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electronics today

MARCH 1978 INTERNATIONAL

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Computerised Musical Doorbell Project:

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3 SPECIAL OFFERS

Pro. Series

RS-9900US.
Two components for one reason: To outperform all other cassette decks.

Audio enthusiasts the world over have come to expect exciting innovations from Technics. The RS-9900US is one of them. Unlike other cassette decks it is a 'cassette system'—the separation of the sensitive amplifier electronics from the mechanical tape transport to obtain optimum performance from each.

Features in the transport unit include a closed loop, double-capstan, 3-motor drive to provide smooth tape travel and closest tape-to-head contact; pitch control of ±5% and full IC logic control of all transport functions to ensure tape safety when switching modes. The true 3-head system permits professional-type tape/source monitoring.

Outstanding among the amplifier unit's many features is the fixed plus variable calibration controls for equalisation lines, and Dolby* record and playback levels. Complete with peak reading meters of studio standards, Dolby* noise reduction circuitry and a built-in 400Hz/8kHz test oscillator for level calibration and head azimuth adjustments.

An evaluation of the Technics RS-9900US capabilities will provide the answer to any contradictions about cassette equipment performance.

*Under licence from Dolby Laboratories Inc.

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AUSTRALIAN OWNED AND PRODUCED

March 1978. Vol. 8 No. 3.

electronics today INTERNATIONAL

Editorial: Les Bell

Publisher: Collyn Rivers

A Modern Magazines Publication
* Recomended retail price only.

Registered for posting as a publication — Category B

PROJECTS

FEATURES

NEWS & INFORMATION


HI-FI EXPLAINED
OUT NOW
Puzzled by parameters?
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Hi-Fi Explained is the answer! It's a complete up-to-the-minute guide to understanding hi-fi written in good plain non-technical English.
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Available from most newsagents or directly from Hi-Fi Review 15-19 Boundary St, Rushcutters Bay. NSW 2011
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News Digest

Experiment in Theatre for Television.

Armstrong Audio/Video Pty Limited has constructed a temporary television centre at the Open Stage Theatre in Melbourne to house one million dollars' worth of technical equipment used for the production of playwright Ray Lawler's "Doll" trilogy.

The television centre contains a video control room, lighting control room and dimmer board.

All of the videotape equipment in the video control room was supplied by Ampex Australia Pty. Ltd, including three VPR-1 broadcast quality videotape recorders and this is the first time these recorders have been used in a major television production in Australia.

Up to three cameras were isolated to each of the Ampex VPR-1 recorders to give the producers greater flexibility when editing the final product. The three plays, "Kid Stakes", "Other Times" and "Summer of the Seventeenth Doll" were produced by the Melbourne Theatre Company and Armstrong Audio/Video for the Seven Network, and will be ready for transmission by late February.

New Eddystone boxes

Two additions have been made to the established range of Eddystone diecast boxes.

The model 9830P offers the advantages of volume with the minimum of height. Like the others, it has a close fitting flanged lid, secured by four countersunk screws.

The box is supplied unfinished, but the surface will accept any finish, including cellulose, with a minimum of preparation. It has applications similar to the present range, but due to its dimensions it may be used as a handheld or pocket unit. Outside dimensions are 119.1 x 93.6 x 30.0 mm.

Two water-resistant boxes have also been introduced. Features are as follows: Metric Taptite screws recessed into the lid of the box to provide a flat top surface. An earth connection facility is provided inside the box. Neoprene sealing ring. Corrosion Resistant to Industrial and Marine environments. Good surface. Finished stove enamelled, medium hammer Grey. Readily machined. Robust and rugged. Diecast in Aluminium Alloy to BS1490 LM6. Outside dimensions are: Model 9732P – 125 x 80 x 45mm; Model 9920P – 220 x 120 x 66mm.

Further information from *R.H. Cunningham Pty. Ltd.*, Melbourne 329-329-9633 and all states.

