front panel is toward the top of the page in this view.



Sweep switch. Wiring SW1 and the EXT. SWEEP input.

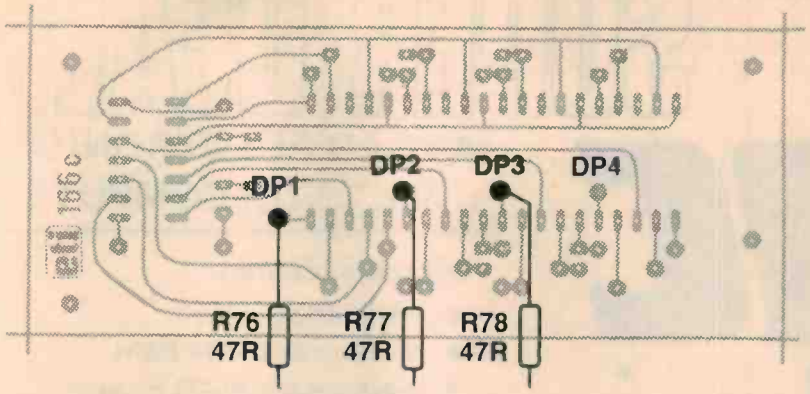
NOTE: The 7805 regulator on the power supply board needs to be larger than the other two as dissipation is higher. Use a Thermalloy THM-6030, D.S.E. no. H-3402, or similar.

Put the generator board aside and tackle the rest of the front panel assembly next. Install the three BNC sockets and the MANUAL/SWEEP switch first. The BNC sockets should be insulated from the panel using a grommet, as explained in Part 3. Don't forget to use earthing lugs as these are wired in with coax cable.

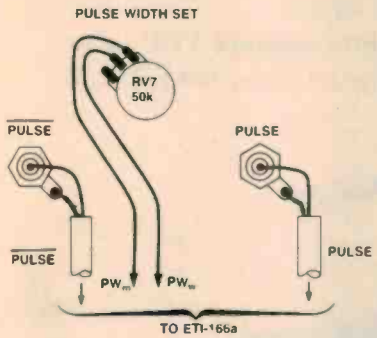
Mount the PULSE WIDTH SET pot. next, followed by the FREQUENCY RANGE switch. The FREQUENCY SET pot. and the PULSE WIDTH RANGE and FUNCTION switches can then be mounted. Don't mount the frequency meter display board yet, just to give yourself a bit more room to move for wiring up the components you've just mounted.

Now, seven diodes have to be mounted on the lugs of the FREQUENCY RANGE switch. This is shown in the diagram here. The wiring to the generator and frequency meter boards comes later. Next run a wire between the EXT. SWEEP input and the topmost lug of the MANUAL/SWEEP switch.

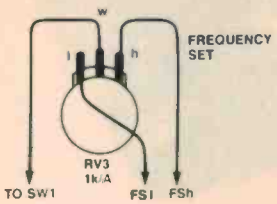
Go back to the generator and frequency



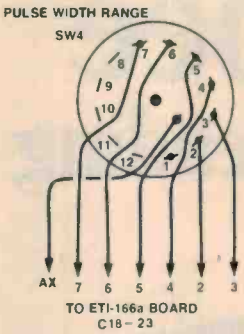
Decimal points. Resistors R76, R77 and R78 are soldered directly to the rear of the ETI-166c Display Board.



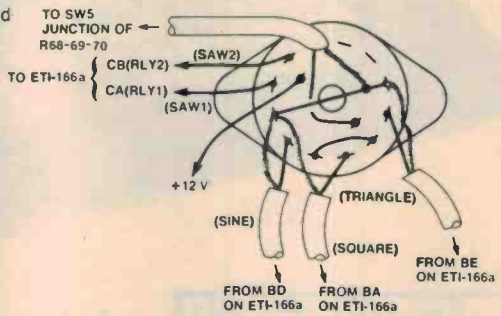
Pulse pieces. Wiring the two PULSE outputs and the PULSE WIDTH SET control.



Freq. set. Wiring the FREQUENCY SET control. Note that the wiper of RV3 goes to the lower contact of SW1, the MANUAL/SWEEP switch.



Wiring SW4. Showing the wiring from the PULSE WIDTH RANGE switch. Note that the top of the front panel is toward the top of the page in this view.



Function select. Wiring the FUNCTION switch, SW3. Note the use of shielded cable.

meter boards. Solder a pc stake or short length of tinned copper wire in every position requiring an external connection. Solder R76, R77 and R78 in position in the rear of the ETI-166c (display) pc board as shown in the accompanying diagram. Note that the CARRY output of the frequency meter (pin 14 of IC16 on ETI-166b) is not used here and no connection needs to be made to it.

Assemble the main generator board into the chassis. Start wiring it to the front panel components by connecting up the MANUAL/SWEEP switch. Follow by wiring up the two PULSE output sockets (use shielded cable). Then wire up the PULSE WIDTH SET pot., twisting its two wires lightly together. Then run the wires between the FREQUENCY RANGE switch and the board (SW2a), leaving the other half — which has the diodes already on it — till later. Wire in the PULSE WIDTH RANGE switch next, followed by the FUNCTION switch. Note where shielded cable is used. The FREQUENCY SET pot. can now be wired in and the power supply connections made.

The two frequency meter boards can now be mounted and wired in. Complete the front panel wiring and you're ready for testing and setting up your instrument. Before you do, *make another thorough check*.

Power up, set up

If you're confident all is well, plug in and switch on. The frequency meter display should immediately light up, settling down in a few seconds to show some frequency or other. Vary the FREQUENCY SET control and the numbers on the display should vary. Vary the FREQUENCY RANGE switch and note that the "Hz" LED lights when it's set on x1, x10 or x100, and the "kHz" LED lights when it's set to x1k, x10k and x100k. If you don't get the indications described, switch off and look for wiring errors.

If all is well, you can start setting it up. An oscilloscope is necessary for this. A noise and distortion meter would be desirable, but is not essential.

First of all, set the frequency range limits. The upper and lower frequency limits of any selected range are determined by just two trimpots — RV1 and RV2, located on the main generator pc board. Set the FREQUENCY RANGE switch to the x100 range and turn the FREQUENCY SET pot. to minimum (fully anti-clockwise). Adjust RV2 so that the display reads something less than 100 Hz, say 75 Hz, or thereabouts. Now swing the FREQUENCY SET pot. to maximum (fully clockwise) and put the FREQUENCY RANGE switch on x100k. Adjust RV1 so that the display reads something well over 1 MHz, such as '1100'.

Looking at the square wave on pin 9 of SW3 (FUNCTION), with SQUARE selected, adjust RV4 to obtain an equal mark-to-space ratio, then adjust RV5 so that the waveform swings symmetrically about 0 V.

Looking at the sinewave on pin 7 of SW3, adjust RV6 for the best looking sine curve (least distortion). If you have a distortion analyser, hook its input to pin 7 of SW3 and adjust RV5 and RV6 for least distortion (you should be able to get it to 2% or less).

Hook the CRO to the FUNCTION output and see that the output controls all work correctly. Note that the output cannot be reduced to zero as R74 prevents grounding the input of the ETI-1520 output amplifier stage. Check the two pulse outputs and see that RV7 works as it should. If the pulse width suddenly decreases as you wind RV7 clockwise, then pin 1 of IC4 (the 74122) should be grounded. Provision for this has been made on the pc board.

Run through all the frequency ranges, checking the waveform outputs and controls. Take a close look at the peak of the triangle wave. If. on any range, you get a 'step' on the 'down ramp' side of the peak, then change the corresponding frequency range capacitor (capacitors C6 to C11). This is caused by too high an internal inductance in the component. You may get a low level 'spike' at the peak of the sine waveform, but it should be of little consequence.

ERRATA PART 3

There are some component numbering errors in the drawing showing the output control wiring in Part 3 of this series. Here are the corrections:

Shown as	Should be
R63	R68
R64	R69
R65	R70
R66	R71
R67	R72
R68	R73
R70 330R	R75 3k3
SW8	SW5
SW10	SW6

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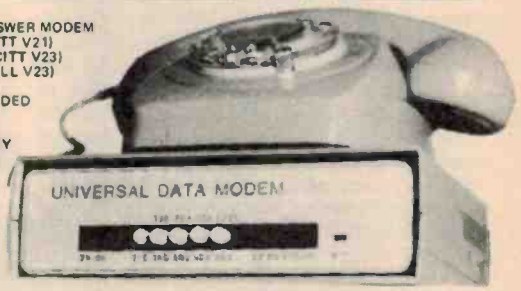

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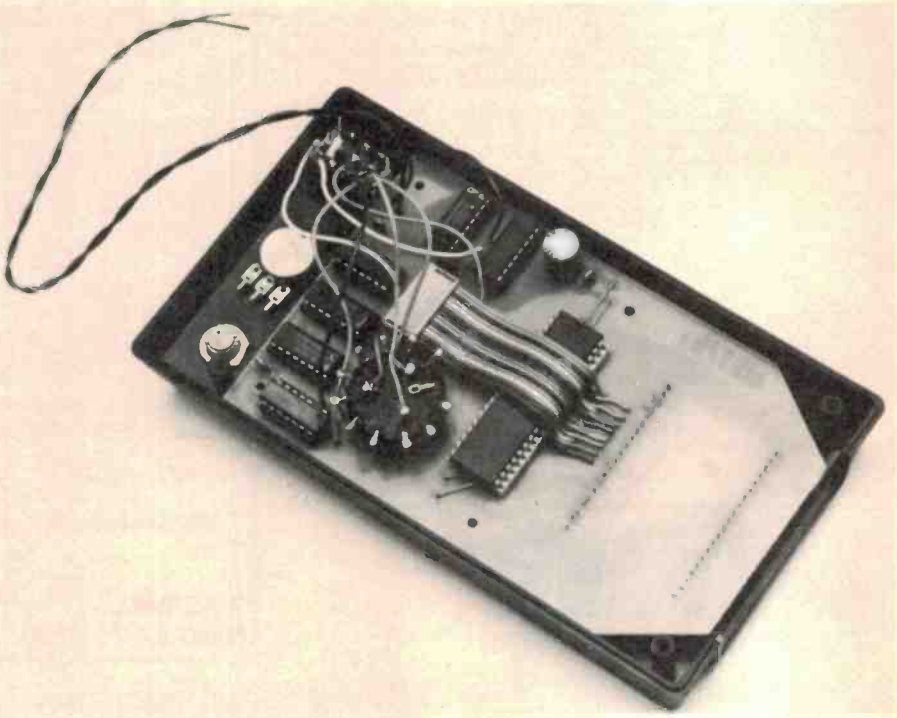
Part 2

Part 1 of this series described the general design and features of the project. Now comes the nitty-gritty — putting it together and getting it going.

THE PROJECT is constructed on two printed-circuit boards designed to fit into the Unimes 2 case from Mayer Krieg. This case comes in two parts — a front and a rear. The main printed-circuit board, ETI-175a, carries the majority of the circuitry and mounts in the front part of the case with the liquid crystal display positioned so that it can be viewed through the 'window'. The two 'top' corners of this board are trimmed at an angle so as to clear the moulded-in pillars at the inside top corners of the case front. The rotary selector switch mounts on the ETI-175a board and I have marked a 'keyhole' which should be drilled to take the locating spigot of the Lorlin switch. This prevents the switch from twisting on the board when it is operated. A small 'I' mark on the board copper side indicates where lug 1 is to be lined up when assembling the switch to the board (this lug is not actually wired in).

The liquid crystal display mounts on the *copper side* of the board and is soldered directly in place without a socket.

The ICM7224IPL counter/display driver chip, a 40-pin device, mounts on the component side of the board. Owing to the restricted space and large number of interconnections between the liquid crystal display and the ICM7224IPL, I decided to use 16-way ribbon cable to bring out the counter control signals and the decimal point connections to the liquid crystal display. At the time, I hoped to use insulation displacement plugs at either end of a short length of ribbon cable with 16-pin IC sockets either side of the counter chip to effect the connections easily. Murphy had other ideas and I found that the ID plug at the 'top' end of the board fouled the battery compartment when the two halves of the case were put together. Thus, it was necessary to solder in the ribbon cable at the liquid crystal display end of the board, as can be seen from the accompanying internal photograph. I used an ID plug at the other end of the ribbon cable, and this goes into a 16-pin IC socket, thus allowing access to the ICM7224IPL device by simply unplugging the cable. I recommend you use a low-profile 40-pin socket for the counter chip. Sockets for the other ICs are optional.



Inside the lid. Showing general assembly of the main pc board and how it fits in the case. This picture was taken before the input wiring was completed. Note the ribbon cable and ID connector linking system.

A cardboard 'mask' with a hole for the display to be viewed through was used to 'mask-down' the area of the case window. I painted it black and glued it in place.

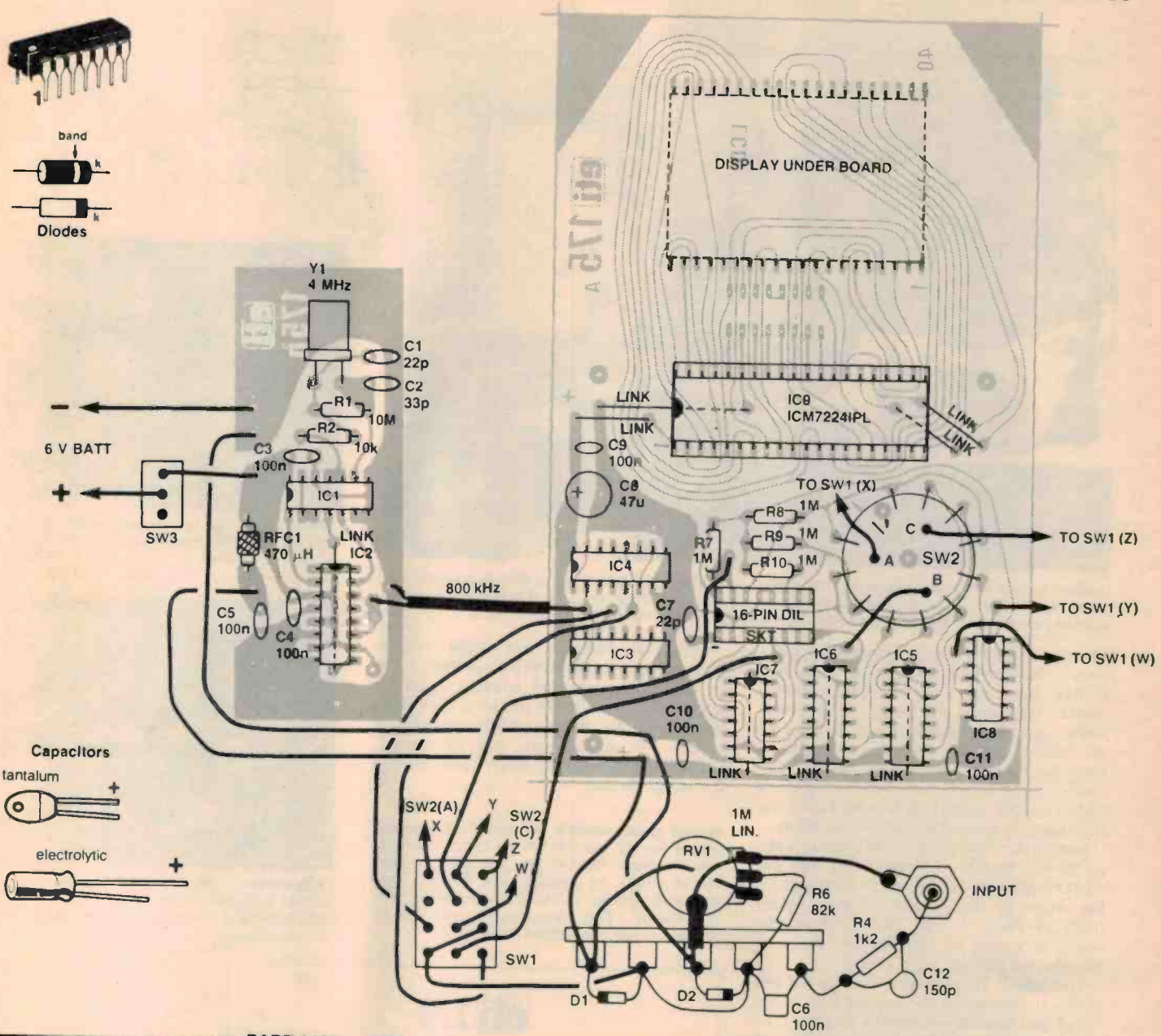
The second, and smaller pc board (ETI-175b) houses the crystal oscillator. This board mounts in the rear section of the Unimes case, right next to the battery compartment.

Construction

No matter whether you've purchased pc boards for this project or built your own, the first thing to do is carefully check each board, looking for incorrectly drilled holes, cracks in the copper tracks and copper 'bridges' between closely-spaced tracks. Fix any faults before proceeding. Check that each board fits into its position in the case halves.

Mark out and drill the case first. Use the ETI-175a pc board as a template to mark out the position of the shaft hole for the rotary switch. The input BNC socket, freq/period toggle switch and level pot mounting hole positions can be marked out next. Note that level pot is a 'miniature' type with a 17 mm diameter body but a standard 6 mm diameter shaft. See that the freq/period switch body does not foul the adjacent case mounting pillar.

The on/off switch is mounted in the side



PART LIST — ETI-175

Resistors ..... all ¼ W, 5%
- R1 ..... 10M
- R2 ..... 10k
- R3 ..... 1k (optional)
- R4 ..... 1k2
- R5 ..... 1M (optional)
- R6 ..... 82k
- R7, 8, 9 10 ..... 1M
- RV1 ..... 1M/A min. 1in. pot.

Capacitors
- C1, C7 ..... 22p ceramic
- C2 ..... 33p ceramic
- C3, 4, 5, 6, 9, 10, 11 ..... 100n 'bluechip' ceramic
- C8 ..... 47µ/25 V RB electro.
- C12 ..... 150p ceramic

Semiconductors
- IC1 ..... 74HC02
- IC2 ..... 74HC160
- IC3, 5, 6 ..... 4518B
- IC4 ..... 4520B
- IC7, IC8 ..... 4011B
- IC9 ..... ICM7224IPL
- Q1 ..... 2N5484
- Q2 ..... 2N3644

Miscellaneous
- LCD1 ..... 4½-digit liquid crystal display (eg: D.S.E. no. Z-4157 or similar)
- SW1 ..... three-pole, four-position Lorlin rotary switch, or similar.
- SW2 ..... 4PDT min. toggle switch
- SW3 ..... SPST min. toggle switch

ETI-175a & bpc board; Scotchcal front panel; case — Unimes 2, part no. 90 61 011 with tilting bail, battery clips etc (see text); 16-pin IDC DIP plug; 16-pin IC socket; about 100 mm of 16-way ribbon cable; 4 MHz HC18/U crystal; two knobs; BNC socket with earth lug; wire etc.

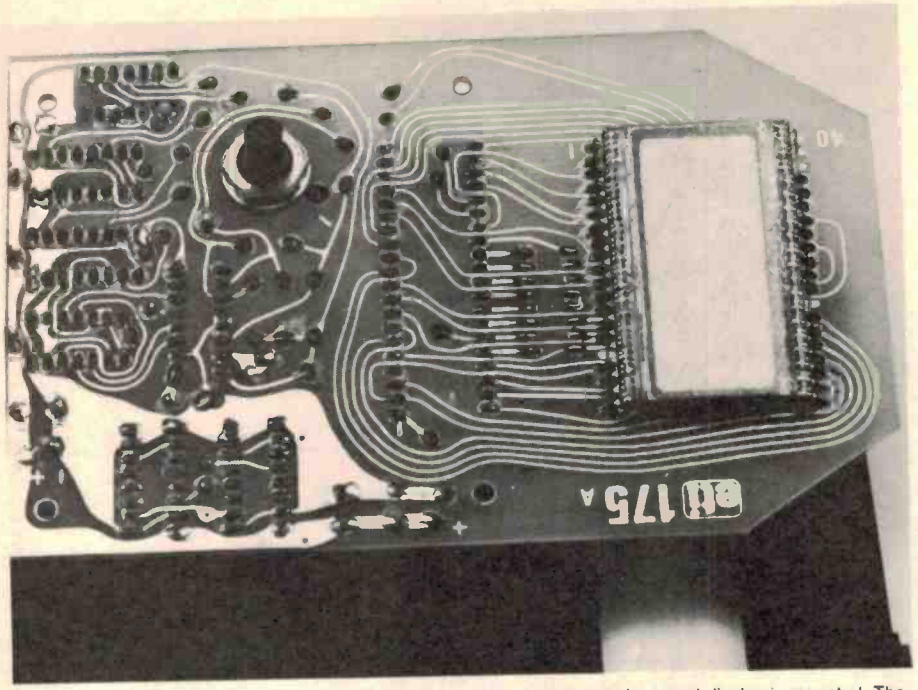
Price estimate $65 - $70

wall of the base, at the left hand side, adjacent to the battery compartment (see internal photograph).

Take care when drilling, centre punch all holes and drill a small diameter pilot hole to start with. This way, you'll avoid expensive traumas with the case.

Now you can tackle the pc boards. It's probably wiser to start with the smaller board (ETI-175b). The link should be soldered in first. Then you can assemble the components in any convenient order, but make sure you get the semiconductors correctly orientated.

The ETI-175a board is a little trickier. Install the links first. If you've elected to use sockets for the ICs, these should be installed next, followed by the resistors and capacitors. Make sure you get the polarised capacitors the right way round.



Display. View of the copper side of the main board showing how the liquid crystal display is mounted. The display comes with a clear film stuck to its face having arrows imprinted on it, the direction of the arrows indicating the pin 1-pin 40 end of the object. Note also the hole for the locating spigot of SW2.

Mount the rotary switch, positioning pin 1 above the marked position as explained earlier. Bend lug 1 *in*, toward the switch centre, then bend the other 11 lugs outward, carefully bending them as near to the base as possible and at right angles so they lay against the switch body. Wire them to the board with short lengths of tinned copper wire. If you're soldering the ICs in place, now's the time to do them.

Install the ribbon cable link next. Take an 80 mm length of 16-way cable and put an ID connector on one end. Strip and tin the wires at the other end then solder them in place at the LCD end of the board as shown on the overlay. Refer to the internal photographs, too.

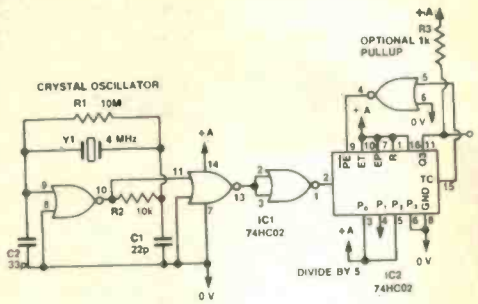
The liquid crystal display is installed last of all. It mounts on the *copper side* of the board and is soldered directly in place. To avoid possible 'solder bridge' shorts to tracks running between the pins of the display, I found that an ordinary soft-lead pencil carefully *rubbed onto the tracks passing between the LCD pins* helped prevent solder bridges. Before soldering the LCD in place, insert it in the board and then hold the board in the lid while you position the display to sit flush against the cutout.

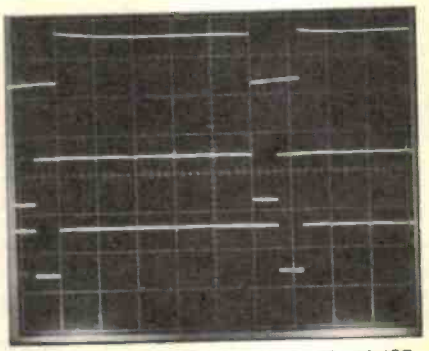
With the two pc boards completed, check them both thoroughly, looking for dry joints, missed soldering and solder bridges between adjacent pads.