Wireless Video Game

A new IC being developed by Intermetall GmbH, the West German division of ITT Semiconductors, is designed to operate with that company's ultrasonic or infrared remote control chips. The SAA1080 is designed to be built into the TV set, and will play up to tem games in colour.

Flat Colour CRT

RCA's David Sarnoff Research Centre, at Princeton, New Jersey, are developing a 76 x 100 cm colour TV display about 50 mm thick. The device uses electron multipliers to create free electrons, which are then accelerated to strike the phosphor screen.

Lavalier Microphone

Sennheiser has now released a new, extremely small lavalier microphone with a frequency response of 50–20,000 Hz.

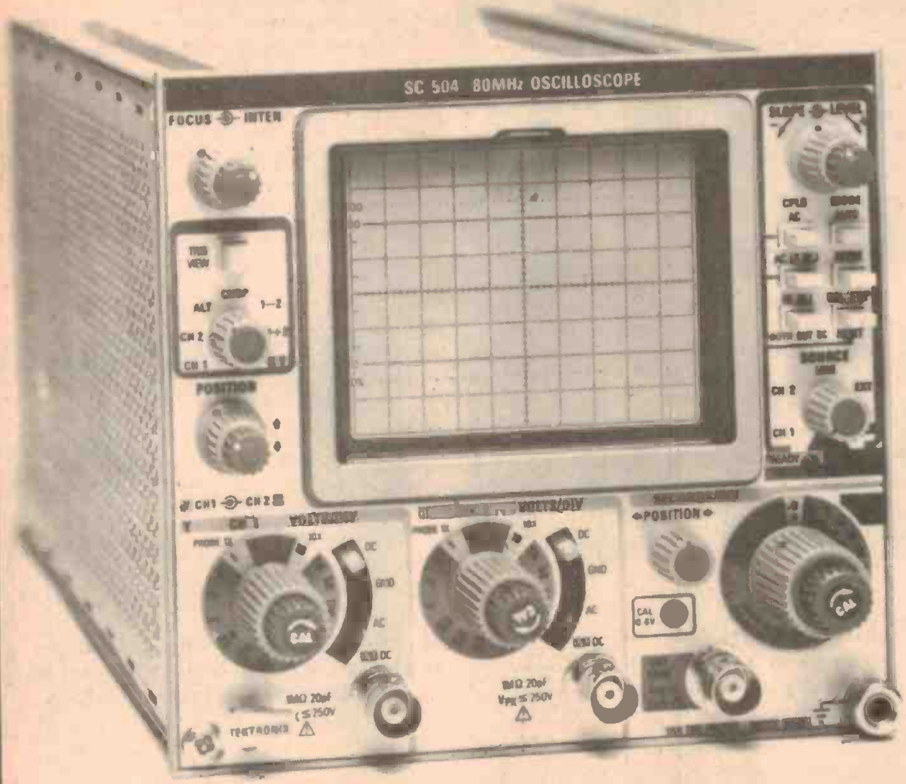
Identified as the MKE 10, it is an omni-directional electret condenser microphone, and has flat frequency response characteristics and low sensitivity to vibrational pick up. For outdoor work it is fitted with built-in pop filter and windscreen, and an additional windscreen is available for severe conditions.

If used with equipment which lacks a powering facility, a battery adaptor, model MZA 10, is available.

Further details from Australian distributors *R.H. Cunningham Pty. Ltd.* (in your phone book).

LCD Projector

Liquid crystals seem to be finding their way into all kinds of devices these days, the latest being a large screen multicolour projection system for tactical displays, now being evaluated by the US Navy. The projector, which was developed by Hughes Aircraft, utilises a single liquid crystal light valve to provide 1,500 lumens on a 10 ft square screen. Reliability, often claimed to be a problem with LCDs, seems quite good – MTBF of the device is 5,000 hours, and a prototype has operated reliably for 1,100 hours over a 17 month period with no degradation or failure.



Novice Licence – Victorian Test

In order to help all actual and prospective candidates for the Novice Amateur Licence, the Youth Radio Clubs Scheme (Victorian Division) will hold a Trial Novice Examination on Saturday April 15, 1978. The place of examination will be near the central area of Melbourne and will be easily accessible by public transport. Parking will be available.

The pass rate in the Official Exam has in the past been low, and the Trial E Exam is intended to improve the degree of preparation of candidates for the actual exam papers. A similar Trial Exam was held in 1977; amongst the Trial Exam candidates who then sat for the May Novice Exam, the pass rate was approximately *twice* the average Novice complete pass rate! Many of these candidates commented that *they would not have passed the official exam if they had not first sat for the trial exam.* Comments were also made on the beneficial effect of (A) decreased nerves (especially in Morse where this is a significant factor), and (B) specific preparation for many questions types.

A great deal of effort and time (including computer time) has gone into ensuring that the Trial Exam will be as similar as possible in all respects to the material and organisation of the Official Exam. Candidates' answer sheets will be returned when marked; since candidates are also allowed to keep the question papers, this forms an invaluable aid in pinpointing weaknesses and consequently optimising study time. Results will be posted within a week of the exam. The Trial Novice Exam is unquestionably the best possible single form of preparation for the Novice Licence Examination.

Please help us by applying as soon as possible. The exam fee is $1.00 (this is used to partially cover costs, the YRCS makes no profits), and should be sent with your application as a postal note or a cheque made out to the Youth Radio Clubs Scheme; please DON'T send cash. The fee should be included with a note containing your:

Surname and initials
Postal address (in full, including postcode)
Telephone number (if none, write "nil")

Applications should be posted to:

YRCS Trial Novice Exam, 11 Vista Avenue, Kew, Vic. 3101.

It is important that applications are prompt, as there are a limited number of places which are expected to fill very quickly. Replies containing all other details of the exam will be posted one to two weeks before the exam.

TM 500 Oscilloscope Plug-In

Tektronix, Inc. have added a new oscilloscope plug-in to the TM 500 family of modular test and measurement instruments. The 80 MHz, dual-trace SC 504 combines with a selection of pulse generators, counters and other TM 500 instruments to form versatile instrument configurations for measurements on digital equipment – all in one convenient package. In addition to compact packaging, this configuration offers a rear panel interface for interconnecting the various instruments. With a front panel control, the SC 504 can, for instance, be switched from displaying external signals to displaying the waveform input to its companion counter or the output from the pulse generator.

Specific performance capabilities of the SC 504 Oscilloscope include 5 mV/div sensitivity at 80 MHz; calibrated sweep rates to 5 ns/div; a selection of channel 1, channel 2, alternate, chopped, channel 1 + channel 2, channel 1 – channel 2, and x-y display modes, z-axis input; and high writing speed. Auto, normal, and single-sweep trigger modes; a selection of AC, AC low frequency reject, AC high frequency reject, and DC trigger coupling; and a choice of channel 1, channel 2, line, external, or interface (TM 500 backplane) trigger sources provide great operational flexibility.

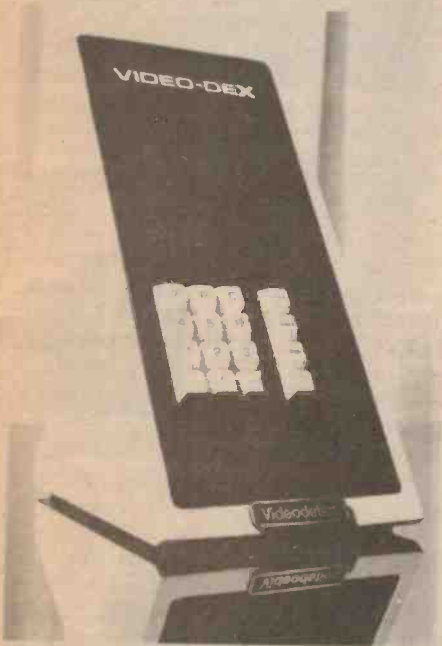
Further information from Tektronix Australia Pty. Ltd., 80 Waterloo Rd., North Ryde, 2113.