Install the wires that run between the two boards and the flying leads to the external components, then screw both boards into the case. Solder the tagstrip for the input components on the rear of the level pot., followed by the components. Then complete the wiring and you're ready to fire it up.

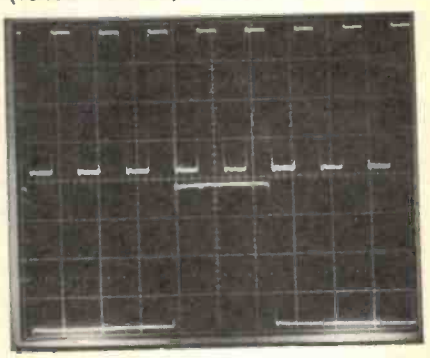
Install the batteries and switch on. The display may read something random. Set it to read frequency and connect a known signal to the input. Set the level control to get a sensible display. On switching to period, the minus sign will be shown. Check that the display reads correctly and it's ready for use. ●

Printed circuit artwork. We have not reproduced artwork for the two ETI-175 pc boards owing to lack of space. However, you can obtain a print, free of charge, by sending us a stamped, self-addressed envelope (A4-size) and requesting "ETI-175 Artwork". Film transparencies can also be obtained — see Shoparound in this issue.

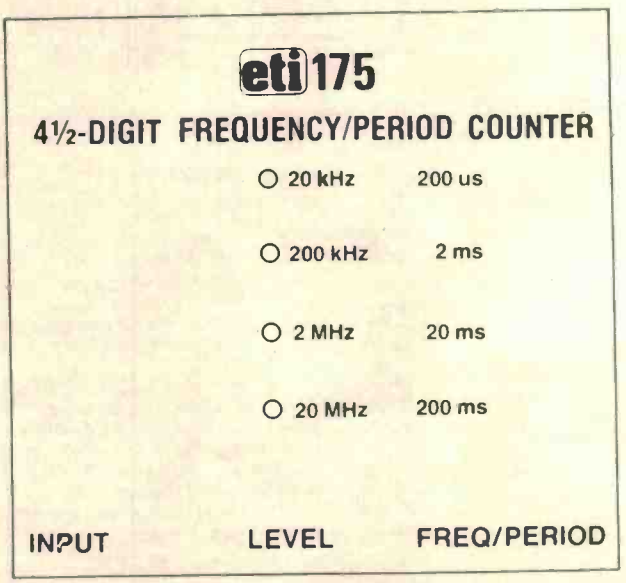




Waveforms — A: Upper trace — pin 10 IC7, COUNT INHIBIT. Middle trace — pin 4 IC7, STORE. Lower trace — pin 3 IC7, RESET. (Vertical — 5 V/div.; Horizontal — 200 µs/div.).



Waveforms — B: Upper trace — pin 1 IC1, 4 MHz oscillator. Lower trace — pin 11 IC2, 800 kHz output. (Vertical — 2 V/div.; Horizontal — 200 ns/div.).



Front panel. Full-size artwork for the project's front panel.

PERFORMANCE ETI-175

Sensitivity

100 mV RMS, 5 Hz — 2 MHz

250 mV RMS, 10 MHz

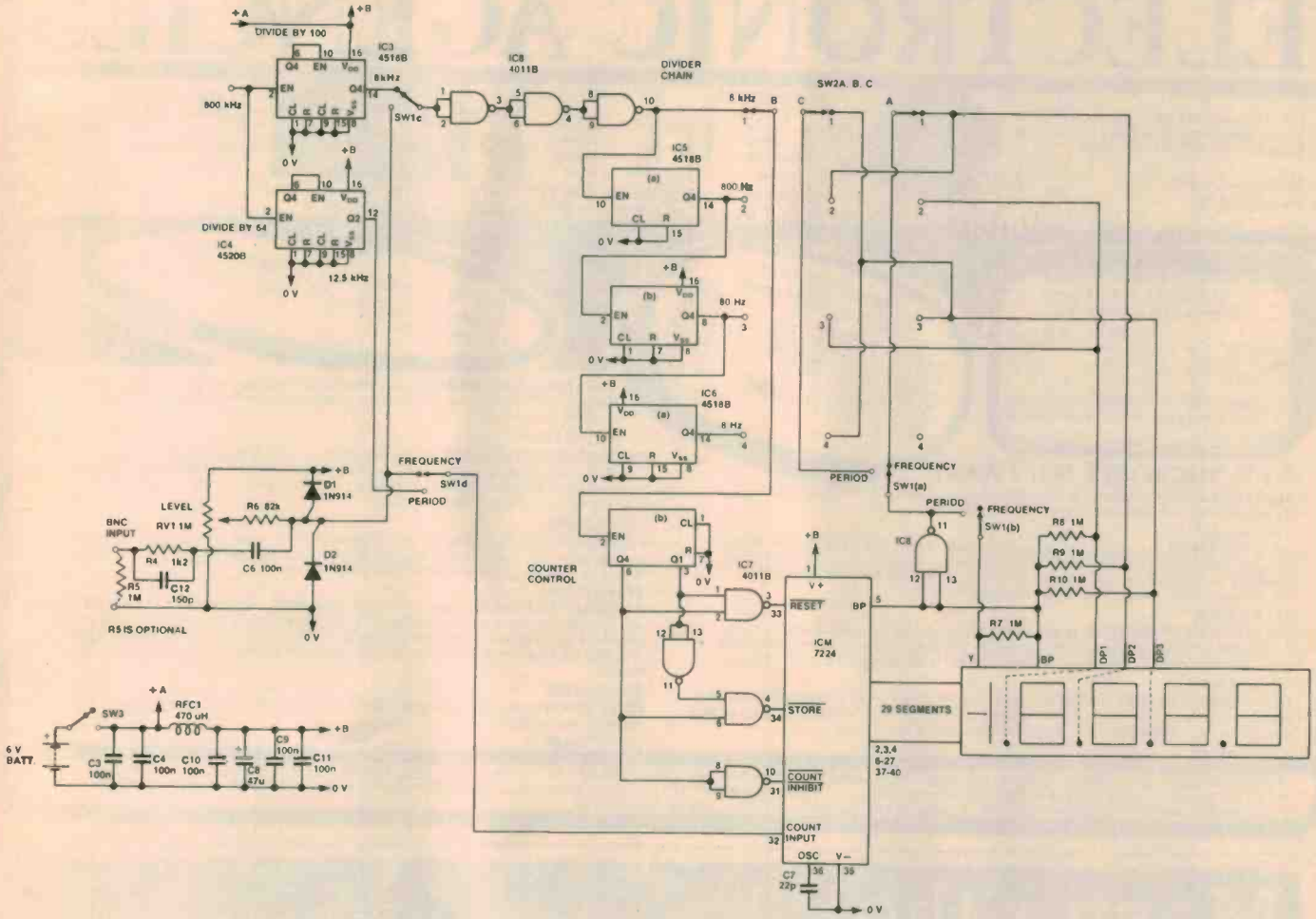
350 mV RMS, 20 MHz

Power supply

4 x AA cells (6 V nom.)

Current drain

7mA



HOW IT WORKS ETI-175

Part 1 gave a block diagram and overview of the project design, so let's get down to the circuit details.

DIVIDER STAGES

IC3 divides the 800 kHz from the crystal oscillator section down to 8 kHz by cascading its dual BCD counters.

IC4 is a dual binary counter connected to divide by 64 and thus produces 12.5 kHz.

IC5 and IC6(a) are BCD counters cascaded to provide four decade-related frequencies that are used for range switching by rotary switch SW2B.

COUNTER CONTROL

The control section centres on a BCD counter, IC6(b) and a quad NAND gate IC7. The BCD counter is clocked by a frequency selected from the divider chain via the rotary switch. The outputs Q4 and Q1 from the counter are gated to derive the counter control signals RESET, STORE and COUNT INHIBIT. The oscilloscope photo No. 1 shows the relation between these signals.

Note that Q4 in a BCD counter is low for eight clock cycles and high for two cycles. Therefore the ICM7224 will count for eight cycles of the IC6(b) clock (pin 2), store the count in its output latch on the next cycle, then reset its counter on the following cycle to complete one decade count of IC6(b).

FREQUENCY MODE

To display frequency in decimal units, the clock for the divider chain is switched to 8 kHz by SW1(c), while the input signal from the preamp is directed to the COUNT INPUT of the ICM7224 by SW1(d).

Now since the counter control section divides the incoming frequency by eight to control the ICM7224 count gate, the effective gate times selected by SW2B are 1 ms, 10 ms, 100 ms and 1 s to provide the four frequency ranges 20 MHz, 2 MHz, 200 kHz and 20 kHz respectively.

SW1(a) selects SW2A to activate the decimal points required for each range. Note that no decimal point is displayed for the 20 kHz range.

PERIOD MODE

To display the period, the input signal and clock reference are interchanged, thus effectively displaying the inverse of frequency i.e: the period. The same clock reference frequency cannot be used for both period and frequency, due to the divide by eight inherent in the counter control circuit.

Thus the clock reference is changed from 8 kHz to 12.5 kHz, and is directed to the count input of the ICM7224 by SW1(d). So if the input period is 100 ms and the 200 ms range is selected, then the ICM7224 will count

8 x 100 ms x 12.5 kHz = 10 000

which is displayed as 100.00.

To get the same count on the 20 ms range, the input period must be 10 ms, but the count is extended to 80 cycles. Similarly, the number of periods counted on the 2.0 ms range is 800 while 8000 cycles of the input period are counted on the 200 µs range.

The minimum period that can be measured is limited by the speed of the CMOS BCD dividers and is about 0.5 µs. Such small periods are normally measured on the frequency range and calculated.

SW1(b) turns on the minus sign annunciator in the LCD display to signify the period mode, while SW1(a) selects SW2C to display the decimal points.

OSCILLATOR/DIVIDER

The 4 MHz oscillator uses one gate from a 74HC02 (IC1), two other gates from this being used as buffers. A 74HC160 presettable counter (IC5) is arranged to divide the 4 MHz oscillator output by five to provide 800 kHz for the counter. As a 74LS160 may be used here, an optional pullup resistor, R3, can be added to the output for it (pin 11).

THE ICM7224IPL

This chip is made by Intersil Inc., of Cupertino California USA. It is imported by R & D Electronics and All Electronic Components of 118 Lonsdale St, Melbourne 3000 act as their retail distributors.

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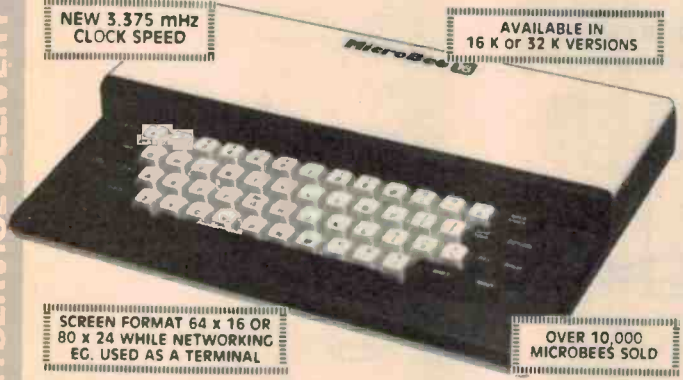

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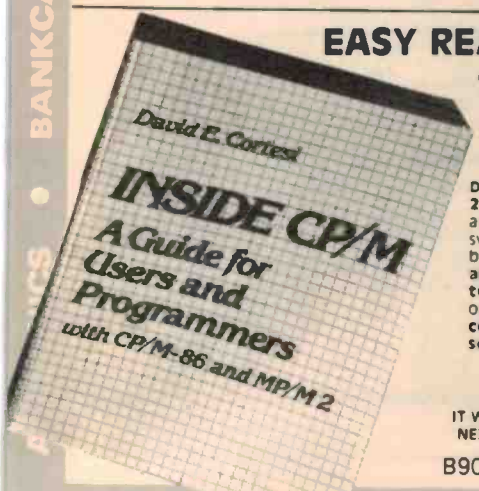

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See Review June EA. p.137.

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LED audio peak programme display

A 'universal' audio peak signal display, this simple project is cheap and easy to build. It features a 10-LED bargraph array and has thousands of applications as an add-on to a hi-fi system.

David Tilbrook

THIS PROJECT can be installed in any audio system to provide a simple visual indication of signal level either at the output of the preamp or at the output of the power amp. It features a 10-LED bargraph-type display that shows the peak signal level over a 30 dB range with a single moving dot or a varying bar of light.

There are a number of reasons for monitoring signal level in an audio amplifier system. Firstly, using a meter or other signal level monitor, you can set up a desired level and always return to the setting at a later time. Secondly, transients in programme material can easily exceed clipping levels in a preamp or power amp, causing distortion. A power amplifier driven heavily into clipping can deliver near-dc to a speaker, possibly causing damage.

The design of this display is adapted from the ETI-458 LED Level Meter which is used in the Series 5000 preamplifier. The ETI-458 features a simultaneous peak and average display with a row of 20 LEDs giving a 60 dB dynamic range. However, the design is more complicated than required for a general purpose level display and, as the pc board is quite large, it is difficult to install as an add-on to a hi-fi system, a mixer or such like.

A VU meter (VU stands for volume unit) is the generally-used 'work horse' audio level meter. It measures the signal level and displays it in decibels (dB). However, it is slow to respond and indicates something between the average and the real peak of the signal voltage so that all but the most repetitive peaks will be hidden. The VU meter could be indicating that the signal level is −15 dB when the peak transients of the signal are actually overloading the amplifier.

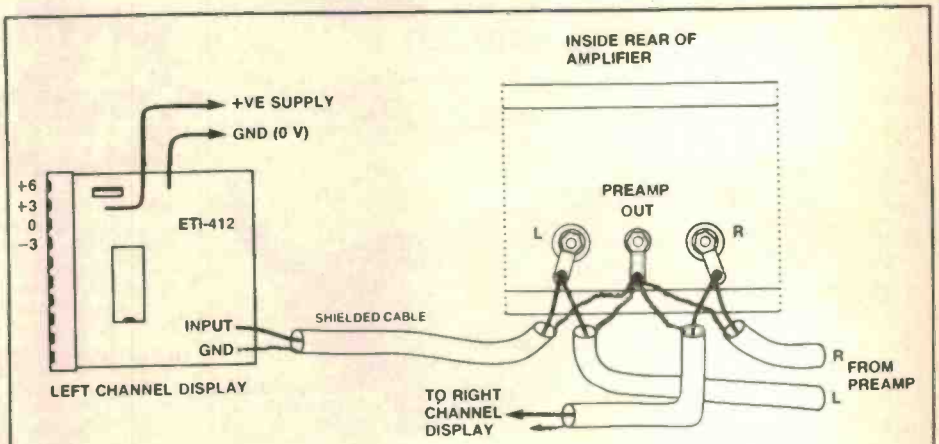


Figure 1. The peak programme display can be hooked up to the hi-fi system to monitor the output of the preamplifier.

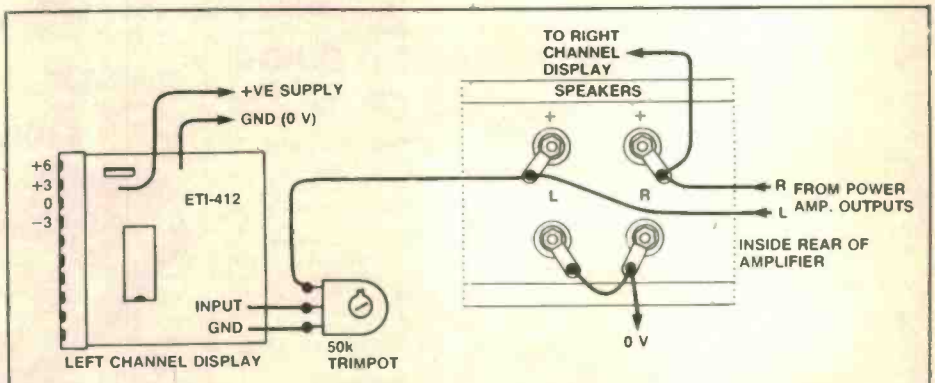
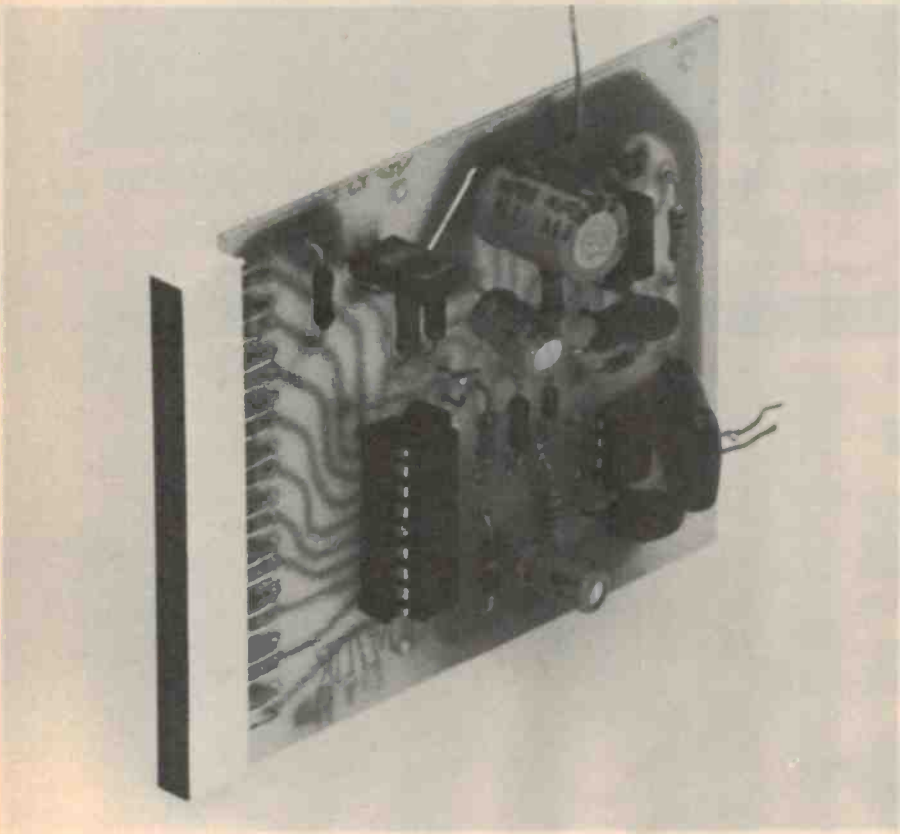


Figure 2. When monitoring the output of the power amplifier the display can be set to indicate the rated power output of the amplifier.



The display could also be used to monitor the output of the power amplifier. It could be set so that the 0 dB level on the display indicates the rated power output of the amplifier.

The display will also be useful for setting signal levels when taping. The advantage of using a peak signal indicating meter when tape recording means you can avoid overloading the tape and the consequent distortion.

The LED display has 3 dB between steps but all you need is a visual indication so a continuous scale is not necessary.

When you are wiring up the circuit it can be set for either a bar or dot display. As the circuit is designed it does not have a switch, but you could add a switch to the circuit so that it is possible to switch from bar to dot mode.

The peak rectifier system used in the ETI-458 LED Level Meter is used in this project. The output of the full wave rectifier, IC1, is fed to a peak follower formed by IC2 and its associated components.

The peak follower has a rapid attack/slow decay characteristic so that it responds quickly to any transients but decays slowly so the display 'hangs on' enabling you to see it easily.

The output from the peak follower goes to IC3, LM3915, which is the LED bargraph driver. The output of IC3 drives the 10-LED display. This was supplied by Altronics and we chose it rather than using separate LEDs as it is easier to use and looks better. ▶

Another disadvantage of most VU meters is their limited dynamic range, being only about 20 dB, as it is a linear analogue meter and has a non-linear scale cramped at one end.

The ETI-412 has a logarithmic scale from −21 dB to +6 dB. As the ear responds logarithmically you need a logarithmic response from a meter. A perceived doubling of loudness is actually a 10 dB change in the sound level.

There are several places where this peak programme display can be connected in a hi-fi system but it is usually used to monitor the output of the preamplifier. It can then be set up so the point where the power amplifier commences clipping will be indicated at the top of the scale.

If you know that the headroom of the amplifier is, for example 3 dB, you can set it up so that the peak transients only go up to the +3 dB level on the display. If the volume is so loud that the level is peaking at +6 dB then you know that the amplifier is being driven into clipping. If you don't have a meter to indicate the peak signal level your ears will tell you that something is wrong as the distortion will be very obvious.

If the amplifier is clipping for a significant proportion of the time the speakers may blow up. While it is simpler to just build a clipping indicator, it is also useful to know something of the dynamics of the signal.

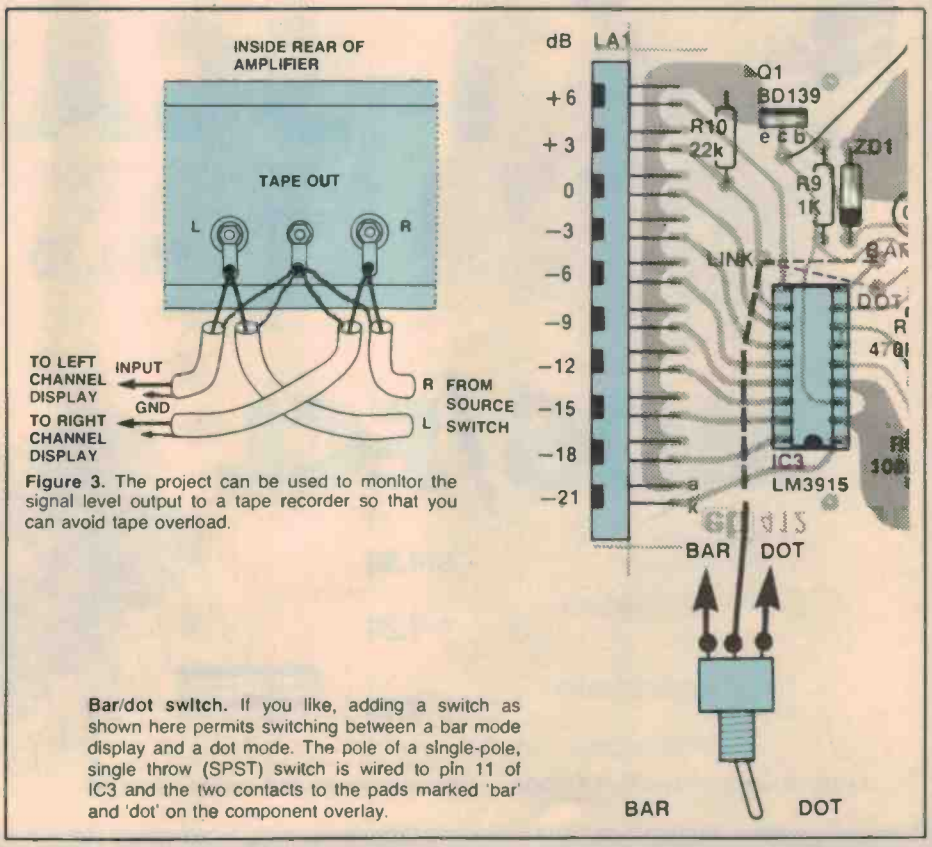


Figure 3. The project can be used to monitor the signal level output to a tape recorder so that you can avoid tape overload.

Bar/dot switch. If you like, adding a switch as shown here permits switching between a bar mode display and a dot mode. The pole of a single-pole, single throw (SPST) switch is wired to pin 11 of IC3 and the two contacts to the pads marked 'bar' and 'dot' on the component overlay.

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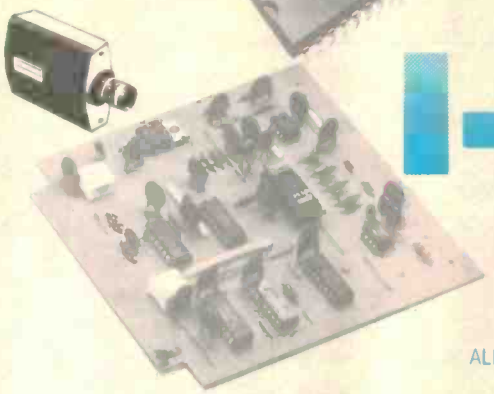

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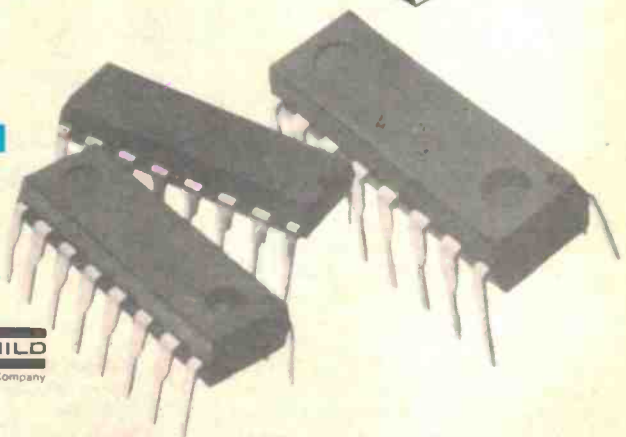

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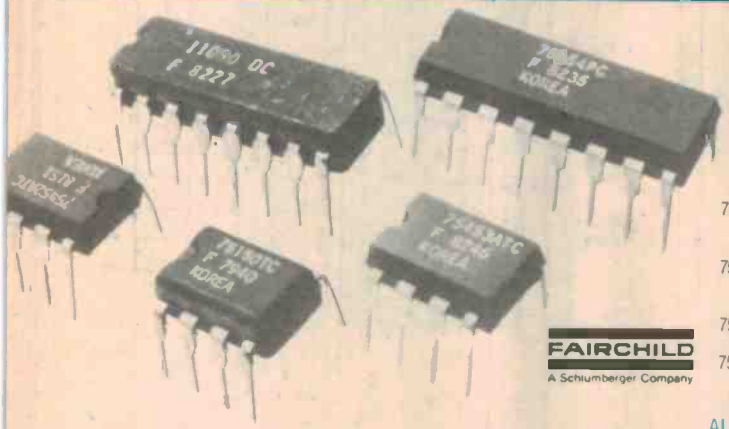

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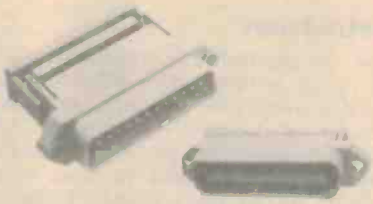

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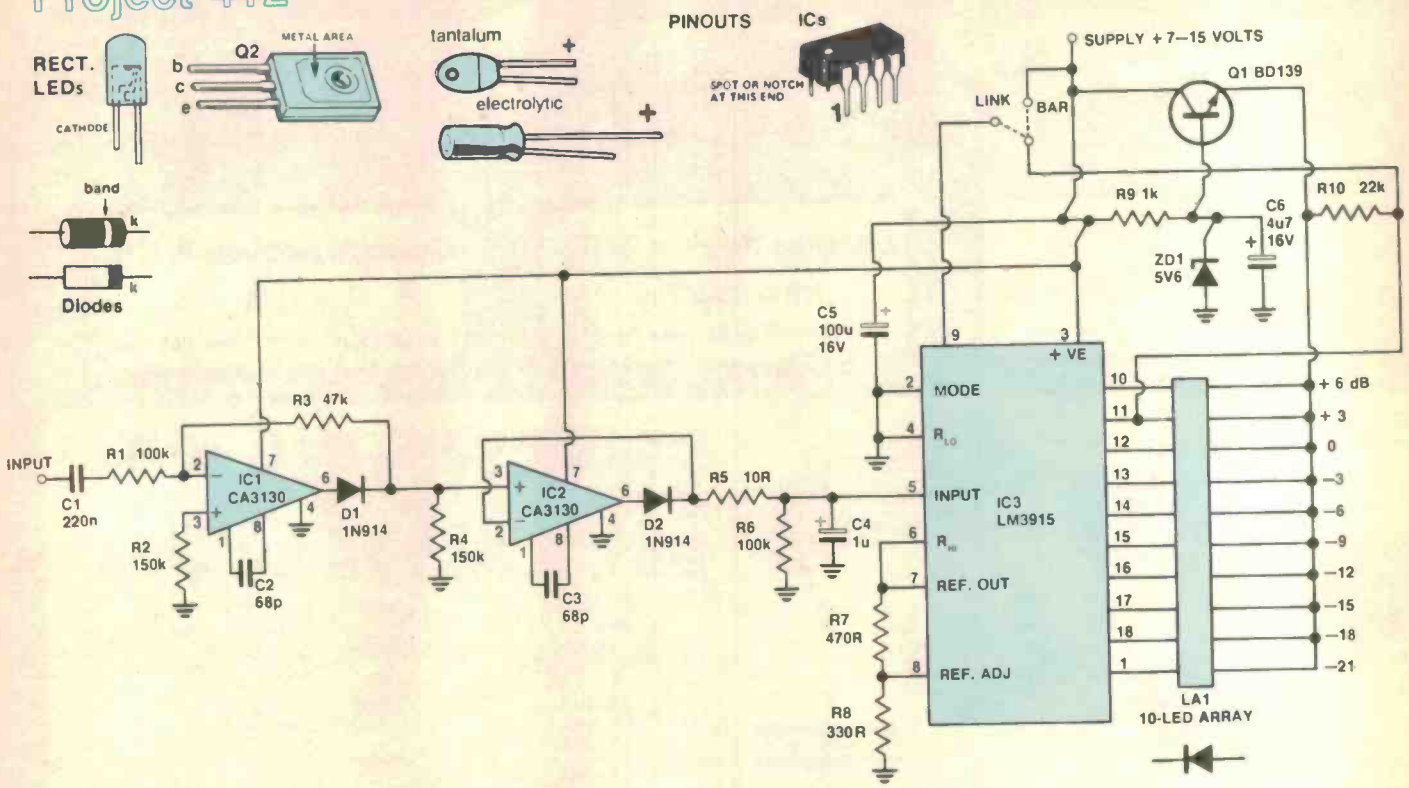


Construction

As you can see from the overlay, the pc board layout is very simple. Before you get carried away with soldering, examine the board very carefully. Regardless of whether you made the pc board yourself or you purchased it, check to make sure that there are no small copper 'bridges' between closely spaced tracks (particularly between IC pins) and no tiny cracks in the tracks. Also make sure that all the holes are drilled correctly.

Those of you who want to use IC sockets in this project can do so.

You can start assembling the pc board by soldering the resistors in place. The three diodes can be soldered in position next, making sure that they are the right way around. If you are using IC sockets then solder them on the board next, otherwise, solder the ICs in next.

Then you can add the transistor BD139 and the capacitors, but check that the three electrolytic capacitors are correctly orientated.

The last thing to work out is which way the LED bargraph goes and solder it in place. The longer leads are the anodes which connect to the single common track along the edge of the board. If you do happen to connect the bargraph back-to-front it is unlikely anything will be damaged when you power it up.

Don't forget to wire up the link for either dot or bar display, depending on what you prefer. If you think that you might like to use either display then you can incorporate a switch into the circuit, as shown in the accompanying diagram.

HOW IT WORKS — ETI-412

The project is quite simple. There are three stages: a full wave rectifier or 'absolute value generator', a 'peak hold' circuit and a logarithmic display driver. The full wave rectifier produces the absolute positive value of the incoming signal and the peak hold circuit 'pumps up' a capacitor to the peak level, this capacitor only being slowly discharged so that the peak of the incoming signal is 'held' on to. The input of the display driver looks at the signal on the capacitor and drives a 10-LED array, each LED coming on in turn when the display driver's input is twice its previous value (ie: at 3 dB intervals).

The full wave rectifier comprises IC1, D1 and surrounding components. The input signal is coupled to the inverting input of IC1 via C1-R1. With a negative-going input signal, the stage acts as an inverting amplifier with a gain of a half determined by the ratio of R3 to R1. Thus, a positive-going output signal appears at the cathode of D1, half the level of the input.

When the input signal is positive-going, IC1's output is driven hard against its negative supply which is the 0 V rail here. Thus, the op-amp's output stage is turned off and, as it has a relatively high output impedance, and D1 is reverse-biased, the input signal will be just divided down by the potential divider formed by R1, R3 and R4. The voltage across R4 will be half the input voltage as R1 + R3 equals R4.

The signal across R4 is coupled to the non-inverting input of IC2, the peak hold stage. IC2 has a gain of one (unity) and the signal at the cathode of D2 will rapidly charge C4 via R5, a low value resistor. When the signal level on the output of IC2 falls below the voltage on C4, D2 will be reverse-biased and C4 will slowly discharge via R6, 'holding' the signal level on C4 long enough for your eyes to see the appropriate display LED lit.

The LM3915 display driver lights the LEDs at 3 dB intervals, according to the level presented at its input, which is across C4. The sensitivity of IC3 is set so that the 0 dB LED lights with 1 V peak at the input.

A regulated supply of 5 V is provided by a simple zener-referenced series regulator. This comprises Q1, ZD1, C6 and R9. The supply input can be anywhere between +7 V as a minimum and +15 V as a maximum (otherwise dissipation in Q1 becomes excessive).

The LM3915 can be arranged to provide either a 'dot' display, where just a single LED is turned on at a time, or a 'bar' display, where all the LEDs up to the peak are turned on. This is done by linking pin 11 to the positive supply rail for BAR mode or to pin 9, with a 22k bias resistor (R19) going to the +5 V supply, for DOT mode operation.

PARTS LIST ETI-412

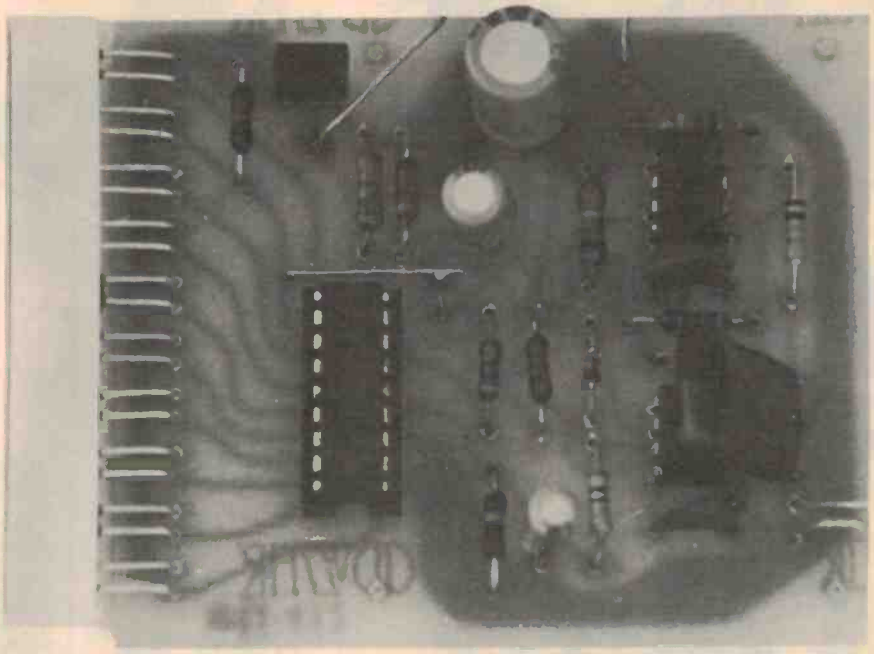
Resistors ..... all ¼W, 5%
- R1, R6 ..... 100k
- R2, R4 ..... 150k
- R3 ..... 47k
- R5 ..... 10R
- R7 ..... 470R
- R8 ..... 330R
- R9 ..... 1k
- R10 ..... 22k

Capacitors
- C1 ..... 220n greencap
- C2, C3 ..... 68p ceramic
- C4 ..... 1µ/6 V low-leakage (RBLL) electro
- C5 ..... 100µ/16 V single-ended electro
- C6 ..... 4µ7/16 V single-ended electro

Semiconductors
- IC1, IC2 ..... CA3130
- IC3 ..... LM3915
- LA1 ..... 10-LED array (Altronics Z-0180)
- Q1 ..... BD139
- ZD1 ..... 5V6

Miscellaneous
ETI-412 pc board; tinned copper wire.

Estimated cost: $15-$18

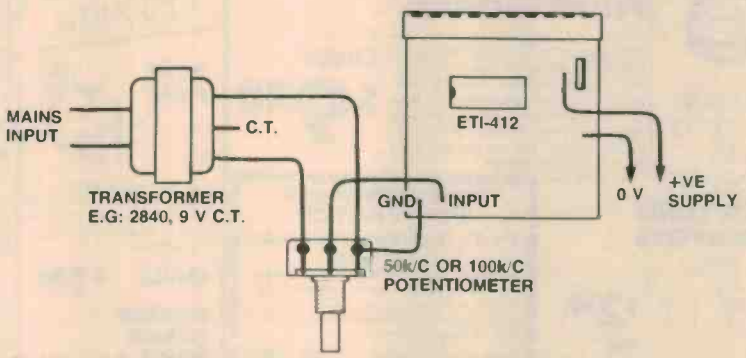


Testing it

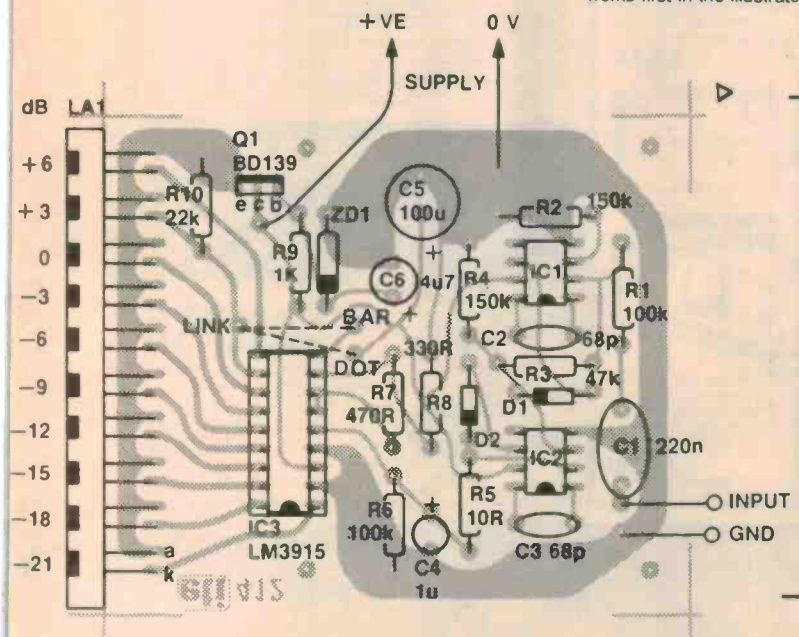
Test this project by attaching it to a +7 −15 V power supply and applying a signal to the input. The input signal can be supplied by an audio signal generator or from the output of a low voltage transformer.

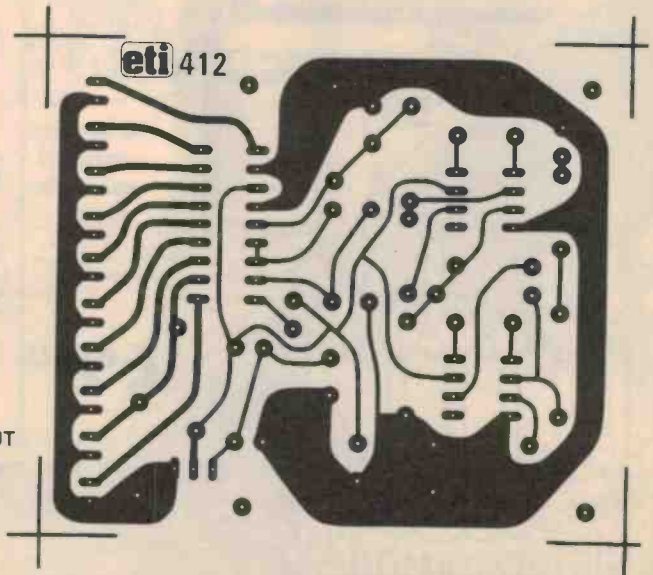
If you are going to use a transformer for this, connect a 100k potentiometer to the output of the transformer with the wiper of the potentiometer connected to the input of the project. If the meter is working properly the display on the LEDs should go up and down as you vary the level.

If the meter does not work at this stage check that all the components have been placed correctly on the board and orientated the right way around. ●



Test it out first. Before installing this project in your hi-fi system make sure that it works first in the illustrated test situation.





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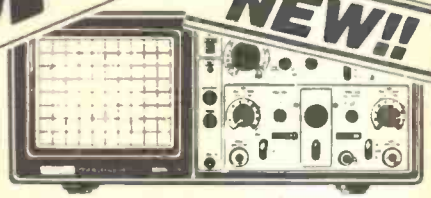

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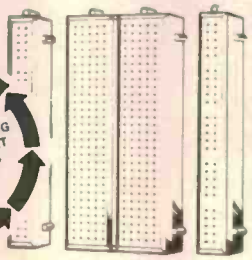

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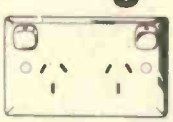

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YOU CAN MONITOR . . .
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★ Total consumption
★ Average speed
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★ Road ice

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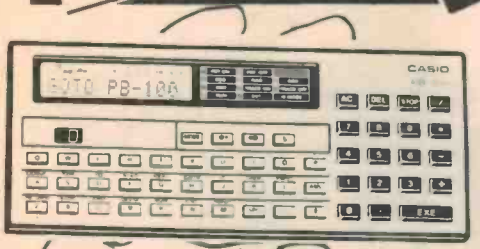

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	Oxford and Adelaide Sts	BONDI JCT.	387 1444
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	Elizabeth Dr & Bathurst St	LIVERPOOL	600 9888
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ACT	96 Gladstone St.	FYSHWICK	80 4944
VIC	260 Sydney Rd.	COBURG	383 4455
	Nepean Hwy & Ross Smith Ave	FRANKSTON	783 9144
	205 Melbourne Rd.	GEELONG	78 6766
	399 Lonsdale St.	MELBOURNE	67 9834
	Bridge Rd & The Boulevarde	RICHMOND	428 1614
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QLD	293 Adelaide St.	BRISBANE	229 9377
	166 Logan Rd	BURANDA	391 6233
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	Bowen & Ruthven Sts	TOOWOOMBA	38 4300
	Ingham Rd & Cowley St West End	TOWNSVILLE	72 5722
SA	Wright & Market Sts	ADELAIDE	212 1962
	Main South & Flagstaff Rds	DARLINGTON	298 8977
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WA	Wharf St & Albany Hwy	CANNINGTON	451 8666
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STORE HOURS

All Dick Smith Stores are open for trading during the normal trading hours for their particular area (either 9-5.30 or 8.30-5). Many stores are also open for late night trading. Please ring the store concerned for their particular hours.

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● **Atherton Qld:** Maarten's Music Centre, 55 Main St. 91 1208 ● **Ballina NSW:** A. Cummings & Co 91-93 River St. 86 2285 ● **Broken Hill NSW:** Hobbies & Electronics, 37 Oxide St. 88 4098 ● **Cairns QLD:** Electronic World, Shop 27 K-Mart, Westcourt Plaza, Mulgrave Rd. 51 8555 ● **Cairns QLD:** Thompson Instrument Services, 79-81 McLeod St. 51 2404 ● **Campbelltown NSW:** Fishers 'Chip' Shop, Shop 3, 274-276 Queen St. 27 1475 ● **Coffs Harbour NSW:** Coffs Harbour Electronics, 3 Coffs Plaza, Park Ave. 52 5684 ● **Darwin N.T.:** Ventronics, 24-26 Cavanagh St. 81 3491 ● **Daniliquin NSW:** Deni Electronics, 220 Cressy St. 81 3672 ● **East Maitland NSW:** East Maitland Electronics, Cnr 99 High St. 33 7327 ● **Echuca VIC:** Webster Electronics, 220 Packenham St. ● **Geraldton WA:** KB Electronics & Marine, 361 Main Terrace, 21 2176 ● **Gladstone QLD:** Purely Electronics, Shop 2, Cnr Herbert & Auckland Sts. 72 4321 ● **Gosford NSW:** Tomorrow's Electronics & Hi Fi, 68 William St 24 7246 ● **Kingston TAS:** Kingston Electronics, Channel Court, 29 6802 ● **Launceston TAS:** Advanced Electronics, 5a The Quadrant 31 7075 ● **Lismore NSW:** Decro Electronics, 3a/6-18 Carrington St. 21 4137 ● **Mackay QLD:** Stevens Electronics, 42 Victoria St. 51 1723 ● **Maryborough QLD:** Keller Electronics, 218 Adelaide St. 21 4559 ● **Mt. Gambier SA:** Hutchesson's Comm, 5 Elizabeth St 25 6404 ● **Mildura VIC:** McWilliam's Electronics, 40 Lemon Ave, 23 6410 ● **Morwell VIC:** Morwell Electronics, 128 George St 34 6133 ● **Nambour QLD:** Nambour Electronics, Shop 4, Lowan House, Ann St. 41 1604 ● **Orange NSW:** M&W Electronics, 173 Summer St. 62 6491 ● **Penrith NSW:** Acorn Electronics, Shop 12, 541 High St. 21 2409 ● **Port Macquarie NSW:** Hall of Electronics, 73 Horton St 83 7440 ● **Rockhampton QLD:** Purely Electronics, 15 East St. 21 058 ● **Shepparton VIC:** G.V. Electronics Centre, 189b Corio St. 21 8866 ● **Southport QLD:** Amateurs Paradise, 121 Nerang St. 32 2644 ● **Toowoomba QLD:** Hunt's Electronics, 18 Neil St. 32 9677 ● **Townsville QLD:** Tropical TV, 49 Fulham Rd. Vincent Village, 79 1421 ● **Wagga NSW:** Wagga Wholesale Electronics, 82 Forsyth St. ● **Wodonga VIC:** A&M Electronics, 78a High St. 24 4588 ● **Whyalla SA:** Mellor Enterprises, Shop 2 Forsythe St. 45 4764

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Dear Customers,

Quite often, the products we advertise are so popular they run out within a few days. Or unforseen circumstances might hold up shipments so that advertised lines are not in the stores by the time the advert appears. And very occasionally, an error might slip through our checks and appear in the advert(after all, we're human too!). Please don't blame the store manager of staff, they cannot solve a dock strike on the other side of the world, or fix an error that's appeared in print. If you're about to drive across town to pick up an advertised line, why not play it safe and give the store a call first.....just in case.

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Dick Smith and Staff

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with our lightning fast fully computerised new mail order system.

Yes! Our mail order service has 'gone computer' offering you even faster, more efficient service than ever before – and (we believe!) much better than anyone else can offer.
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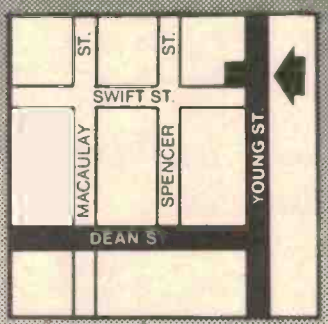
When you place your next order you'll find a special note enclosed telling you all about our amazing new system.
We think you'll agree . . . it's pretty special!

OPENING THIS MONTH

NEW STORE IN ALBURY



Come to the corner of SWIFT AND YOUNG ST. (060) 218 399
You'll find highly trained electronics enthusiasts, ready & able to help you!