Analog-Digital Conversion Notes:

The first major updating of Analog Devices' highly successful Analog-Digital Conversion Handbook (1972) not only gives a new look at basic understanding and application of data conversion, but also includes two new chapters addressing the contemporary challenges of monolithic IC converter designs and interfacing with microprocessors and computers. Considerable coverage is also given to current designs, technologies, and production techniques employed in conversion circuits, including thin-film-on-CMOS, laser-wafer-trimming, I^2L, and hybrids. The book is aimed at the engineer or scientist who now uses or is likely to use converters in his work. (ISBN: 0-916550-03-6). Write: Parameters Pty. Ltd., P.O. Box 480, Crows Nest, NSW, 2065. Please include cheque for $10.00 which includes packing and posting.

Random Access Video

Using the Video-Dex 2010 U-Matic users can now select instantaneously any spot required for presentation. In addition, the presentation begins on the first frame without the need for old-fashioned countdown. Both of these factors are vital for television stations, advertising agencies, universities or anyone needing a precise and professional presentation.



Professional Video Services Pty. Ltd. of 35-43 Clarence Street, Sydney, has announced the release in Australia of the Video-Dex 2010 random access controller for U-Matic videocassette machines. The Video-Dex 2010 keeps accurate track of tape location by generating storing and displaying precise numerical addresses for every point on the tape - with one second accuracy. This results in reduced search time and operator error.

A presenter can select any part of a videocassette to show. Once the selection has been placed in the Video-Dex, the presenter need not touch the U-Matic machine, as the Video-Dex will search out that particular programme or programme segment and bring it up on the monitor and can even stop after the presentation if so programmed.

The U-Matic videocassette machine can even be in a different room since all the presenter needs is the Video-Dex 2010 control panel. All functions of the U-Matic can be controlled from the Video-Dex control panel including freeze-frame, if the U-Matic is so equipped.

The Video-Dex does not interfere with the normal functions of the U-Matic machine. Demonstrations of Video-Dex can be arranged by contacting Professional Video Services on (02) 290 3359.

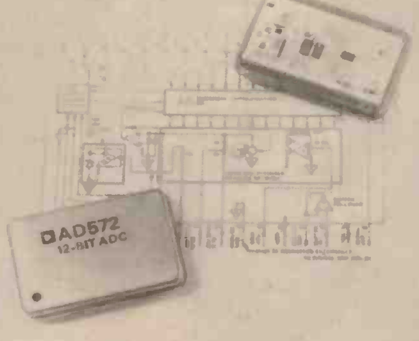
Tape Chip

A new IC from National, the LM1818, combines all the electronics required to build a tape deck except the bias oscillator. The chip carries two preamplifiers for record and playback, automatic level control circuitry, meter drive, and most importantly, record/playback switching. 15 transistors are used to create a more flexible and reliable switching circuit than the mechanical types previously used. Samples are being shipped now, with production sceduled for June, at a US price around the dollar mark in volume.

12-Bit A/D Converter series

A series of integrated circuit 12-bit analog-to-digital converters, which includes the industry's first A/D converter to guarantee no missing code operation over the full -55°C to +125°C military/aerospace temperature range, has been introduced by the Microelectronics Division of Analog Devices. The new AD572 is packaged in an all-metal, hermetically-sealed, electrostatically and electromagnetically shielded dual-in-line package, and is available in "A", "B", and "S" versions offering a range of temperature operation and performance characteristics for both industrial and military/aerospace requirements.