Dick Smith Electronics

SHOPAROUND

ETI-690 Little Big Board computer

Now here's a kit that's got lots of support! Developed by Pulsar Electronics from Melbourne, who are wholesaling the pc boards, boot EPROM and documentation (plus complete kits), it's an ideal 'starters' CP/M system. No need to extol its virtues here, any of the following suppliers will do it for us! At press time, Little Big Board kits were obtainable from: **Avtek Electronics** in Sydney (02)267-8777, **Promark Electronics** in Sydney (02)439-6477 and **Sheridan Electronics** in Sydney (02)699-5922. In Canberra, **Steve's Communications** (062)80-4339. Victorian constructors should try **Ellistronics** in Melbourne (03)561-5844, **Magraths** in the city (03)347-1122, **Rod Irving Electronics** in the city and Northcote (03)489-8131 and **Stewart Electronics** city south (03)543-3733. Out west, there's **Altronics** in Perth (008)99-9007 (call from anywhere for a local call fee) or (09)381-7233. In Queensland, try **Rover Engineering** (071)43-5918 or **Baltec Systems** (07)369-5900.

As the board artword is copyright to Pulsar, we aren't reproducing the artwork. However, as stated earlier, boards and the boot EPROM, with full documentation, are available if you want to supply the rest yourself.

Now here's the good bit. In the event that you cannot get your Little Big Board to work satisfactorily (but after having checked everything thoroughly), Pulsar offers a 'fixit' service. You just pack your Little Big Board in a padded bag or post office cardboard carton, enclose $50 and Pulsar will return it in working order. However, they have to charge for dead chips or components incorrectly soldered in place. Refer to the article.

ETI-671 Microbee parallel printer interface

Now that the printer war is well and truly under way, you can take advantage of it with our simple little interface. Parallel input printers are the cheapest, serial types have an internal RS232 interface which bumps the price up.

This project will be available through **Altronics** in Perth and **Avtek** in Sydney, **Rod Irving Electronics** in Melbourne and **Jaycar/Electronic Agencies** in Sydney. You might also try **All Electronic Components** in Melbourne and **Tomorrows Electronics** in Gosford.

The printer we chose to use with out Microbee and interface is the Multitech MPF-II printer, a 40-column dot matrix machine with graphics capability. At $234 retail, it must be the cheapest way to get hard copy from any 'proper' printer available at the moment. It is distributed by **Emona Enterprises**, Suite 204/661 George St, Sydney 2000 NSW. (02)212-4815. They have distributors in all states.

However, the ETI-671 will interface to 80-column printers don't forget, and the handshake signal is there, too.

Ready-made pc boards for this project should be available from the above suppliers as well as the suppliers listed in this column in the September issue.

If you're making your own pc board, a same-size film positive or negative of the artwork can be obtained from us for $1.00, post paid. Make out your cheque or money order to 'ETI Artwork Sales' and send your order to ETI-671 Artwork, ETI Magazine, P.O. Box 227, Waterloo 2017 NSW. Make sure you ask for a positive or a negative, according to what you want.

ETI-672 Microbee-teletype interface

The cheap way to get hard copy from your Microbee. Teletype machines can be had for prices well under $100 and they make quite an acceptable substitute for a 'real' printer.

This project will be carried by the same suppliers as those listed for the ETI-671, so far as we are aware. The same advice applies for pc boards.

For those making their own pc boards, same-size positive or negative film can be obtained for $1.00 from ETI-672 Artwork, ETI Magazine, P.O. Box 227, Waterloo NSW 2017.

ETI-412 LED audio peak programme display

An excellent add-on for a hi-fi system, sound mixer, P.A. system, etc. The 10-LED array used is imported and sold by **Altronics** in Perth. It's certainly neater and easier to use than a bunch of ten individual LEDs. We understand kits will be available from **Altronics, Avtek** in Sydney and **Rod Irving Electronics** in Melbourne. You might also try **All Electronic Components** in Melbourne and **Jaycar/Electronic Agencies** in Sydney.

Printed circuit boards will be available from the suppliers listed on this page in the September issue. If you're making your own board, same-size film positive or negative of the artwork is available for $2.00 from ETI-412 Artwork, ETI Magazine, P.O. Box 227, Waterloo NSW 2017. Make out your cheque or money order to 'ETI Artwork Sales' and ensure you ask for a positive or negative according to the type of photoresist you're using.

ETI-166 Function/ pulse generator

The final part, and your instrument's ready for use. We understand kits will be available from **Rod Irving Electronics** in Melbourne, **Altronics** in Perth and **Jaycar/Electronic Agencies** in Sydney. You might also try **All Electronic Components** in Melbourne.

Ready-made pc boards should be available from the above suppliers as well as those listed in Shoparound last month. The same goes for front panel Scotchcals. For those hardy constructors wanting to make their own (double-sided) ETI-166a boards, same-size film positive or negative artwork for both sides of the board can be obtained for $10.00 post paid from ETI-166a Artwork Sales, P.O. Box 21, Waterloo NSW 2017. The front panel artwork can be obtained from us for $9.00. Make sure you clearly ask for the **ETI-166a**, not just ETI-166, to avoid confusion with the previous boards. Ensure, also, that you specify positive or negative film, according to the type of photoresist you're using.

ETI-175 20 MHz handheld frequency meter

Every toolkit and workbench should sport one of these (or more!). At press time, **Altronics** in Perth, **Rod Irving Electronics** and **All Electronic Components** in Melbourne were kitting up for this project.

The ICM7224IPL counter/display driver IC used in the project is imported and distributed by R & D Electronics. **All Electronic Components** in Melbourne are their retail distributors so, for constructors assembling this project for themselves, they will be able to supply this IC over the counter (or by mail order). The 4½-digit display is available from a number of sources. Dick Smith Electronics also stock one (LCD4.5), cat. no. Z-4175.

Printed circuit boards will be available through the suppliers listed in this column last month. Same-size film positive or negative of the artwork, for those making boards for themselves, can be obtained from us for $4.00, post paid. Front panel artwork is also available for $1.50. Make cheques or money orders payable to 'ETI Artwork Sales', and send your order to ETI-175 Artwork, ETI Magazine, P.O. Box 227, Waterloo NSW 2017. Please make sure you specify positive or negative film, according to what you want.

Component shortages

With the pickup in the US economy, the American electronics industry is ordering up components like there's no tomorrow, particularly semiconductors. Manufacturers' and distributors' current inventories have been rapidly depleted in recent times and lead times for delivery have blown out from days to something like 13 weeks at the shortest and 52-74 weeks at the longest. Components particularly affected are 4000 Series CMOS, high speed (HC) CMOS, 74LS TTL and popular resistor values (we hear 10k and 100k resistors will be worth their weight in gold shortly).

A spokesman from the Dick Smith organisation said they're suspending production on certain projects and deleting others from their inventory. Jaycar's page-8 advertisement in the last issue gave warning of this trend, saying lead times were then quoted as four to six months, but they've lengthened since then and are likely to remain at the times quoted above for the next year at least.

The upshot is this — prices will inevitably rise (we've had it too good for the past few years) and shortages will definitely occur.

Our advice? Forget gold futures — semiconductor futures will be the big profit earner in the months to come. *Buy! Buy! Buy!*

WE are a No.1 Kit Supplier

SERIES 5000

PRICES SLASHED

As designed by ETI

PREAMPLIFIER

PRICES SLASHED this month only

~~$269~~ $259

SPECIFICATIONS

Frequency response:	High-level input: 15Hz-130 kHz, +0, −1 db Low-level input — conforms to RIAA equalisation, ± 0.2 dB
Distortion:	1kHz <0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation).
S/N noise:	High-level input, master full, with respect to 300 mV input signal at full output (1.2V): >92 dB flat >100 dB A-weighted. MM input, master full, with respect to full output (1.2V) at 5 mV input, 50 ohm source resistance connected: >86 dB flat >92 dB A-weighted. MC input, master full, with respect to full output (1.2V) and 200 μV input signal: >71 dB flat >75 dB A-weighted.

POWER AMPLIFIER

Please note that the "Superb Quality" Heatsink for the power amp was designed and developed by Rod Irving Electronics and is being supplied to other kit suppliers. This product cost $1,200 to develop so that your amplifier kit would have a professional finish as well as sound. We also have a new range of rack mounting boxes which will be released soon.

SPECIFICATIONS

Power output:	100W RMS into 8 ohms (± 55 V supply).
Frequency response:	8 Hz to 20 kHz, +0 −0.4 dB 2.8-Hz to 65 kHz, +0 −3 dB. NOTE: These figures are determined solely by passive filters.
Input sensitivity:	1V RMS for 100W output.
Hum:	−100dB below full output (flat).
Noise:	−116 dB below full output (flat, 20 kHz bandwidth).
2nd harmonic distortion:	<0.001% at 1 kHz (0.0007% on prototypes) at 100 W output using a ± 56 V supply rated at 4 A continuous. <0.003% at 10 kHz and 100 W.
3rd harmonic distortion:	<0.0003% for all frequencies less than 10 kHz and all powers below clipping.
Total harmonic distortion:	Determined by 2nd harmonic distortion (see above).
Intermodulation distortion:	<0.003% at 100 W. (50 Hz and 7 kHz mixed 4:1).
Stability:	Unconditional

Price Slashed ~~$299~~ $289

THIRD OCTAVE GRAPHIC EQUALIZER

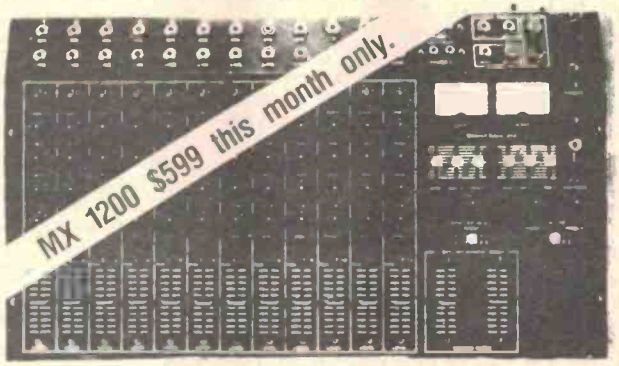
SPECIFICATIONS E.T.I. Dec. 1982

Bands:	28 Bands from 31.5 Hz to 16 kHz
Noise: 20 kHz bandwidth	<0.008 mV, sliders at 0, gain at 0 (−102 dB).
Distortion:	0.007% at 300 mV signal, sliders at 0, gain at 0; max. 0.01%, sliders at minimum.
Frequency Response:	12 Hz-105 kHz, +0, −1 dB, all controls flat.
Boost & Cut:	14 dB

1 unit $199

2 units $379

MX-1200 MICROPHONE/AUDIO MIXER



This unit features: 12 microphone line inputs with pan, bass, treble, effect and fold back controls for each channel • LED peak indicators for each channel • 2 turntable inputs with cross-fade and individual output controls • master equaliser for bass, midrange and treble • variable headphone output etc. etc. • complete with carrying case.

~~$699~~

SPECIFICATIONS:
INPUTS
Level/impedance Mic. 46 db/1K
Line 22 db/16K a 12
Phono 52 db/50K STEREO = 2 (.2mv) at 1KHz
Effect Return (Aux) 20 db/50K = 1
OUTPUTS
Level/impedance L & R 0 db/2K
Effect Send 0 db/2K F/B Out 0 db/2K
Head phone Stereo + 10 db/600 (100 -1K)
EQUALISATION
Channel
Bass ± 15db
Treble ± 15db
Master
Bass ± 12db
Treble ± 10db
Middle ± 12db

FADER & CONTROLLERS
12 channel fader, Slide, 80mm, LOG 25%
2 Master fader: Slide, 80mm, LOG 15%
12 F/B Volume, 300, LIN
1 F/B Master level, 300 LIN
12 Effect Send, 300, LIN
1 Effect Return, 300, LOG 45%
2 Phono, 300, LOG 15%
1 Head Phone, 300 LOG 15%
S/N, 58DB
FREQUENCY RESPONSE: 20-20 KHz
TOTAL HARMONIC DISTORTION: Less than 0.1%
METER: 2 Illuminated VU Meters 0db = 0.775v
PEAK INDICATOR: 12 LED Peak Indicators
VOLTAGE: 240 VAL 50Hz
POWER CONSUMPTION: 7.2 watts
DIMENSIONS: 620 (W) x 386 (D) x 108 (H) mm (supplied complete with carrying case)

EXTRA FEATURES OF OUR KITS

POWER AMPLIFIER

KIT PRICE $299 P&P $8.00

- 1% Metal Film Resistors are used where possible
- Prewound Coils are supplied
- Aluminium case as per the original article
- All components are top quality
- Over 200 Kits now sold
- We have built this unit and so know what needs to go into every kit
- SUPER FINISH Front panel supplied with every kit at no extra cost to you
- We are so confident of this kit that we can now offer it assembled and tested so that people who do not have the time can appreciate the sound that this applifier puts out. This is done on a per order basis delivery approx. two weeks after placement.

only $425

*All parts available separately for both kits

PREAMPLIFER

KIT PRICE $259 P&P $8.00

- 1% Metal Film Resistors are supplied
- 14 metres of Low Capacitance Shielded are supplied (a bit extra in case of mistakes)
- English "Lorlin" Switches are supplied no substitutes as others supply
- We have built and tested this unit and so know what needs to go into every kit
- Specially imported black anodised aluminium knobs
- Again as with the power amp we are offering this kit A & T at a price which we do not believe there is a commercial unit available that sounds as good. Same delivery as the P.A.

only $425

Errors and omissions excepted.

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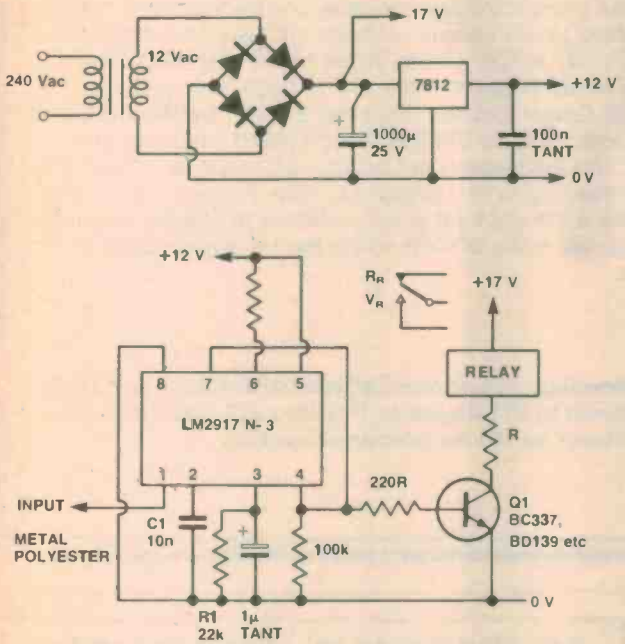
Mail orders: P.O. Box 235 Northcote, Vic. 3070

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.



Frequency operated switch

This circuit was designed by **A. Macdonald of Croydon Victoria.** It will turn on a relay (or a triac, SCR etc) when a given input frequency is reached.

Using the components shown in the circuit, the switching frequency is 480-500 Hz where

$$f_{switching} = \frac{1.27}{V_{CC} \times R_1 \times C_1}$$

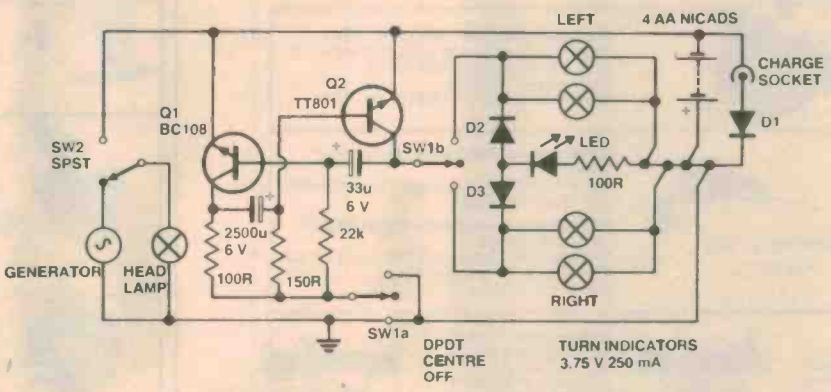
The IC can interface directly with proximity switches and can be used for overspeed protection of any rotation device. The input may be either a sine, square or triangle wave.

The circuit uses the LM2917 frequency/voltage converter in a switch mode so that when the input frequency exceeds a specified amount, its output will go high. This causes the transistor to switch on, turning on the relay and switching the contacts.

The 22k resistor R1 may be varied to change the frequency at which the device switches.

$$R = \frac{17 - V_{RELAY}}{V_{RELAY}} R_{RELAY} = \left[\frac{17}{V_{RELAY}} - 1\right] R_{RELAY}$$

Turn indicators for a push-bike



Alec Phillips of Myrtleford Victoria found that it is quite dangerous when he is riding his push-bike at night, especially when he is approaching or waiting at an intersection in a town.

The indicator unit is powered by four AA Nickel Cadmium batteries, which are mounted, with most of the components, in a small jiffy box under the seat. S1, S2, D2, D3, the LED and 100R resistor are mounted on a small panel on the handlebars.

The purpose of S2 is solely as an added bonus to power the head and tail lights when stopped at intersections or when climbing a steep hill at low speed.

The main circuit is very simple. D1 is to prevent any short circuit in the charge socket by the plug. D1 is also necessary in case of reverse polarity. The LED shows that the indicators are on. D2 and D3 drive the LED from either the left or right-hand side.

S1 is a DPDT 'centre off' mini toggle, Q2 is a TT801 because it drives the indicators direct.

The 3.75 V, 250 mA lamps were obtained from the local cycle shop. These low voltage globes are used because the terminal voltage of the batteries is 4.8 V, less a 0.6 V loss in Q2, leaving approximately 4.2 V on a 3.75 V globe. This gives a bright flashing indicator.

HERE IT IS!

Over 20 of our top-popularity projects from recent years' ETIs plus several projects from a few years back that have enjoyed renewed interest. All assembled in one big volume — there's something to suit every electronics enthusiast's interest, from the ETI-250 Simple House Alarm to the ETI-1500 Discriminating Metal Detector, from the ETI-325 Auto-probe to the ETI-562 Geiger Counter, from the ETI-724 Microwave Oven Leak Detector to the ETI-565 Laser. TWENTY projects, in all — PLUS: 'An Introduction to Lasers', 'pH — the Acid Test' and 'Experimenting With Ultrasonics'. Top Projects Vol. 7 also contains a Shoparound guide on where to obtain pc boards, front panels, kits and components for the projects between its covers.

At all newsagents and selected specialist outlets, or by mail order direct to ETI Magazine, P.O. Box 227, Waterloo NSW 2017. Please add $1 for post and handling.

IDEA OF THE MONTH

Simple negative/positive probe ★★★★

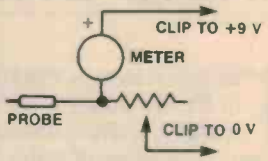
Paul Redfern, Hamersley WA (age 13 years)

This very simple probe appears to be an obvious circuit, but it hasn't been done here before.

There are only two components in this circuit, a meter (650 ohms/250 A, full scale) and a variable resistor (50k).

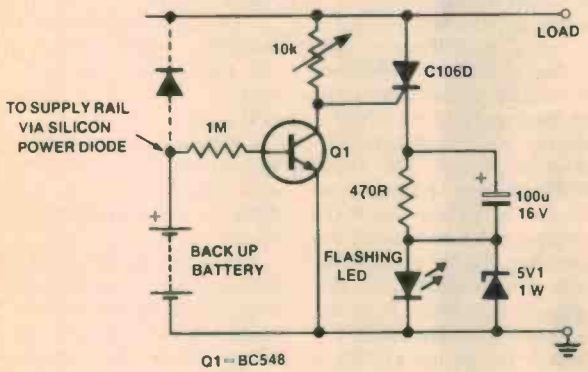
To determine whether the reading is positive or negative attach the two clips to the power supply of the circuit you want to test. Centre the meter by adjusting the variable resistor, then touch the part of the circuit you want to measure.

If the voltage is positive the meter will swing towards the positive side, and vice versa.



Battery watchdog

In most equipment where there is a battery back-up, there is no indication of the condition of the battery.



The battery may lie around forgotten until it is eventually required, but then you find that it is no longer serviceable and may even have leaked corrosive acid damaging components and the pc board.

C.W. Catherwood of Lismore NSW has designed a simple circuit which indicates a dying battery in a battery back up system. It only uses a few components and the small pc board can be easily incorporated into most equipment.

Q1 and the 10k preset potentiometer form an adjustable voltage divider. It is controlled by the base current of Q1 via the 1M resistor and the value set on the 10k potentiometer.

The voltage on the divider feeds the gate of the SCR, switching it on. The SCR then conducts through the flashing LED, indicating an unserviceable battery.

The zener diode maintains the five volts required by the flashing LED. The electrolytic capacitor across the series dropping resistor forms an RC network which determines the flashrate.

The voltage of the battery which is to be tested can be determined by adjusting the 10k potentiometer. This could be done by using an adjustable power supply in place of the battery.

'IDEA OF THE MONTH' CONTEST

PRIZE WORTH $90!

COUPON

Cut and send to: **Scope/ETI 'Idea of the Month' Contest, ETI Magazine, P.O. Box 227, Waterloo NSW 2017.**

"I agree to the above terms and grant *Electronics Today International* all rights to publish my idea in ETI Magazine or other publications produced by it. I declare that the attached idea is my own original material, that it has not previously been published and that its publication does not violate any other copyright."

* Breach of copyright is now a criminal offence.

Title of Idea .....

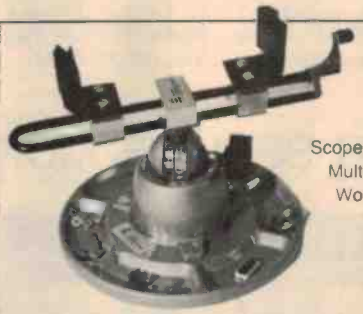
Signature .....

Name .....

Date .....

Address .....

..... Postcode .....



Scope Panavise Multi-Purpose Work Centre.

Scope Laboratories, which manufactures and distributes soldering irons and accessory tools, is sponsoring this contest with a prize given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI Magazine. Each month, we will be giving away a Scope Panavise Multi-Purpose Work Centre, Model 376 300 312, comprising a self-centering head (376), standard base (300) and tray base mount (312), all worth about $90! Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, each winner will be paid $10 for the item published. You must submit original ideas of circuits which have not previously been published. You may send as many entries as you wish.

RULES

This contest is open to all persons normally resident in Australia, with the exception of members of the staff of Scope Laboratories, The Federal Publishing Company Pty Limited, ESN, The Litho Centre and or associated companies.

Closing date for each issue is the last day of the month. Entries received within seven days of that date will be accepted if postmarked prior to and including the date of the last day of the month.

The winning entry will be judged by the Editor of ETI Magazine, whose decision will be final. No correspondence can be entered into regarding the decision.

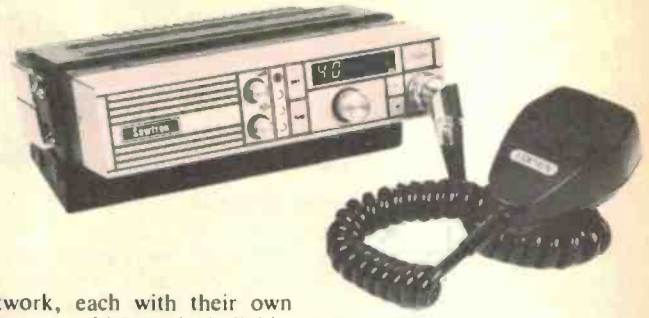
The winner will be advised by telegram the same day the result is declared. The name of the winner, together with the winning idea, will be published in the next possible issue.

Contestants must enter their names and addresses where indicated on each entry form. Photostats or clearly written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from the bottom of the page of the contest. In other words, you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

This contest is invalid in states where local laws prohibit entries.

Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.

NEW MOBILE UHF CB FITS DIN-SIZE CAR RADIO DASH APERTURE



The new Sawtron 990 UHF CB transceiver is small enough to fit the smallest DIN-size car radio dash aperture yet features a front-mounted speaker, making it ideal for mounting in some of today's compact vehicles.

Like the model 880 it replaces, the 990 features a removeable control head allowing the transceiver section to be mounted remotely if desired.

We had the opportunity to evaluate the 990 recently and it proved a top performer. The receiver sensitivity measured 0.26 μV for 12 dB SINAD and the transmitter delivered the full power output. With the squelch on, it draws just 600 mA and around 800 mA when receiving a signal with the audio set at a comfortable listening level. At maximum audio output (2 W), it draws 1.5 A. On transmit, it draws 2.8 A.

The Sawtron 990 has a number of unusual design features that make it stand out from the others on the market, apart from its unique mechanical design. Firstly, it employs a non-mixing direct output phase-locked loop system for frequency generation. This has no frequency multiplier chain and is claimed to generate less noise and out-of-band spurii than other systems.

Secondly, an EPROM is used for setting channel frequencies, repeater offsets etc. Should D.O.C. allocate different frequencies or repeater offsets for the CBRS in the future, the cost of making the changes is quite cheap and quick to implement.

The receiver is a double-conversion superhet employing two monolithic crystal filters and two ceramic filters to ensure excellent selectivity, adjacent channel and image frequency rejection.

The transmitter uses an RF power amplifier IC rated to withstand extreme VSWR conditions, reducing the possibility of expensive 'blowups' if you lose your antenna, etc.

The control head incorporates rotary controls for volume, squelch and channel selection, plus 'soft touch' push-switches for power on/off, tone, repeater and tens/units selection for the 'selecall" function. LED indicators are used to show you the status of operation (Tx/Rx, channel no. etc). Note that the microphone socket is located on the *right hand* side of the panel!

The selecall system is optional. This uses a three-tone encoding system that allows you to have up to 81 transceivers in a network, each with their own call tones, which can be individually called by any other transceiver within the system and which automatically acknowledges receipt of the call. The last two tones can be operator selected on the transceiver.

The Sawtron 990 is ruggedly built, employing a diecast aluminium chassis and control head, able to withstand the rigours of the roughest mobile environment much better than plastic-cased transceivers.

On the air, the 990 proved a good 'talker' and 'listener'. We were able to obtain mobile-to-base communications from well-known bad spots in the Hunter Valley and good mobile-to-mobile contact as well. The audio on transmit was reported as smooth and very clear. The 990's receiver provides very good reception, 'hanging on' tenaciously to quite noisy signals and still giving good clear sound from the front-mounted loudspeaker.

If you're in the market for a top-performing UHF transceiver, the Sawtron 990 is worth very close scrutiny for either base or mobile applications. The importers indicate that commercial versions will be available shortly. **Contact Imark Pty Ltd, 167 Roden St, West Melbourne 3003 Vic. (03)329-5433.**

SATELLITE TRACKING SOFTWARE

A new book on software for tracking a variety of satellites is obtainable from the British amateur satellite group, AMSAT-UK.

The new handbook, called *Satellite Tracking Software for the Radio Amateur*, has been written by John Branegan, GM41HJ.

The programs are written in a variant of MicroSoft BASIC and can be run on a ZX81 directly or adapted to other machines.

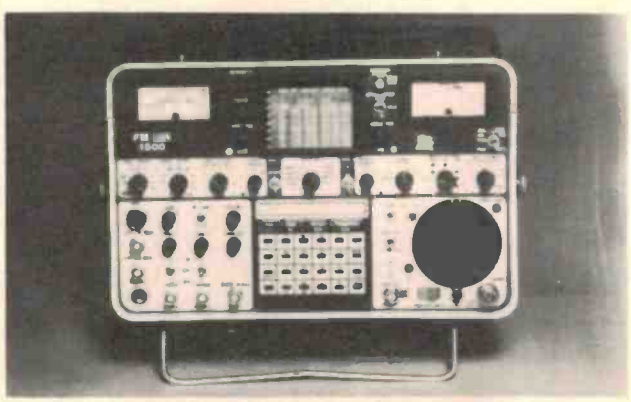
Programs in the book cover geostationary, circular and elliptical orbits which suit all currently operational amateur satellites, Soviet Meteor weather satellites, American NOAA weather satellites and almost anything liable to come along in the future.

Further details are obtainable from **AMSAT-UK, c/o R.I.C., Broadbent, 94 Herrongate Road, Wanstead Park, London, England E12 5EQ.**

IFR's MICROPROCESSOR SERVICE MONITOR

The American IFR company's latest communication service monitor to be released in Australia, the microprocessor-controlled, digitally synthesised FM/AM-1500, integrates the functions of several different pieces of test equipment into a single, compact, portable unit.

The FM/AM-1500 has a keyboard entry system and LCD display for programmed frequency readout, processor-controlled memory functions and a cathode-ray tube capable of alphanumeric or waveform displays.



The unit features a full-scan 1-1000 MHz spectrum analyser which includes a minimum scan position of 1 KHz per division with a 300 Hz bandwidth.

Standard features of the FM/AM-1500 include AM and FM signal generators, digitally coded squelch, a 2 uV receiver for AM, FM and SSB, a tracking generator with full scan to 1000 MHz, a sweep generator, a cable-fault locator, two programmable audio tone generators, and audio and RF frequency error meters.

For further information, **contact Vicom International, 57 City Road, South Melbourne Vic. 3205. (03)62-6931.**

HIGH-GAIN, LOW-DRAG UHF MOBILE WHIPS

Three mobile whips to cover the 400 MHz to 510 MHz range are available from Benelec, featuring an epoxy coating that provides solidly bonded windings, low air drag, low inertia sway and a gloss finish.

The Model 2-625 is colour-coded black and covers 400-450 MHz, Model 2-626 is colour-coded red and covers 450-470 MHz while the Model 2-627 covers 470-510 MHz and is colour-coded blue.

Each antenna comes with a standard 8 mm 24 tpi female base ferrule that fits standard UHF antenna mounts.

Further details on these and other antennas in Benelec's extensive range can be obtained from **Benelec, P.O. Box 21, Bondi Beach NSW 2026. (02)665-8211.**

HANDS-FREE TRANSCEIVER WITH NOISE-CANCELLING MIC

Even when operating where a high level of background noise is experienced, such as encountered in many industrial applications, the latest version of Standard's C-900 Talkman transceiver allows the operator's voice to come across clearly.

The new Talkman has built-in a unique noise-cancelling microphone which picks up the operator's voice while attenuating background noise.

Besides allowing clear communication, this system also prevents transmitter lock-up which would normally render the voice-operated transceiver unusable when background noise is present.

Claimed to be unique, in currently being the only unit of its type and price available in Australia with a noise cancelling

microphone, the new Talkman is said to be ideally suited for many hundreds of communications applications.

For further information on the Talkman C-900 Headset communicator, contact **GFS Electronic Imports, 15 McKeon Road, Mitcham Vic. 3132. (03)873-3939.**

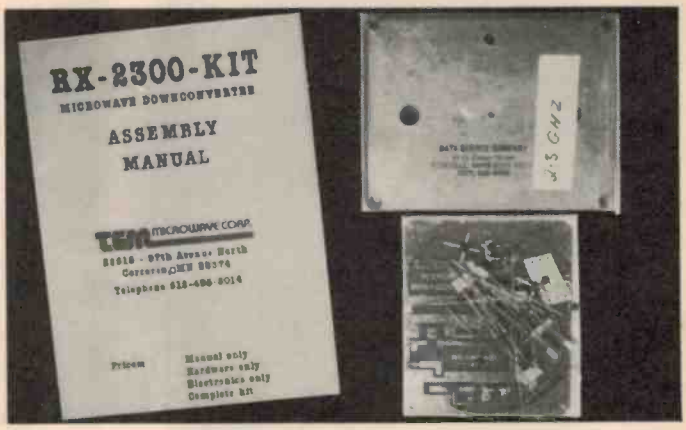
LICENCE FEES TO RISE

The Federal Minister for Communications, Mr Michael Duffy, has announced a general rise in licence fees for radiocommunication stations in all services.

Radio amateur licence fees will rise from $18 to $19 per year, while citizens' band licence fees will rise from $9 to $11. Land mobile fees will not rise but the associated base station fees will. Licence fees for both amateur and CB repeaters will rise from $20 to $25 per year.

Mr Duffy said that in former years fees were levied on a cost recovery basis. But as part of the overall 1983-84 Budget strategy, the Government had made a decision to exercise its option under the Radiocommunications Licence Fees Act 1982 and include a royalty component in the fee structure.

Mr Duffy said about $21.5 million would be collected in licence fees in 1983-84, about $4 million of this being the royalty component.



DOWNCONVERTER KIT

New from GFS Electronic Imports is a 2.3 GHz downconverter kit, the Model RX-2300.

It is designed for easy assembling and may be tuned to any 50 MHz band between 1.69 and 2.7 GHz. Services included within this range are weather satellites and NASA's S-Band Space Shuttle video and audio link, as well as a NASA beacon on the moon. The IF frequency is user-selectable between 54 and 220 MHz.

Because use is made of a low-noise microwave transistor, the RF amplifier stage of the RX-2300 exhibits an extremely good sensitivity.

All components are supplied with the kit, including an instruction manual, diecast metal case and BNC connectors. The price of the kit is $89, plus $5 postage.

For further information, contact **GFS Electronic Imports, 17 KcKeon Road, Mitcham Vic. 3232. (03)873-3939.**

PHONE PATCH — IT'S ON!

Telecom has widened the range of circumstances where radio phone patch connections will be made to the telephone network.

Announcing this mid-September, Telecom emphasised that the radio phone patch services would be confined to specified user groups — mostly those with mobile radio services. The services could not be resold.

Telecom will continue to be the provider of the Public Mobile Telephone Service through the rapid expansion of its high technology, cellular radio now operating in Melbourne and Sydney and soon to be introduced in other capital cities and regional centres.

There is a growing need for radio phone patch facilities among the following specified user groups:

- Emergency Services operating mobile radio.
- Amateur Radio Operators.
- CB Radio Operators.
- Common Interest groups operating mobile radio.

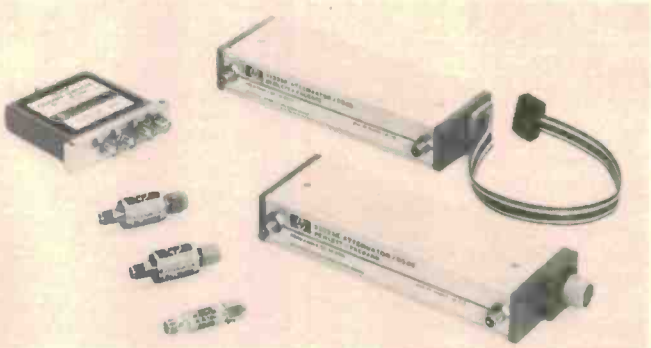
There are a number of examples, such as farmers who wish to make phone calls from their tractors via radio back to their home telephone, and country taxi services which want to be able to contact emergency services direct from their vehicles.

Australian amateur radio operators will be able to enjoy the phone patch arrangements available in some overseas countries.

Details of the new policy have been available from 19 September and copies may be obtained from Telecom's Melbourne headquarters (03)606-7616.

Existing permits will be updated to the new conditions and new applications will be accepted from 1 November, 1983. The phone patch equipment must be approved, and wired in place by Telecom.

PRECISION MICROWAVE COMPONENTS



Microwave system designers have several new precision coaxial components available from Hewlett-Packard: a programmable 90 dB step attenuator, fixed attenuators, attenuators from 3 to 40 dB, and a coaxial-switch element for matrix switches.

The HP 33323K is a coaxial step attenuator with 10 dB steps to 90 dB over the dc to the 26.5 GHz band. Key features include accuracy (±2.8 dB at 90 dB and 26.5 GHz) as well as low SWR (less than 1.8 at 26.5 GHz), combined with compact size and rugged design. Switching coils of the HP 33323K operate momentarily at 24 Vdc for 10 ms and have magnetic latching.

Three models of fixed attenuators provide coverage from dc to 26.5 GHz. The HP 33340A operates from dc to 12 GHz, the HP 33340B from dc to 18 GHz, and the HP 33340C from dc to 26.5 GHz. Each model is available with fixed values of 3, 6, 10, 20 or 30 dB. The A/B suffix models use SMA connectors, while the HP 33340C relies on the high-performance APC-3.5 connector. The environmental performance includes −40 to +75°C operating temperatures.

In designing the complex matrices for signal switching, the HP 33311B-CO4 coaxial switch provides a cross-bar switching action well-suited for microwave signals. It connects both crossing lines with low insertion loss or passes both signals through the intersection with at lest 90 dB of isolation, dc to 18 GHz. By combining these switches with the common SPDT type, larger matrices may be configured. For example, a 3 x 4 matrix requires six HP 33311B-CO4 switches and five of the SPDT type.

For further details, contact **Hewlett-Packard Australia, 31-41 Joseph Street, Blackburn Vic. 3130. (03) 890-6351.**

SCALAR'S RUGGED LIGHT STICK

Designed for use in the mining industry, Scalar Industries' new LS6/LS10 light stick features lightweight yet rugged construction which makes it ideal for vehicle roofrack mounting.

A special feature of the ground-insulated LS6/LS10 is the use of high-intensity LEDs, which provide a very long operational life span.

The LED lens cover is made of resilient polycarbonate tubing, and the unit's whip rod is parallel 9 mm glass-fibre, mounted into a black anodised ferrule.

For further information, contact **Scalar Industries, 20 Shelley Avenue, Kilsyth Vic. 3137. (03)725-9677.**

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That's right! A fully configured Z80 computer running at maximum capacity, on a single **PCB. On board disk controller** drives up to four double sided, double density drives either 8" or 5". **2 by RS232 I/O Ports,** both may be software configured, use one for a terminal the other for a printer or modem etc. **Battery backed real time clock** software accessible for automatic dating of documents, timing during games. Fully **STD buss compatible** — choose from thousands of ready available play in card options. **Bootstrap Monitor** on board — boots to **CP/M.** Choose from the world's **largest range of software.**

ALTRONIC KIT FEATURES

Two versions of the bootstrap monitor supplied. One set **for 1200 baud operation** enables connection to **MICROBEE 16 & 32K IC'S** utilizing their terminal emulation facilities. The other set for **9600 baud** operation.
Complete set of **IC** sockets.
Double sided plated through **PCB** — solder masked and pretinned.
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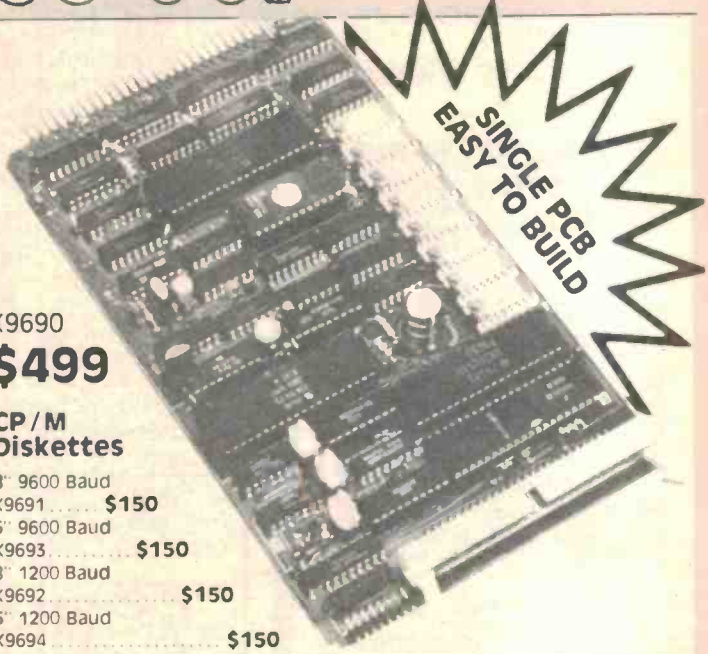
2 x DB25P's and ribbon cable for peripheral connections.
Quality components used throughout including solder and full documentation.



K9690
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K9693 ..... **$150**
8" 1200 Baud
K9692 ..... **$150**
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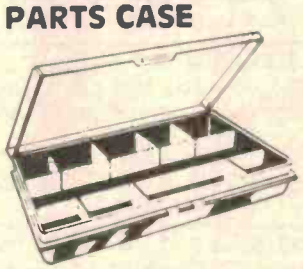
K9694 ..... **$150**

LEDS

Z 0140	Led 3mm Red	.14	.10
Z 0141	Led 3mm Green	.20	.18
Z 0143	Led 3mm Yellow	.22	.20
Z 0150	Led 5mm Red	.14	.10
Z 0151	Led 5mm Green	.20	.18
Z 0152	Led 5mm Yellow	.22	.20
Z 0154	Led 5mm Orange	.25	.22
Z 0159	Led 5mm Flashing FRL4403	.49	.45
Z 0160	Led Rectangular Red	.22	.19
Z 0162	Led Rectangular Green	.25	.22
Z 0164	Led Rectangular Yellow	.25	.22
Z 1072	Led Infra Red CQY89A	.55	.52

TECHNICIAN'S UTILITY PARTS CASE



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19.5mm mounting hole required. Supplied with two keys. Hundreds of applications for security type applications.

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INDUSTRY PREFERRED TYPE

ALL ONE PRICE
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10 up $1.80

Resistance	Cat	Resistance	Cat	Resistance	Cat
100 R	R 2410	5K	R 2423	200 K	R 2433
200 R	R 2415	10 K	R 2425	500 K	R 2435
500 R	R 2417	20 K	R 2427	1 M	R 2437
1 K	R 2419	50 K	R 2429	2 M	R 2439
2 K	R 2421	100 K	R 2431		

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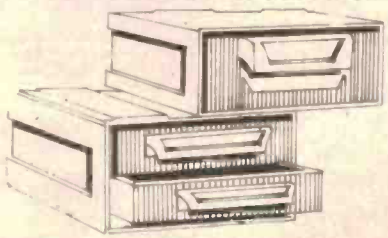
H 0435 Single Way $2.20
H 0436 Double Drawers $2.20



FUSE HOLDER 3AG

32 x 6.3mm Fuse
S 6000 ... ~~.95~~
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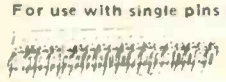
MOLEX PIN SOCKETS

For use with single pins up to .5mm diam.



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Supplied on "Break off" header pre-spaced .1 inch.

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SATURDAY ARVO KITS

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K1106 ..... **$6.50**
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K1123 ..... **$13.95**
SOUND BENDER
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• FOR DESPATCH P&P CHARGES AND ADDRESS DETAILS PLEASE REFER TO OUR AD. ON PAGE 15 •

WIN A SCANNER

Here's a great opportunity to get into listening in on the exciting "world beyond shortwaves". You could win this top-line J.I.L. Model SX-200 Scanner worth nearly $600. All you have to do is answer the five questions below and tell us in 25 words or less what features of the SX-200 most attract you.

The SX-200 has been generously donated by G.F.S. Electronic Imports of Melbourne as a prize in this contest, which is jointly sponsored by ETI and G.F.S. Electronic Imports.

The J.I.L. Model SX-200 is a popular scanner having many features. Covering a frequency range of 26-88, 108-180 and 380-514 MHz, it uses a keyboard providing a selection of over 33 000 channels. Up to 16 frequencies may be placed in a non-volatile memory. Scanning can be carried out over a specific frequency range by programming upper and lower frequency limits.

Unique squelch circuitry is employed, having three modes, allowing the receiver to (a) stop scanning with open audio on carrier only, (b) to stop on carrier with closed audio until modulation is applied to the carrier, or (c) not stop at all until carrier and modulation are detected.

A front panel-mounted fine-tuning control ensures that all Australian-allocated two-way radio frequencies are covered. AM or FM reception is possible on all brands. Direct operation from 240 Vac or 12 Vdc is provided for.

ETI staff have used this scanner and found it very sensitive, free from spurii and easy to use. It has the greatest frequency coverage of any scanners we have seen.

RULES

This contest is open to all persons normally resident in Australia with the exception of members of the staff of G.F.S. Electronic Imports, Federal Publishing Company, Gordon & Gotch Pty Ltd and/or associated companies.

Entries should be addressed to **ETI/G.F.S. SX-200 Scanner Contest, ETI Magazine, P.O. Box 21, Waterloo, NSW 2017.**

Closing date for the contest is November 30, 1983. Entries received within seven days of that date will be accepted if postmarked prior to and including November 30, 1983.

The contest will be judged by the Editor and Managing Editor of ETI whose decision will be final. No correspondence can be entered into regarding their decision.

In the event of one or more tied results occurring in the multi-choice questions amongst entrants, the finalists' entries will be judged on the written answer to the last question.

The winner will be advised by telegram the same day the result is declared. The name of the winner, together with the winning answers, will be published in the next possible issue of ETI.

Contestants must enter their names and addresses where indicated on each entry form. Photostats or clearly written copies will be accepted, but if sending copies you must cut out and include with each entry the month and page number from the bottom of the right hand page of the contest. In other words you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

This contest is invalid in States where local laws prohibit entries.

Entrants must sign the declaration accompanying this contest that they have read the above rules and agree to abide by their conditions.

NOTE: Please read contest rules carefully, especially if sending in multiple entries.

- You may enter as many times as you wish but you must use a separate entry form for each entry and include the month and page number cut from the bottom right hand page of the contest. You must put your name and address where indicated on each entry form.

ENTRY FORM

The world's first radio patent was applied for in Britain in 1896. Who made the application?

Heinrich Hertz ☐
Maxwell Newton ☐
Guglielmo Marconi ☐
Andre Poppov ☐
Roger Harrison ☐

In what month was the application made?

March ☐
April ☐
May ☐
June ☐
July ☐

In July 1897, the British Wireless Telegraph and Signal Co was formed, concentrating on installing radio in ships. The first was installed in:

The Florida ☐
The Kaiser Wilhelm der Grosse ☐
The Titanic ☐
Australia II ☐
Brittania ☐

The transistor was invented in 1948 by a team of three scientists. They were:

Wright, Shottky and Ohl ☐
Martin, Barton and Fargo ☐
Shockley, Bardeen and Brattain ☐
Thomson, Korn, Creed ☐

In what year was Australia's Wireless Telegraphy Act passed into law?

1901 ☐
1905 ☐
1919 ☐
1915 ☐

Tell us, in 25 words, or less what features of the SX-200 scanner most attract you.

.....

.....

.....

.....

.....

Name .....

Address .....

.....

..... **Postcode** .....

I have read the Contest Rules and agree to abide by their conditions.

Signed .....

Date .....

CONTEST CLOSES NOVEMBER 30, 1983. Any entries reaching us after that date must be postmarked no later than November 30, 1983.

SEND ENTRIES TO: **ETI/G.F.S. SX-200 Scanner Contest, ETI Magazine, P.O. Box 21, Waterloo, NSW 2017.**

FERGUSON TRANSFORMERS

PRINTED CIRCUIT BOARD MOUNTING TRANSFORMERS

PL9/5VA	$7.95	PL24/5VA	$7.95	PL18/12VA	$10.50
PL12/5VA	$7.95	PL30/5VA	$7.95	PL24/12VA	$10.50
PL15/5VA	$7.95	PL40/5VA	$7.95	PL30/12VA	$10.50
PL18/5VA	$7.95	PL161/5VA	$10.50		

LOW PROFILE CHASSIS MOUNTING TRANSFORMERS

PL12/20VA	$14.75	PL12/60VA	$19.50	PL24/40VA	$16.50
PL15/20VA	$14.75	PL15/60VA	$19.50	PL30/40VA	$16.50
PL18/20VA	$14.75	PL18/60VA	$21.50	PL40/40VA	$16.50
PL24/20VA	$14.75	PL24/60VA	$21.50	PL30-9/40VA	$23.50
PL30/20VA	$14.75	PL12/40VA	$16.50		
PL40/20VA	$14.75	PL15/40VA	$16.50	PL30/60VA	$21.50
PL1.5-18/20VA	$23.50	PL18/40VA	$16.50	PL30-9/60VA	$25.50

CONVENTIONAL CHASSIS MOUNTING TRANSFORMERS

PF3577	$33.90	PF3993	$23.90	PF4362	$57.90
PF3783	$79.50	PF4244	$46.50	PF4363	$57.90
PF3787	$21.50	PF4354	$49.50	PF4405	$44.50
PF3788	$43.50	PF4361/1	$49.50		

BELL TRANSFORMERS

PP84/1000 $15.50 PP88/1000 $15.50 PP812/500 $15.50

AUDIO TRANSFORMERS

MT552 $28.50 OP590 $46.50 OP592 $36.90

D.C. POWER SUPPLIES

PPA30C $12.90 PPA60C $12.90 PPA90C $12.90
PPA4.50C $12.90 PPA7.50C $12.90

BUILD YOUR OWN SPEAKERS WITH PHILIPS

Part No.	Price
ADO 1610 T8	$16.95
ADO 2160 SQ8	$49.50
AD70601 W8/620	$28.50
AD 12250 W8	$83.00

P.C. EDGE CONNECTORS

S100 gold plated wire wrap	$8.50
S100 solder tail	$7.90
D2 Motorola bus	
43 86 solder tail	$8.50
43 86 gold plated wire wrap	$11.50

10 TURN POTENTIOMETERS

Stock resistance values

50R 100R 200R
500R 1K 2K 5K
10K 20K 50K
100k

Spectrol model 534 + shaft
Price 1 9 **$12.50**
10 + values may be mixed **$11.50**

DIP PLUGS

Ideal for use with flat ribbon cable or to mount components on

14 pin $1.50 24 pin $2.90
16 pin $1.90 40 pins $5

POWER TRANSFORMERS

SPECIALLY DESIGNED FOR MICROCOMPUTERS

- Good regulation electrostatic shield
- RI 810 8V @ 10A x 15V @ 1A **$36.50**
- RI 820 8V @ 20A 15V @ 1A 15V @ 3A **$43.50**

20 TURN CERMET TRIM POT

SPECTROL 43P ACTUAL SIZE

STOCK RESISTANCE VALUES
10R 20R 50R 100R 200R 500R 1K 2K 5K 10K 20K 50K 100K 200K 500K 1M 2M

1 9	$1.80
10 99	$1.60
100	$1.30

Values may be mixed.

Hexadecimal Keypad

$42.50

19 key pad includes 1 10 keys ABCDEF and 2 optional keys and a shift key

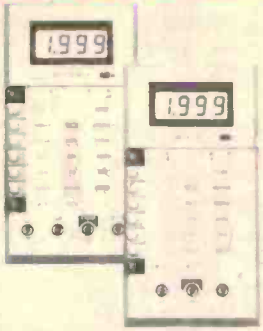
Ideal for dream project

MULTIDIALS

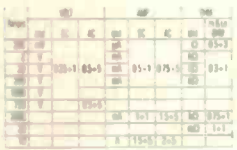
Dials to suit 10 T Pots

Model 21 1 8" dia	$24.50
Model 16 9" dia	$19.50
Model 18 1" x 1.75" dia	$27.50

RITRON DIGITAL MULTIMETERS



- 28 Ranges
- Push Button Operation
- Auto Polarity
- Low Battery Indicator
- Full Overload Protection
- Finger Guards on Probes and Shrouded Plugs for Safety
- Accuracy: 1 year 18°C to 28°C (+ % of reading + No. of Digits) 200 hour battery life

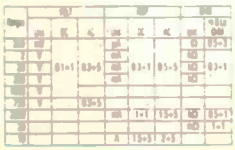


Q16010 specifications

1-4	5+
$59.95	$54.95

Q17040 specifications

1-4	5+
$89.95	$84.95



TEXTOOL ZIP* DIP 11 SOCKETS

16 Pin Zip* Dip 11	$11.50
24 Pin Zip* Dip 11	12.50
40 Pin Zip* Dip 11	17.50

Zero Insertion Pressure

DIP SWITCHES SPST

P.N	No of Switches	Price
SD3	3	$1.60
SD4	4	1.70
SD5	5	1.90
SD6	6	2.30
SD7	7	2.40
SD8	8	2.50
SD9	9	2.70
SD10	10	3.00

DIP SWITCHES SPST

cermet single TURN TRIM POT

Spectrol model 63P ACTUAL SIZE

STOCK VALUES
10R 20R 50R 100R 200R 500R 1K 2K 5K 10K 20K 50K 200K 500K 1M 2M

1 9	$1.20
10 99	$1.00
100	$0.90

Values may be mixed.

HEATSINKS

High Thermal Capacity Black Anodised

	1-4 $	5-9 $	10-49 $	50-99 $	100-499 $	500 plus $
HS1 — 38mm	1.85	1.75	1.50	1.35	1.00	0.90
HS2 — 75mm	3.00	2.90	2.50	2.00	2.00	1.50
HS3 — 150mm	5.80	5.40	4.90	3.80	2.90	2.70
HS4 — 225mm	8.10	7.60	7.10	5.90	4.50	4.30
HS5 — 300mm	8.90	8.40	7.90	6.50	4.90	4.60

Unanodised

HS11 — 38mm	1.40	1.20	1.00	0.90	0.80	0.70
HS12 — 75mm	2.50	2.20	1.90	1.60	1.25	1.20
HS13 — 150mm	4.90	4.50	4.00	3.20	2.45	2.40

RS232 & "D" TYPE CONNECTORS

PART NO	DESCRIPTION	1 9	10-25	25+
DE 9P	9 PIN MALE	$3.50	$3.50	$3.10
DE 9S	9 PIN F MALE	4.50	4.20	3.90
DE 9C	9 PIN COVER	2.20	2.10	1.90
DA 15P	15 PIN MALE	4.50	4.20	3.90
DA 15S	15 PIN F MALE	5.10	4.90	4.70
DA 15C	15 PIN COVER	2.30	2.10	2.00
DB 25P	25 PIN MALE	5.90	5.60	5.10
DB 25S	25 PIN F MALE	6.90	6.60	6.10
DB 25C	1 pc Grey Hood	2.40	2.20	2.00
DB 25C2B	2 pc Black Hood	2.80	2.70	2.50
DB 25C2G	2 pc Grey Hood	2.70	2.50	2.40
DC 37P	37 PIN MALE	7.90	7.50	7.10
DC 37S	37 PIN F MALE	10.90	9.90	9.10
DC 37C	37 PIN COVER	4.90	4.50	4.10
DH S	Hardware set (2 Pairs)	2.10	1.90	1.80

BLANK CASSETTES T.D.K.

TDK ADC60	1 for $3.99	10 for $28.60
TDK DC60	1 for $2.30	10 for $19.99
TDK ODC60	1 for $3.85	10 for $34.10
TDK SAC60	1 for $3.85	10 for $34.10
TDK SAXC60	1 for $6.30	10 for $50.60
TDK DC90	1 for $2.60	10 for $22.10
TDK ADC 90	1 for $3.85	10 for $33.00
TDK SAC90	1 for $4.65	10 for $42.90
TDK ODC90	1 for $5.20	10 for $59.50
TDK SAXC90	1 for $5.99	10 for $59.99
TDK DC120	1 for $4.99	10 for $40.70
TDK ADC120	1 for $5.99	10 for $53.00

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Ph: (03) 489 8131. ERRORS AND OMISSIONS EXCEPTED

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48–50 A'BECKETT STREET, MELBOURNE (03) 347-9251

VHF LISTENERS' GUIDE

Part 1 26-88 MHz

We present here a computer-sorted listing of frequency channels and the services that occupy them for hobbyists and services interested in monitoring communications activity on the very high frequency bands. This, the first portion of our list, covers the frequency band from 26 MHz, at the 'top end' of the shortwave band, to 88 MHz, where the FM broadcast band starts. It has been compiled from a variety of sources, generally publicly available, and cross-checked where possible. It is the first such comprehensive listing of this sort published in Australia. However, we make no claims regarding its completeness.

The listing is presented state by state, with the channels listed in ascending frequency. Where known, the modulation mode — frequency modulation (FM) or amplitude modulation (AM) — has been indicated. In general, these days, FM is the predominant mode about 30 MHz. Brief details of the services using particular channels are given. Note that some channels are shared, but the services may be geographically separated. Those channels which are common nationally, including beacons, satellites etc, are listed separately. Beacons identifying in morse have the modulation mode indicated as CW.

We publish this listing as a public service. Such a list could readily be compiled by most individuals but we have used our resources to research the data and compile and sort the listing using a computer, saving you the trouble and months of effort involved.

This section of the spectrum is used by many emergency and disaster services, particularly bushfire brigades. As the peak bushfire risk period is approaching, 'keeping an ear' on the appropriate channels in your area may give you timely warning of events and developments important to you, certainly well in advance of news announcements on TV or the broadcast bands.

For those interested in 'anomalous' or enhanced propagation at VHF, then listening to services on certain channels in strategic areas can give warning of developing propagation conditions — a favourite pastime of the VHF amateur after long distance (or DX) contacts. Strategically located beacons in other countries have been included for this purpose.

NATIONAL

26.965		NATIONAL	HF CB BAND CH.
26.975		NATIONAL	CH.2
26.985		NATIONAL	CH.3
27.005		NATIONAL	CH.4
27.015		NATIONAL	CH.5
27.025		NATIONAL	CH.6
27.035		NATIONAL	CH.7
27.055		NATIONAL	CH.8
27.065		NATIONAL	CH.9
27.075		NATIONAL	CH.10
27.085		NATIONAL	CH.11
27.105		NATIONAL	CH.12
27.115		NATIONAL	CH.13
27.125		NATIONAL	CH.14
27.135		NATIONAL	CH.15
27.155		NATIONAL	CH.16
27.165		NATIONAL	CH.17
27.175		NATIONAL	CH.18
27.185		NATIONAL	CH.19
27.205		NATIONAL	CH.20
27.215		NATIONAL	CH.21
27.225		NATIONAL	CH.22
27.235		NATIONAL	CH.24
27.245		NATIONAL	CH.25
27.255		NATIONAL	CH.23
27.265		NATIONAL	CH.26
27.275		NATIONAL	CH.27
27.285		NATIONAL	CH.28
27.295		NATIONAL	CH.29
27.305		NATIONAL	CH.30
27.315		NATIONAL	CH.31
27.325		NATIONAL	CH.32
27.335		NATIONAL	CH.33
27.345		NATIONAL	CH.34
27.355		NATIONAL	CH.35
27.365		NATIONAL	CH.36
27.375		NATIONAL	CH.37
27.385		NATIONAL	CH.38
27.395		NATIONAL	CH.39
27.405		NATIONAL	CH.40
27.720	AM	NATIONAL	MARINE
27.860	AM	NATIONAL	MARITIME CALL/WORK
27.880	AM	NATIONAL	MARITIME DISTRESS
27.900	AM	NATIONAL	MARITIME SHIP/SHORE
27.910	AM	NATIONAL	MARINE
27.940	AM	NATIONAL	MARITIME INTERSHIP
28.230	CW	NZ MT. CLIMIE	ZL2MHF AMATEUR BEACON
28.266	CW	STH AFRICA SALISBURY	ZS2JV AMATEUR BEACON
28.280	CW	VENEZUALA CARACAS	YV5AYV AMATEUR BEACON
28.290	CW	HONG KONG	VS6HK AMATEUR BEACON
28.315	CW	STH AFRICA JOHANNESBURG	ZS6DN AMATEUR BEACON
28.888	CW	USA HOLLYWOOD	W6IRT AMATEUR BEACON
29.510	FM	NATIONAL	UOSAT OSCAR 9 SATELLITE
29.600	FM	NATIONAL	10 M SIMPLEX AMATEUR RADIO
46.250	AM	NATIONAL	CH.0 VISION CARRIER
50.005	CW	HAWAII HONOLULU	W6HTH/KH6 ATTENDED AMATEUR BEACON
50.005	CW	STH AFRICA NATAL	ZS5VHF AMATEUR BEACON
50.005	CW	SOLOMON IS HONIARA	H44HIR AMATEUR BEACON
50.008	CW	JAPAN MIE	AMATEUR BEACON
50.035	CW	STH AFRICA GIBRALTAR	ZB2VHF AMATEUR BEACON
50.040	CW	STH AFRICA	ZS6VHF AMATEUR BEACON
50.040	CW	USA SAN DIEGO	WA6MHZ AMATEUR BEACON
50.050	CW	USA SAN FRANCISCO	K6FV ATTENDED AMATEUR BEACON
50.055	CW	STH AFRICA	ZS6XJ AMATEUR BEACON
50.065	CW	HAWAII PEARL HARBOUR	KH6EQI AMATEUR BEACON
50.075	CW	HONG KONG	VS6SIX AMATEUR BEACON
50.085	CW	USA LOS ANGELES	WA6RJA AMATEUR BEACON
50.100	CW	STH AFRICA	ZS6HVB ATTENDED AMATEUR BEACON
50.103	CW	TAHITI	FO8DR ATTENDED AMATEUR BEACON
50.103	CW	US SAMOA	AH8A AMATEUR BEACON
50.105	CW	ANTARCTICA McMURDO	KC4AAD AMATEUR BEACON (CHECK ACTIVITY)
50.110	CW	JAPAN MINAMI	JDIYAA JARL BEACON
50.110	CW	SAIPAN	KH0AB ATTENDED AMATEUR BEACON

50.144	CW	PONAPE	KC6IN ATTENDED AMATEUR BEACON
51.020	CW	NZ AUCKLAND	ZL1KHF ATTENDED AMATEUR BEACON (ZLIADE)
51.750	FM	NATIONAL	CH.0 SOUND CARRIER
51.999	CW	SAMOA PORT VILA	VT8PV AMATEUR BEACON (CHECK ACTIVITY)
52.013	CW	PNG PORT MORESBY	P29SIX AMATEUR BEACON
52.100	CW	ANTARCTICA MACQUARIE IS	VK0AP AMATEUR BEACON
52.100	CW	ANTARCTICA CASEY BASE	VK0BC AMATEUR BEACON (CHECK ACTIVITY)
52.250	CW	NZ PALMERSTON NORTH	ZL2VHP AMATEUR ATTENDED BEACON
52.500	CW	JAPAN NAGOYA	JA2IGY JARL BEACON
52.510	CW	NZ MT CLIMIE	ZL2MHF AMATEUR BEACON (ZL2ACT TRUSTEE)
52.525	FM	NATIONAL	6 M SIMPLEX AMATEUR RADIO
57.250	AM	NATIONAL	CH.1 VISION CARRIER
62.750	FM	NATIONAL	CH.1 SOUND CARRIER
64.250	AM	NATIONAL	CH.2 VISION CARRIER
69.750	FM	NATIONAL	CH.2 SOUND CARRIER
69.750	FM	NATIONAL	TV CH.2 SOUND
86.250	AM	NATIONAL	CH.3 VISION CARRIER

ACT

71.540	ACT	FIRE BRIGADE
76.670	ACT	AMBULANCE
77.540	ACT	BUSH FIRE

NSW

28.262	CW	NSW SYDNEY	VK2RSY AMATEUR BEACON
28.335	AM	NSW SYDNEY	VK2WI SUNDAY MORNING BROADCASTS
52.420	CW	NSW SYDNEY	VK2RSY AMATEUR BEACON
52.425	CW	NSW GUNNEDAH	VK2RGB AMATEUR BEACON
70.675		NSW NEWCASTLE	FIRE
70.737		NSW NEWCASTLE	TAXI
72.562		NSW ALBURY	ELECTRICITY SUPPLY
72.650		NSW SPRINGWOOD	MUNICIPAL COUNCIL & BUSHFIRE (VL2EN)
72.800	FM	NSW TAMWORTH	CITY COUNCIL
72.890		NSW BLUE MTS	BUSHFIRE
72.980		NSW SYDNEY	FORESTRY COMM.
73.040		NSW SYDNEY	FORESTRY COMM.
73.100		NSW ALBURY	ELECTRICITY SUPPLY
73.100		NSW SYDNEY	FORESTRY COMM.
73.160		NSW SYDNEY	FORESTRY COMM.
73.327		NSW NEWCASTLE	POLICE
73.575		NSW NEWCASTLE	CRANE SERVICES
73.850		NSW ALBURY	CITY COUNCIL
73.880		NSW TAMWORTH	TAXIS
73.987		NSW CENTRAL WEST	EVANS SHIRE
74.042		NSW SYDNEY	2BE BEGA
74.237		NSW CENTRAL WEST	ORANGE CITY COUNCIL
74.270		NSW CENTRAL WEST	GABONNE SHIRE
75.470		NSW CENTRAL WEST	WELLINGTON SHIRE
75.590		NSW WOLLONDILLY	BUSHFIRE BRIGADE
75.590		NSW TAMWORTH	BOOLAROO SHIRE COUNCIL
75.862		NSW SYDNEY	TAXI TRUCKS
75.920		NSW TAMWORTH	ASHFORD SHIRE COUNCIL
76.040	FM	NSW	FIRE
76.085	FM	NSW	AMBULANCE CH.3
76.115	FM	NSW	AMBULANCE CH.4
76.145	FM	NSW	AMBULANCE CH.5
76.370	FM	NSW	AMBULANCE CH.7
76.550	FM	NSW SYDNEY	AMBULANCE
76.580		NSW SYDNEY	AMBULANCE
76.610		NSW SYDNEY	AMBULANCE
76.625		NSW	AMBULANCE
76.640		NSW SYDNEY	AMBULANCE
76.670		NSW SYDNEY	AMBULANCE
76.670		NSW TAMWORTH	AMBULANCE
76.670		NSW ALBURY	AMBULANCE
76.670		NSW CENTRAL WEST	AMBULANCE
76.670	FM	NSW TAMWORTH	AMBULANCE
76.670		NSW NEWCASTLE	AMBULANCE
76.685	FM	NSW SYDNEY	AMBULANCE
76.690		NSW SYDNEY	AMBULANCE
76.700	FM	NSW	AMBULANCE CH.2
76.715		NSW NEWCASTLE	AMBULANCE
76.730		NSW SYDNEY	AMBULANCE
76.760		NSW SYDNEY	AMBULANCE
76.790	FM	NSW	AMBULANCE CH.6
76.820		NSW SYDNEY	AMBULANCE
76.820	FM	NSW TAMWORTH	EAST/WEST
76.820		NSW TAMWORTH	EAST-WEST AIRLINES
76.850		NSW SYDNEY	AMBULANCE
76.880		NSW SYDNEY	AMBULANCE
76.895		NSW	AMBULANCE
76.910		NSW SYDNEY	AMBULANCE
76.940	FM	NSW	AMBULANCE CH.8
77.000	FM	NSW	AMBULANCE CH.9
77.000		NSW NEWCASTLE	ELECTRICITY SUPPLY
77.080		NSW CENTRAL WEST	ELECTRICITY COMM.
77.090		NSW CENTRAL WEST	ELECTRICITY COMM.
77.120		NSW CENTRAL WEST	ELECTRICITY COMM.
77.210	FM	NSW	AMBULANCE CH.0
77.240		NSW CENTRAL WEST	YOUNG SHIRE
77.390		NSW NEWCASTLE	WATER SUPPLY
77.420		NSW TAMWORTH	NEW ENGLAND SOCIETY
77.540		NSW NEWCASTLE	WATER SUPPLY
77.660		NSW CENTRAL WEST	YOUNG TAXIS
78.040		NSW SYDNEY	FIRE BRIGADE
78.055		NSW SYDNEY	FIRE
78.055		NSW NEWCASTLE	FIRE
78.055		NSW GOSFORD	PUBLIC WORKS (VL2BF)
78.065		NSW SYDNEY	FIRE
78.070		NSW SYDNEY	FIRE
78.070		NSW GOULBURN	FIRE
78.100		NSW SYDNEY	FIRE BRIGADE
78.100		NSW NEWCASTLE	FIRE
78.120		NSW SYDNEY	FIRE BRIGADE
78.125		NSW SYDNEY	FIRE
78.130		NSW SYDNEY	FIRE
78.150		NSW SYDNEY	FIRE BRIGADE
78.160		NSW BLUE MTS	PUBLIC WORKS (VL2BF)
78.160		NSW TAMWORTH	FIRE
78.160		NSW SYDNEY	FIRE BRIGADE
78.175		NSW SYDNEY	FIRE BRIGADE (30 KHz SPACING)
78.190		NSW SYDNEY	FIRE BRIGADE
78.220		NSW SYDNEY	FIRE BRIGADE
78.250		NSW SYDNEY	FIRE BRIGADE
78.280		NSW SYDNEY	FIRE BRIGADE
78.750	FM	NSW SYDNEY	FIRE
78.825		NSW CAMPBELLTOWN	MUNICIPAL COUNCIL & BUSHFIRE (VL2HA)
80.040		NSW TAMWORTH	CITY COUNCIL
80.160		NSW	WATER BOARD RANGERS FIRE CONTROL
80.760	FM	NSW TAMWORTH	CITY COUNCIL
82.110		NSW CENTRAL WEST	ELECTRICITY COMM.
82.140		NSW CENTRAL WEST	ELECTRICITY COMM.
82.170		NSW CENTRAL WEST	ELECTRICITY COMM.
82.980		NSW SYDNEY	DAILY MIRROR
83.100		NSW NEWCASTLE	BHP LOCOS
83.760		NSW ALBURY	POLICE
83.880		NSW TAMWORTH	POLICE
83.940	FM	NSW SYDNEY	POLICE
84.000		NSW NEWCASTLE	POLICE
84.000		NSW TAMWORTH	POLICE

84.480		NSW SYDNEY	V.R.A.
84.480		NSW ALBURY	BORDER RESCUE

QLD

28.270	CW	QLD TOWNSVILLE	VK4RTC AMATEUR BEACON
52.440	CW	QLD TOWNSVILLE	VK4RTL MT STUART AMATEUR BEACON (VK4ZBJ TRUSTEE)
73.670		QLD MACKAY	PIONEER SHIRE COUNCIL
74.000	FM	QLD	FIRE BRIGADE
74.060		QLD BRISBANE	FIRE
74.090		QLD	FIRE
74.120		QLD	FIRE
74.137		QLD BRISBANE	SOUTH COAST FIRE
76.127	FM	QLD BRISBANE	BRISBANE CITY COUNCIL
76.130	FM	QLD BRISBANE	BRISBANE CITY COUNCIL
76.367	FM	QLD BRISBANE	BRISBANE CITY COUNCIL
76.370	FM	QLD BRISBANE	BRISBANE CITY COUNCIL
76.457	FM	QLD BRISBANE	BRISBANE CITY COUNCIL
76.460	FM	QLD BRISBANE	BRISBANE CITY COUNCIL
77.330		QLD	POLICE
77.375		QLD	POLICE
77.390		QLD	POLICE
77.420		QLD COUNTRY	POLICE
77.450		QLD	POLICE
77.480		QLD	POLICE
77.495		QLD	POLICE
77.510		QLD	POLICE
77.540		QLD	POLICE
77.570		QLD	POLICE
78.250		QLD BRISBANE	TOW TRUCKS
78.675		QLD BRISBANE	LOGAN SHIRE
78.825		QLD BRISBANE	ELECTRICITY COMM.
79.045		QLD MACKAY	ELECTRICAL BOARD MAIN ROADS
79.075		QLD BRISBANE	ELECTRICITY COMM.
79.087		QLD BRISBANE	ELECTRICITY COMM.
79.120		QLD MACKAY	ELECTRICAL BOARD MAIN ROADS
79.150		QLD MACKAY	ELECTRICAL BOARD MAIN ROADS
79.405		QLD MACKAY	NERO SHIRE COUNCIL
79.435		QLD MACKAY	SARINA SHIRE COUNCIL
79.750	FM	QLD BRISBANE	Q.A.T.B.
79.810		QLD BRISBANE	Q.A.T.B.
79.835		QLD BRISBANE	AMBULANCE
79.840	FM	QLD BRISBANE	Q.A.T.B.
79.870		QLD BRISBANE	Q.A.T.B.
79.875		QLD BRISBANE	AMBULANCE
79.960	FM	QLD BRISBANE	Q.A.T.B.
81.362		QLD BRISBANE	TAXIS
82.975		QLD BRISBANE	Q.A.T.B.
82.980		QLD MACKAY	Q.A.T.B.
82.985		QLD ROCKHAMPTON	AMBULANCE
83.815		QLD BRISBANE	TAXIS
83.850		QLD BRISBANE	TAXIS
84.600		QLD BRISBANE	TAXIS
84.775		QLD BRISBANE	TAXIS

SA-NT

28.260	CW	SA ADELAIDE	VK5WI AMATEUR BEACON
52.200	CW	NT DARWIN	VK8VF AMATEUR BEACON (VK8GB TRUSTEE)
52.150	CW	SA YORK PENINSULA	VK5KK AMATEUR BEACON (CHECK ACTIVITY)
53.000	CW	SA ADELAIDE	VK5VF AMATEUR BEACON (MAY CHANGE)
72.920		SA	POLICE
73.040		SA	AMBULANCE
73.100		SA	POLICE
73.160		SA	POLICE
73.160		SA	AMBULANCE
73.190		SA	AMBULANCE
73.250		SA	AMBULANCE
75.430		SA	TAXIS
75.740		SA	ROYAL AUTO. ASSOC.
75.750		SA	ROYAL AUTO. ASSOC.
75.800		SA	ROYAL AUTO. ASSOC.
77.060		SA	TAXIS
77.090		SA	MARINE & HARBOURS DEPT
77.930		SA	GLENELG SAILING CLUB
80.190		SA	TAXIS
80.400		SA	TAXIS
80.460		SA	TAXIS
80.510		SA	TAXIS
80.525		SA	STATE ENERGY COMM.
80.530		SA	TAXIS
82.675		SA	FORESTRY SERVICE

TAS

52.370	CW	TAS HOBART	VK7RST AMATEUR BEACON
52.400	CW	TAS ULVERSTONE	VK7RNT AMATEUR BEACON (VK7ZIE TRUSTEE)
52.470	CW	TAS LAUNCESTON	VK7RNT AMATEUR BEACON
70.940		TAS LAUNCESTON	TAXI
71.480		TAS LAUNCESTON	TAXI
72.440		TAS	ULVERSTONE TAXI
73.310		TAS	HYDRO-ELECTRIC COMM.
73.520		TAS	HYDRO-ELECTRIC COMM.
73.640		TAS	HYDRO-ELECTRIC COMM.
73.760		TAS	HYDRO-ELECTRIC COMM.
73.790		TAS	HYDRO-ELECTRIC COMM.
73.940		TAS	TAXIS
74.120		TAS	MONSON
74.210		TAS	BURNIE TAXI
75.615		TAS	TAXIS
76.390		TAS	STATE EMERGENCY SERVICES (SES)
76.400		TAS	NORTH WOODCHIPS
76.430		TAS	AUSTRALIAN NEWSPRINT
76.460		TAS	A.N.M. MAYDENE
76.640		TAS DEVONPORT	POLICE
76.670		TAS LAUNCESTON	POLICE
76.700		TAS BURNIE	POLICE
76.770		TAS	FIRE CONTROL
76.790		TAS	RURAL FIRE BRIGADE - STATE DISASTER
76.820		TAS	BELL BAY MUTUAL AID GROUP
76.820		TAS	FIRE
76.850		TAS	FIRE
76.940		TAS	FIRE (FORESTRY COMM.)
76.970		TAS	FIRE (FORESTRY COMM.)
77.000		TAS	FORESTRY NAT PARKS LANDS FISHERIES
77.120		TAS	WILDLIFE PARKS
77.210		TAS	URBAN FIRE BRIGADES
77.240		TAS	HAZEL BRASH
77.360		TAS LAUNCESTON	AMBULANCE
77.370		TAS LAUNCESTON	FIRE
77.540		TAS	MAIN ROADS
77.630		TAS	AMBULANCE
77.840		TAS	AMBULANCE
78.070		TAS LAUNCESTON	TAXI
78.100		TAS	DEVONPORT TAXI
78.580		TAS	TRANSPORT COMM.
80.040		TAS NW. COAST	TELECOM
80.280		TAS LAUNCESTON	TELECOM

VIC

28.265	CW	VIC MT BAINBRIDGE	VK3RWI AMATEUR BEACON (MAY CHANGE)
40.680		VIC GIPPSLAND	A.P.M. VOICE PAGING

52.330	CW	VIC MT ANAKIE	VK3RGG AMATEUR BEACON (VK3AWV TRUSTEE)
52.436	CW	VIC MT BAINBRIDGE	VK3RMV AMATEUR BEACON (VK3OT TRUSTEE)
70.040		VIC BALLARAT	TAXI
71.162		VIC GIPPSLAND	OIL RIGS HELICOPTER
71.240		VIC GIPPSLAND	FORESTRY COMM.
71.330		VIC GENERAL	FORESTRY COMM.
71.330		VIC GIPPSLAND	FORESTRY COMM.
71.330		VIC BENDIGO	FORESTRY COMM. (INC FIRE TOWER)
71.345		VIC CENTRAL	FORESTRY COMM.
71.345		VIC GIPPSLAND	FORESTRY COMM.
71.360		VIC EAST/WEST	FORESTRY COMM.
71.375		VIC EAST/WEST	FORESTRY COMM.
71.390		VIC NORTH	FORESTRY COMM.
71.390		VIC GIPPSLAND	FORESTRY COMM.
71.420		VIC GIPPSLAND	FOSTER BUSINESS (SHARED)
71.510		VIC GIPPSLAND	ESSO LONGFORD
71.540	AM	VIC	BAYLEY YARRAGON
71.615		VIC GIPPSLAND	NATIONAL PARKS
71.660		VIC	NATIONAL PARKS SERVICE
71.670		VIC BENDIGO	AMBULANCE
72.140	AM	VIC	ATLAS TAXIS
72.140		VIC	CHETWYND TAXI TRUCKS
72.240		VIC	D.ROBINSON
72.410		VIC	REGAL TAXIS
72.500		VIC	STATE ELECTRICITY COMM.
72.590		VIC	STATE ELECTRICITY COMM.
72.600		VIC	STATE ELECTRICITY COMM.
72.650		VIC	STATE ELECTRICITY COMM.
72.710		VIC	STATE ELECTRICITY COMM.
72.740		VIC	REGAL TAXIS
72.860		VIC COUNTRY	AMBULANCE OLD FREQ
73.040	FM	VIC	H.& R. TOWING
73.040		VIC	HEINE BROS
73.040		VIC MELBOURNE	HIRE CARS
73.100		VIC	AUSTRALIAN PAPER MILLS
73.130	FM	VIC MELBOURNE	PHILIPS
73.160		VIC GIPPSLAND	WALTER WRIGHT
73.160		VIC	YELLOW CAB SERVICES
73.190		VIC	R.BRIGHT
73.190	FM	VIC	NESTLES
73.370		VIC	WONTHAGGI HOSPITAL
73.460		VIC	ARROW TAXIS CH.1
73.470		VIC	ARROW TAXIS CH.2
73.640		VIC	H.H.GREEN
73.700		VIC MELBOURNE	MELBOURNE CITY COUNCIL
73.730		VIC GIPPSLAND	SIDES DRILLING
73.730	AM	VIC	SORRENTO TAXIS
73.730		VIC GIPPSLAND	MORWELL BUSINESS (SHARED)
73.880	FM	VIC	ALBION REID
74.000		VIC	AMBULANCE
74.000		VIC	MUNICIPAL COUNCILS (VARIOUS)
74.030		VIC	HOLT & HANNAH
74.060		VIC GIPPSLAND	HOUSING MINISTRY
74.420		VIC	RBH MOTORS
74.420		VIC GIPPSLAND	LANDS DEPARTMENT
74.420		VIC	VICRAIL
74.540		VIC	ORBOST TAXIS
74.540	FM	VIC	ALBION REID
74.570	FM	VIC	EARTHLIFT
74.570	FM	VIC	SILVERS
75.440		VIC	DARBYSHIRE
75.470	FM	VIC	DIAMOND VALLEY BRIGADE
75.470		VIC	COOTES & STAFF
75.500		VIC	ALSTERGREN (3PP)
75.500	FM	VIC	P & O
75.500	FM	VIC	BARKER AND TAYLOR
75.500	FM	VIC	SERURA SERVICES
75.560		VIC	CAMEO TOW TRUCKS
75.560		VIC	ELDRIDGE ELECTRONICS
75.590		VIC	MORNINGTON TAXI TRUCKS (VH3IJ)
75.680		VIC	MI4 INVESTIGATIONS
75.680		VIC	CAMEO TRANSPORT
75.680	FM	VIC	LILYDALE PANELS
75.800		VIC BALLARAT	STATE ELECTRICITY COMM.
75.860		VIC	STATE ELECTRICITY COMM.
75.950		VIC	CONCRETE PLANT
76.040		VIC	HAWTHORN TAXI TRUCKS (3HF)
76.070		VIC	HESTERS
76.070	FM	VIC	DE PLEDGE (3XY)
76.130		VIC	GEELONG PRE-MIX CONCRETE
76.190		VIC	WORMALDS
76.250		VIC NORTH	AMBULANCE - VIC CIVIL CH.3
76.280	FM	VIC	MORNINGTON WRECKERS
76.310		VIC GEELONG	GEELONG FIRE COUNCIL
76.340	FM	VIC	INSURANCE LOSS ADJUSTORS (3NG)
76.370		VIC	T.N.T.
76.430		VIC ROSANNA	AMBULANCE - VIC CIVIL CH.1
76.460		VIC	A.N.M.
76.490		VIC SOUTH	AMBULANCE - VIC CIVIL CH.2
76.520		VIC	WERRIBEE CITY COUNCIL
76.550	FM	VIC COUNTRY	AMBULANCE NEW
76.580		VIC	NORTHERN RADIO TAXIS
76.580		VIC GIPPSLAND	MORWELL TAXI
76.640		VIC	SHERBROOKE SHIRE
76.640		VIC	SHERBROOKE SHIRE COUNCIL
76.670		VIC COUNTRY	VL3WX
76.670		VIC BALLARAT	BALLARAT AMBULANCE
76.670	FM	VIC COUNTRY	AMBULANCE
76.670		VIC GEELONG	AMBULANCE
76.670		VIC LATROBE VALLEY GIPPSLAND	AMBULANCE
76.670		VIC BALLARAT	AMBULANCE
76.675		VIC	AMBULANCE
76.685		VIC	AMBULANCE
76.700		VIC	AMBULANCE
76.700		VIC	WAYNE NICKLESS
76.715		VIC	AMBULANCE
76.730		VIC	AMBULANCE SERVICE PENINSULA (VL3PY)
76.760		VIC	AMBULANCE
76.760	AM	VIC	AMBASSADOR TOW TRUCKS
76.775		VIC	AMBULANCE
76.790		VIC	AMBULANCE
76.805		VIC	AMBULANCE
76.880		VIC	TAURUS CONSTRUCTIONS
77.000	FM	VIC	ANDERSON NORMAN
77.000	FM	VIC	COLONY INTERIORS (3EZ)
77.000		VIC	HOWIE & HALES
77.060		VIC	RAPID TRANSPORT
77.120		VIC	UNITED TOWING
77.120		VIC	DURAL LEEDS
77.180		VIC	FRANKSTON TAXIS
77.240		VIC GIPPSLAND	STATE ELECTRICITY COMM. LOCOS
77.240		VIC	VIC-RAIL
77.360		VIC	BREAD/CAKE DELIVERIES
77.360	FM	VIC	AUSTRAL BAKERIES
77.420		VIC	M.M.B.W. CH.4
77.425		VIC	TOW TRUCKS
77.450		VIC	M.M.B.W. CH.5
77.540	AM	VIC	ANODISERS OF AUSTRALIA (3TS)
77.540	FM	VIC	C.I.C. AUSTRALIA (3NJ)
77.540	AM	VIC	ALL HOUR REFRIGERATION (3XI)
77.600		VIC	MELBOURNE TOW TRUCKS
77.650		VIC	EMBASSY TAXIS
77.660	AM	VIC	EMBASSSY TAXIS
77.690		VIC	McKEE & FORD
77.712		VIC	EMBASSY TAXIS
77.720	AM	VIC	EMBASSY TAXIS

77.750	FM	VIC	W.A. CURRIE & CO
77.780		VIC	DOWNARDS
77.840		VIC	ASSOC TAXI SERVICE CH. 1.
77.900		VIC	WEST SUBURBAN TAXIS
77.960		VIC	ALJON TOW TRUCKS (3SZ)
77.960		VIC	METROPOLITAN CAR RADIO
77.960		VIC	RINDOLI SPAGHETTI
77.960		VIC	P.G.WALLACE
77.990		VIC	ASSOC TAXI SERVICE CH. 2.
78.070		VIC GIPPSLAND	TELECOM MT. TASSIE 3ZM
78.700		VIC	P.M.G. MOBILE RX
79.090		VIC	BRICK TRANSPORTS
80.100		VIC GIPPSLAND	SALE TAXIS
80.130		VIC	SOUTHERN TYRE SERVICE
80.340		VIC GIPPSLAND	SKYFARMERS LEONGATHA
80.430		VIC	MILDURA APPLIANCES
80.520		VIC	TAURUS CONSTRUCTIONS (VH3CGI)
80.580		VIC GIPPSLAND	BASS/GIRDIES BUSINESS (SHARED)
80.580	FM	VIC	UNIVERSAL RADIO TAXIS
80.670		VIC GIPPSLAND	COWES ESTATE AGENT
80.820		VIC	GAS & FUEL
80.825		VIC BENDIGO	CITY COUNCIL
80.840		VIC GIPPSLAND	BASS/GIRDIES BUSINESS (SHARED)
80.910	FM	VIC	G.E.PORTER
80.940		VIC	GEELONG RADIO CABS
80.970		VIC GIPPSLAND	STATE RIVERS HEYFIELD
81.000	FM	VIC	ARNOLDS TRANSPORT (3BR)
81.000		VIC	BRANDON REFRIGERATION (3CG)
81.000		VIC	GREEN McCANDLISH
81.000		VIC	McINNES TRANSPORT
81.060	FM	VIC	ASTORIA TAXIS
81.160		VIC	TOW TRUCKS
81.180		VIC	DEPT OF COMM. DEMO CHANNELS
81.300		VIC	RYECROFT
81.300		VIC	BAYSIDE MOTORS (3ZM)
81.330		VIC GIPPSLAND	GAS & FUEL CORP
81.420		VIC	FRIDGIDAIRE (3UY)
81.420		VIC GIPPSLAND	BAIRNSDALE TAXI
81.420	AM	VIC	BLUE TAXI TRUCKS (3DI)
81.420	FM	VIC	ARARAT TAXIS
81.540	AM	VIC	S.NORTON
81.600		VIC GIPPSLAND	GAS & FUEL CORP
81.660		VIC GIPPSLAND	ELECTRICIAN TRARALGAR
81.660		VIC	J.CHILVER (LEONGATHA)
81.780	AM	VIC	ALWYN TAXIS
81.840		VIC	UNITED TAXIS
81.840	FM	VIC	INTRAXIC. TOW TRUCKS
81.840		VIC	AUSSIE TRANSPORT (3HI)
81.960	FM	VIC	LEAMON R.A. PTY LTD (3LM)
81.960	FM	VIC	DROMANA TAXIS
81.960		VIC	TOW TRUCKS
81.960	FM	VIC	ACTION WASTE DISPOSAL
81.960		VIC	AW PANELS
82.110	FM	VIC	HASTING TAXIS (3LX)
82.110	FM	VIC	LAMB & BELL (3PM)
82.200		VIC	STATION 3UZ
82.200		VIC	OLIVER J.NILSEN & CO
82.260		VIC BALLARAT	WEBB
82.440		VIC	GILBARCO
82.500		VIC GIPPSLAND	KORUMBURRA TAXI
82.500		VIC	BELGRAVE HEATING (3KC)
82.530	AM	VIC	BALCOMA GARDEN SUPPLIES (3FC)
82.530		VIC	ANDREW ANTENNA
82.530		VIC	W.DOLL (3YZ)
82.530	FM	VIC	BELGRAVE HEATING (3KC)
82.530		VIC	SELECT TYRE SERVICES (3SR)
82.560		VIC	GEELONG W.T. & S.T.
82.620		VIC	LEIGHTON
82.680		VIC	PENINSULA MIXED CONCRETE (3DC)
82.950	FM	VIC	SEAFORD PETROLEM
82.950		VIC CRANBOURNE	PENINSULA MIXED CONCRETE (3CHE)
83.010		VIC	TV REPAIR 3 RR
83.160		VIC	MALLEYS
83.280		VIC	A.A.REEVES
83.340		VIC	LUXURY CABS
83.340	AM	VIC	CRIB POINT TAXIS
83.370	FM	VIC	CREIGHTON BLINDS
83.370		VIC	COIN SLOT MACHINES
83.400		VIC GIPPSLAND	TELECOM MT. TASSIE 3ZM
83.520	FM	VIC	J.LEGGE
83.580		VIC	HADLEY
83.700		VIC GIPPSLAND	STATE RIVERS & WATER SUPPLY
83.700		VIC	YELLOW EXPRESS COURIER
83.760	FM	VIC	TWO BAYS GARDEN SUPPLIES
83.790	FM	VIC	BALWYN PLUMBING
84.240		VIC	P.M.G. MOBILE RX
84.300		VIC	GAS & FUEL
84.330		VIC	MEDICAL SERVICES
84.480		VIC	WODONGA BORDER RESCUE
84.480		VIC GEELONG	BORDER RESCUE
84.540	FM	VIC	MANNOR MESSENGERS
84.600		VIC	ALTON PAGE TOW TRUCKS
84.690		VIC	GO AHEAD SECURITY
84.720		VIC	NORTHERN SUBURBAN TAXIS CH 2
84.840		VIC WANGARATTA	MOBIL OIL
84.840		VIC	MOBIL
84.840		VIC GIPPSLAND	MORWELL BUSINESS (SHARED)
84.840		VIC	HEALESVILLE TAXIS
84.840		VIC	PIVOT TAXIS
84.870		VIC	BLACK CABS
84.900		VIC	NORTHERN SUBURBAN TAXIS CH 1
85.100	FM	VIC	A.C.B.

WA

28.264	CW	WA PERTH	VK6RTV AMATEUR BEACON
28.266	CW	WA ALBANY	VK6RTW AMATEUR BEACON
52.300	CW	WA PERTH	VK6RTV AMATEUR BEACON
52.320	CW	WA CARNARVON	VK6RTT AMATEUR BEACON (VK6OX TRUSTEE)
52.350	CW	WA KALGOORLIE	VK6RTY AMATEUR BEACON (MAY CHANGE)
52.800	CW	WA ALBANY	VK6RTW AMATEUR BEACON (MAY CHANGE)
70.260		WA KALGOORLIE	POLICE
73.520		WA	STATE ENERGY COMM.
74.420		WA	ROYAL AUTO CLUB
74.480		WA	ROYAL AUTO CLUB
76.460		WA ALBANY	FIRE (AND OTHER SUBURBAN)
77.090		WA NORTH PERTH	FIRE BRIGADE
77.120		WA NORTH PERTH	FIRE BRIGADE
78.970		WA	LOCUM
79.080		WA	POLICE
79.140		WA MORRIDIN	POLICE
79.210		WA BUNBURY	POLICE
79.230		WA	POLICE
79.290		WA ALBANY	POLICE
79.600		WA PERTH	AMBULANCE
79.625		WA PERTH	AMBULANCE
79.630		WA PERTH	AMBULANCE
80.035		WA	AMBULANCE
80.085		WA BUNBURY	AMBULANCE
80.550		WA ALBANY	AMBULANCE
80.820		WA	TOW TRUCKS
80.850		WA NORTH PERTH	FIRE BRIGADE
82.860		WA	TOW TRUCKS
84.300		WA	PLUMBERS

WIRE WRAP and PROTOTYPING

S100 BOARDS

BLANK BOARD H19120
For use in all popular S100 Computers (5.3"x10").
Holes on .100" grid.
No etched circuitry except contact fingers.
Allows maximum flexibility in layout.
Fibreglass PCB

	PRICE
H19120	$29.50

HORIZONTAL BUSSES H19125
For use in all popular S100 Computers (5.3"x10").
Horizontal power and ground busses.
Accommodates DIP packages (.3", .4", .6" and .9" centres)
Two hole pads on wiring side allow tack soldering of sockets to board.
Area for heat sink and voltage regulator.
Two rows of pads along top of board for I/O connectors.
Holes on .100" grid.
Fibreglass PCB

	PRICE
H19125	$39.50

VERTICAL BUSSES H19130
For use in all popular S100 Computers (5.3"x10").
Vertical power and ground busses.
Accommodates DIP packages (.3", .4", .6" and .9" centres).
Two hole pads on wiring side allow tack soldering of sockets to board.
Area for voltage regulator and heat sink.
Two rows of pads along top of board for I/O connectors.

	PRICE
H19130	$39.50

PAD PER HOLE H19135
For use in all popular S100 Computers (5.3"x10").
Individual pads surround each hole (.100 grid), allowing maximum flexibility in circuitry layout.
Area provided for voltage regulator and heat sink.
Fibreglass PCB

	PRICE
H19135	$39.50

SPOOLS. 30 AWG KYNAR WIRE

		PRICE 1–9	10+
W19400	50FT Spool WW Wire Blue	4.95	3.95
W19405	50FT Spool WW Wire Red	4.95	3.95
W19410	50FT Spool WW Wire Yellow	4.95	3.95
W19413	50FT Spool WW Wire Black	4.95	3.95
W19420	100FT Spool WW Wire Blue	6.95	5.95
W19425	100FT Spool WW Wire Red	6.95	5.95
W19430	100FT Spool WW Wire Yellow	6.95	5.95
W19435	100FT Spool WW Wire Black	6.95	5.95
W19460	500FT Spool WW Wire Blue	16.95	14.95
W19465	500FT Spool WW Wire Red	16.95	14.95
W19470	500FT Spool WW Wire Yellow	16.95	14.95
W19475	500FT Spool WW Wire Black	16.95	14.95
W19480	1K Spool WW Wire Blue	24.50	21.50
W19485	1K Spool WW Wire Red	24.50	21.50
W29490	1K Spool WW Wire Yellow	24.50	21.50
W19495	1K Spool WW Wire Black	24.50	21.50

WIRE KITS

These kits offer an excellent initial assortment of the most popular sizes of precut wire.
They suit the needs of anyone from the beginner to the serious wire wrapper.
Available in a rainbow assortment (each length same color).

Kit #1 W19390

NO. WIRES	LENGTH
200	3"
250	3½"
100	4"
100	4½"
100	5"
100	6"

Kit #2 W19395

NO. WIRES	LENGTH
250	2½"
500	3"
500	3½"
500	4"
250	4½"
250	5"
100	5½"
100	6"
100	6½"
100	7"

W19390 $19.95
W19395 $47.50

APPLE® BOARDS

BLANK BOARD H19150
Holes on .100" grid.
No etched circuitry except contact fingers allows maximum flexibility in layout.
Additional 40-pin connector for I/O.
Fibreglass PCB

	PRICE
H19150	$29.50

PAD PER HOLE H19160
Individual pads surround each hole, allowing maximum flexibility in circuitry layout.
Additional 40-pin connector for I/O.
Fibreglass PCB

	PRICE
H19160	$39.50

HORIZONTAL BUSSES H19155
Horizontal power and ground busses.
Accommodates DIP packages (.3", .4", .6" and .9" centres).
Two holes on wiring wide allow tack soldering of sockets to boards.
Holes on .100" grid.
Additional 40-pin connector for I/O.
Fibreglass PCB

	PRICE
H19155	$39.50

BARE PREDRILLED FIBREGLASS BOARD

CAT No.	SIZE	PRICE
H19100	4.5"x8.5"	$9.95
H19105	4.5"x17"	$18.95
H19110	8.5"x17"	$37.50

SOCKET WRAP ID

Socket wrap (wafer) is slipped over IC socket pins or wire wrap posts. To help identify pins when wire wrapping.

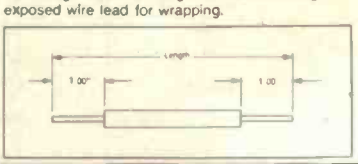
	IC PINS	Quantity PER PACK	Price Per PACK
H19154	14	10	$3.95
H19156	16	10	$3.95
H19158	18	10	$3.95
H19160	20	5	$3.95
H19162	22	5	$3.95
H19164	24	5	$3.95
H19168	28	5	$3.95
H19170	40	5	$3.95

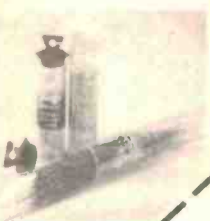
WIRE WRAP WIRE

#30 AWG Kynar insulated precut wire is available in graduated lengths of ½" (2.5"—10.0" long). Choice of colors for convenience.
Wire is packaged in 1" plastic tubes with color-coded caps for quantity designation.

W19021	2.5" PRECUT WIRE RED	$2.95	W19048	6.0" PRECUT WIRE YELLOW	$3.75	W19076	10.0" PRECUT WIRE BLACK	$5.95	
W19022	3.0" PRECUT WIRE RED	$2.95	W19052	8.0" PRECUT WIRE YELLOW	$4.95	W19223	3.5" PRECUT WIRE RED	$7.95	
W19023	3.5" PRECUT WIRE RED	$3.25	W19056	10.0" PRECUT WIRE YELLOW	$5.95	W19224	4.0" PRECUT WIRE RED	$7.95	
W19024	4.0" PRECUT WIRE RED	$3.25	W19061	2.5" PRECUT WIRE BLACK	$2.95	W19203	3.5" PRECUT WIRE BLUE	$7.95	
W19026	5.0" PRECUT WIRE RED	$3.50	W19062	3.0" PRECUT WIRE BLACK	$2.95	W19204	4.0" PRECUT WIRE BLUE	$7.95	
W19028	6.0" PRECUT WIRE RED	$3.75	W19063	3.5" PRECUT WIRE BLACK	$3.25				
W19032	8.0" PRECUT WIRE RED	$4.95	W19064	4.0" PRECUT WIRE BLACK	$3.25	W19243	3.5" PRECUT WIRE YELLOW	$7.95	
W19036	10.0" PRECUT WIRE RED	$5.95	W19066	5.0" PRECUT WIRE BLACK	$3.50	W19244	4.0" PRECUT WIRE YELLOW	$7.95	
W19001	2.5" PRECUT WIRE BLUE	$2.95	W19068	6.0" PRECUT WIRE BLACK	$3.75	W19263	3.5" PRECUT WIRE BLACK	$7.95	
W19002	3.0" PRECUT WIRE BLUE	$2.95	W19072	8.0" PRECUT WIRE BLACK	$4.95	W19264	3.5" PRECUT WIRE BLACK	$7.95	
W19003	3.5" PRECUT WIRE BLUE	$3.25							
W19004	4.0" PRECUT WIRE BLUE	$3.25							
W19006	5.0" PRECUT WIRE BLUE	$3.50							
W19008	6.0" PRECUT WIRE BLUE	$3.75							
W19012	8.0" PRECUT WIRE BLUE	$4.95							
W19016	10.0" PRECUT WIRE BLUE	$5.95							
W19041	2.5" PRECUT WIRE YELLOW	$2.95							
W19042	3.0" PRECUT WIRE YELLOW	$2.95							
W19043	3.5" PRECUT WIRE YELLOW	$3.25							
W19044	4.0" PRECUT WIRE YELLOW	$3.25							
W19046	5.0" PRECUT WIRE YELLOW	$3.50							

Wire length is overall length of wire, including 1" exposed wire lead for wrapping.





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Also at:

Ritronics Wholesale Pty. Ltd.

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LETTERS

Dear Mr Nicholls,

I refer to your 'power down' mains appliance timer project, ETI-265, published in ETI July 83. The following observations may interest you.

1. The relay supply is taken from the regulated source although there seems to be no reason why the 18 V side cannot be used to separate heavy current switching from the electronics.

2. LED1, being a diode, will isolate the base of Q1 when not conducting. Add a resistor between the base and emitter or shift LED1 to assure Q1 is off when it is supposed to be.

3. The addition of another pushbutton switch connected across C4 will allow the appliance to be manually switched off if required.

4. The value of R2 is a lot higher than necessary. It is in circuit for a very short time and a value this high may subject pin 1 of IC2 to noise. Use 2k2 to reduce the variety of the inventory.

5. Label 9 missed off pin of IC2c.

6. Some ICs have inputs which the manufacturer recommends should not be at a voltage more than a bit over V_{cc}. Is the 4093 like this? It does seem to matter because if the device is on while the mains is switched off, the voltage across C1 and C2 will rapidly fall while the voltage across C3 may even be near its maximum and be isolated from discharge by a high impedance (up to 3M?).

7. Many people would like the time to be adjustable eg: 10% to 100% of nominal so that a 30 minute timer would have an adjustment from three to 30 minutes etc.

8. Having a 'danger' label on the pc board is a good idea.

9. It is a pity that the transformer has red and black wires.

10. The two active wires should be labelled brown.

11. Although I have found split bobbin transformers very reliable, some people may prefer that a plastic base not be used. A plastic base does not provide a low resistance path to earth, therefore faults making the exposed metal live would not blow a fuse. Consider earthing the transformer.

12. Good to provide on the pc board the facility to strap to various divider outputs.

13. If you took the relay supply from the unregulated side you could make the regulated supply 5 V which allows TTL compatibility and makes C3 cheaper.

14. I don't agree that the supplier should not supply R1. The supplier should not risk goodwill for the sake of one resistor which he can include in the price.

15. I have not read the circuit operation description in detail but "½ of that, ¼ of that, etc" is not as clear an explanation as is needed.

16. C4 is a good idea.

17. EA has advertised a similar design for next month (August — Ed), so it will be interesting to see what they offer.

Hoping all this interests you.

G. Cutter
Bentleigh, Vic.

Taking your points in order.

1. It is not advisable to operate relay coils on voltages much greater than the manufacturer's rating, due to the possibility of failure by overheating.

For example, the data for the Fujitsu FBR611DO12 relay, which is the general type used in the project, shows that using an operating voltage of 18 V will derate the maximum safe ambient temperature to 35° C; this temperature is likely to be exceeded in many situations. In any case, the relay only draws 40 mA.

2. A base-emitter resistor is not required in this circuit. the maximum junction temperature attained by Q1 is only a few degrees above ambient. At such junction temperatures the leakage current I_{CEO} is insignificant.

3. The extra switch you suggest may be added if you wish, however, the same result may be obtained by switching off at the power point. The project was conceived as a fixed interval timer, and most applications would not require a cancel function.

4. Values of 100k for resistors in CMOS circuits are typical, if not low. Your comment would apply to TTL circuitry. The 4093 IC has particularly good noise immunity anyway, since it has hysteresis.

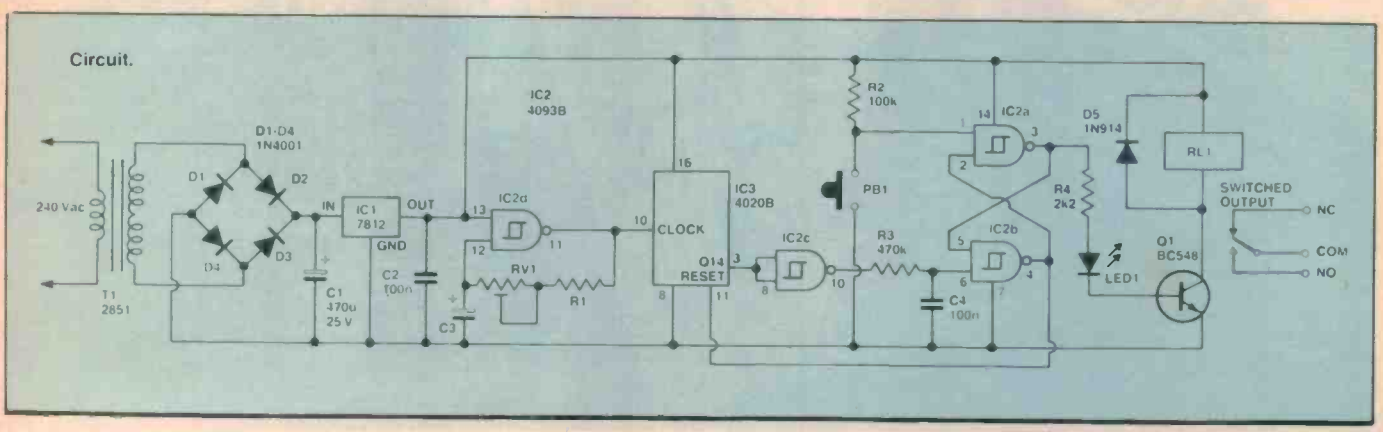
5. The case of the missing label. Shock! Horror! An investigation was launched as soon as we heard of the mysterious disappearance of the label on pin 9. Although the house detective failed to locate it, he surmised that it fell off the layout sheet and was secreted out of the office on the sole of some unsuspecting dupe. To avoid such incidents in the future we have instituted a programme with trained sole inspectors on every door.

6. CMOS devices are fabricated with input protection circuits to reduce the chance of static electricity damaging the thin gate insulation. The protection usually takes the form of a series resistor of about 200-400 ohms from the input pin to a pair of clamp diodes. One diode goes to the V_{cc} rail, the other goes to the V_{dd} rail. The diodes have an energy rating sufficient to discharge typical static safely, however, their continuous current rating is only about 10 mA.

Looking at the 'power down' circuit, it may seem that C3 could cause excessive current to flow through the protection diode associated with pin 12 of the 4093, if the mains is disconnected while the relay is energized. A number of factors act to reduce this current to safe levels in the published circuit.

Firstly, the maximum voltage across C3 is only 8 V. Secondly, the maximum recommended capacitance for C3 is 100u. Most importantly, however, is the presence of C1, the power supply filter capacitor, which allows the supply rail to decay slowly. ▶

Circuit.



LETTERS

Take these factors into account and use a value of 200 ohms for the input resistor of the CMOS gate and a value of 285 ohms for the relay coil (as per Fujitsu data). This results, after solving the differential equations, in a maximum current flow of less than 2 mA.

7. The project was not intended to have a wide range adjustment control, which is why the trimpot was specified. ETI has published other timers that cover this area.

8. A bouquet at last!

9. Sorry, they are made that way.

10. All right, all active wires should be strictly labelled brown.

11. The suggested construction method uses insulating washers or bolts to mount the transformer, thus eliminating the problems of any exposed live metal.

12. OK, but why do you ask question 15?

13. For starters, there are no TTL equivalents for either CMOS device. The nearest is the 74132, a quad Schmitt NAND gate, but it has different pinouts to the 4093. In any case, C3 would not be cheaper since the use of TTL would limit the feedback resistance in the Schmitt oscillator to a much lower value than I have used. This would result in an increase in cost for the larger value of C3 required.

14. It would be reasonable not to expect a kit supplier to include R1 since its value is determined by the timing interval you choose, and there are eleven different values for R1 according to what you want. Anyway, the article says "may not supply", not "should not supply".

15. The explanation seems clear enough to most people. If you have a maximum timing interval of 30 minutes, then fitting the binary period switch will give you the following intervals: 30 mins, 15 mins, 7½ mins, 3¾ mins.

16. C4 is essential to avoid initiating a timing interval on power up.

17. Our competitor's device has a different application to the power down.

Geoff Nicholls
Project Engineer

Dear Sir,

We write in reference to an advertisement placed by Bertas International Pty Ltd in the June 1983 issue of ETI, regarding the Colour Genie home computer.

We are the Hong Kong manufacturers of the Colour Genie home computer and we take exception to the said advertisement.

EACA International Ltd has never entered into any agreement, verbal or otherwise, with Bertas International Pty Ltd, regarding the distribution of Colour Genies in Australia.

EACA International Ltd wishes to advise your readers that we are not associated with Bertas International Pty Ltd in any manner whatsoever and that Bertas International Pty Ltd is not our appointed distributor of representative in Australia.

Mark Sim
General Manager
EACA International Ltd
Hong Kong

Dear Sir,

Your telegram, expressing congratulations for winning the 'Idea of the Month' award for August 1983, was a great surprise.

I was delighted with the prize. The Scope Panavise multi-purpose work centre proves to be a valuable tool and is a great help in constructing my projects.

I, and undoubtedly many of your readers, appreciate your efforts for conducting the contest.

Patricia Vandermost
East Brighton, Vic.

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COMPUTERS

ACT VIC-20 BIMONTHLY NEWSLETTER: Many interesting articles and programs. October issue $1.50. Bimonthly $8 per year. Write to Chris Groenhout, 25 Kerferd St, Watson ACT 2602.

FOR SALE: TRS-80 Model III, 48K RAM, two disk drives and software, $1995. Phone David (003)44-8843 after 9 pm EST.

FOR SALE: SUPER 80 Disassembler, Cassette $9. Sprocket fanfold paper 243 x 280 mm, 2000 pages, $19. Siemens M100 Teleprinter, $85. R. Vowels, 93 Park Drive, Parkville Vic. 3052.

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MICROBEE USERS GROUP of SA: GPO Box 767, Adelaide SA 5001. Contact Brian Uren (Secretary) on (08)260-5038, 6-8 pm for details of membership, meetings and newsletters.

WANTED: Central Data 2650 DOS manual plus hard copy of program listing. Dennis Collins, 88 Warden St, Christchurch New Zealand.

FOR SALE: VDU CARD SCVT/100 64 char by 16 line, $80 neg. D. Hock, Churchill (051)22-1157 ah.

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WANTED: DGZ80 S100 CPU card, with DGOS, in working order. Tony, 14 Wulagi Cres, Wulagi NT 5793. (089)27-5539.

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WANTED: WIRELESS WORLD January 1982 issue in good clean condition for collection. J. Lavender, 3 Raw Place, Farrer ACT 2607. (062)86-4029.

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DILBERT

How the Computer Industry works

The Managing Director says to the Product Manager, "We need a-nother/new product." The Product Manager speaks to the Engineering Manager, saying "Come up with a a-nother/new product." The Engineering Manager then speaks to the Engineering staff, saying, "We're gonna create a-nother/new product." In return, the Engineering staff says to the Engineering Manager, "Who's gonna do the software; what are we gonna call it?" The Engineering Manager then speaks to the Marketing Manager, saying, "We're creating a-nother/new product and you've gotta come up with a name for the software and hardware." The Engineering Manager then speaks to the Software Development Manager, saying, "We're creating a-nother/new product and you've gotta do the software." The Software Manager asks, "What are we gonna call it?" and the Engineering Manager replies, saying, "I've already spoken to the Marketing Manager."

Next week's board meeting sets the deadline date and the release date and the Managing Director's secretary books the Hilton for the Press Release.

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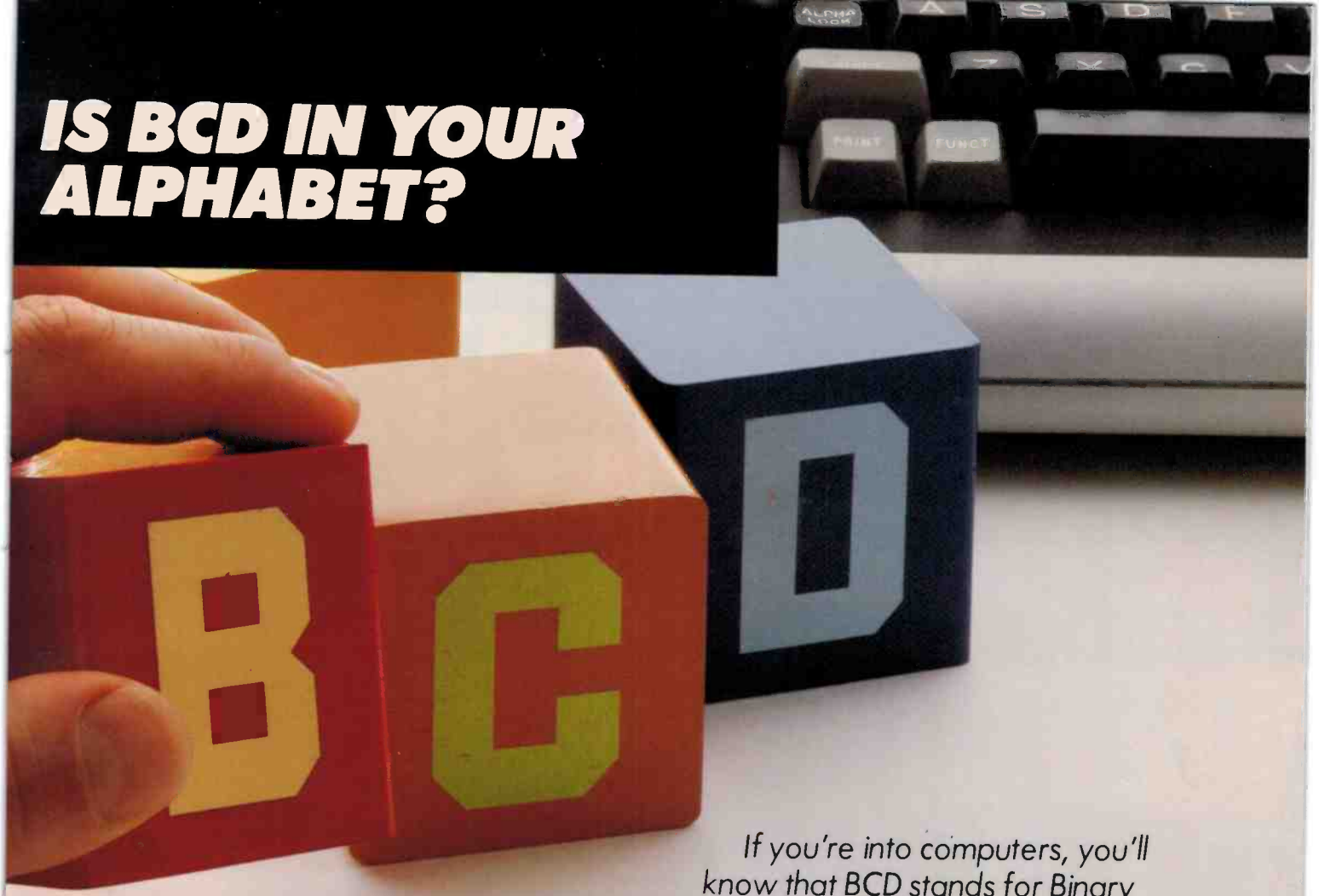

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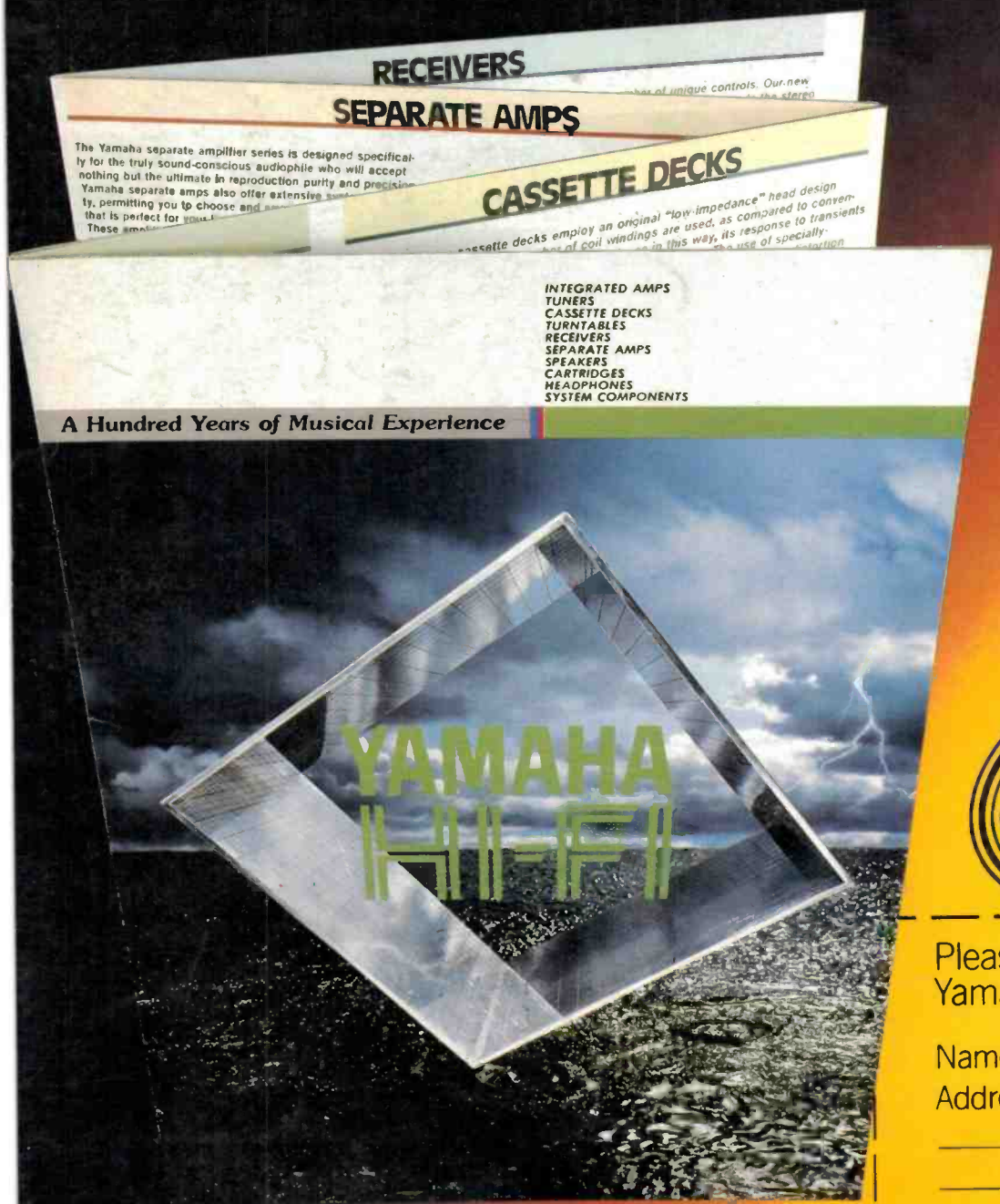

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