For further information contact Bruce McCarthy, *Parameters Pty. Ltd., P.O. Box 480, Crows Nest, NSW, 2065 – Phone 439-3288.*



Watch Battle

The U.S. digital watch market is still in turmoil as Timex and Texas Instruments lock horns. The latest round of price curbs has seen TI introduce LCD models at the $15 mark, unveiled at the Las Vegas Consumer Electronics Show, while Timex have lowered all their prices with their cheapest model at $24.95. On the sidelines, both Fairchild and National Semiconductor are looking at moving back up in the market to more expensive models with increased value.

Dimmer Sensor

Siemens has introduced a new MOS IC which can replace rotary potentiometers used in light dimmer switches. By touching a sensor surface it is possible to vary the brightness of light bulbs and also to switch them on and off.

A PMOS depletion-type IC, S 566 B, has been used to design a dimmer switch without mechanical parts. There is ample room for the circuitry in conventional switch boxes and there is no need for wiring modifications.

To switch a lamp on or off the sensor must be touched briefly for about 60 ms to 400 ms. When a lamp is switched on, the last selected brightness level is restored. To make the lamp brighter or dimmer, the sensor must be touched for longer than 400 ms without interruption. If this is repeated, the direction

of brightness control is reversed. The time taken to go through the entire brightness range from dark to bright back to dark is about 7 seconds.

Any number of mechanical switches or sensors (consisting of a transistor and three resistors) can be connected to a special input of the 8-pin MOS IC which is mounted in a dual in-line package.

For further information please contact Siemens Industries Limited, Melbourne, Sydney, Brisbane and Perth.

Telecom Approved Recorder

Telecom has sanctioned the use of a modified version of a "National" cassette recorder, designated model No: RQ 413 SP for use as an attachment to record telephone conversations. The modifications to the standard "National" recorder comply with Telecom specifications, and installation must be carried out by Telecom technicians. This involves the fitting of a signal box in the telephone circuit, into which the recorder is plugged. It will record phone conversations at the press of a button, and may also be used as a conventional cassette unit, to replay standard tapes of conversations or music. Thus it can double as a dictating machine and a playback unit for information gathered on tape by people in the field.

Application for installation must be made on Telecom form TS72, which sets out the conditions under which it may be operated. The recommended retail price of the unit ready for installation is $170.00 plus a Telecom installation charge to around $25.00

The unit is available now from National dealers in all States.

ATDA Urges Comsat System

The Australian Telecommunications Development Association has come out in support of a national communications satellite system for Australia to augment existing communications systems.

This is contained in a submission by the association to the Australian Government Task Force which is inquiring into all aspects of a national satellite system.

The association has stressed in its submission that if the decision to go ahead with a satellite system was made a large proportion of it must be developed and built in Australia.

"The establishment of a national communications satellite provides the opportunity to build up our industry by allowing us to be involved to the maximum possible extent" the submission states. "This must not be another major project going to overseas sources. The Australian telecommunications industry was established to provide communications services for this country from local manufacture.

"Australia's future for manufacturing lies in the areas of high technology."

Digital Speech Interpolation

Research into telephone conversations has revealed that of any group of speakers, only about one third are actually talking at one time. New equipment being installed at ground stations as part of the International Time Division Multiple Access satellite communication system uses this principle to save satellite channels by monitoring telephone lines and only allocating them a satellite channel when there is a speech signal present. The equipment incorporates five Texas Instruments TMS9900 16-bit microprocessors. The engineers who designed the system seem to have decided that the obvious alternative of asking callers not to pause for breath would not meet with widespread public approval!

ETI/Unitrex Calculator Contest

In the January issue we left our man in PNG held captive by a lying and a truthful guard in a hut with two doors, only one of which leads to freedom. He was allowed one question to help him decide which exit to take.

No doubt about it, if Shane Martin of Barraba, NSW was caught in that situation, he would escape easily. Shane wins this month's calculator for his answer: he would ask 'Which door would the other guard say is the door freedom?', and then exit by the opposite door to the one the guard indicates.

Our propagation expert, of course, being a propagation expert, calmly waited for a magnetic equatorial Sporadic-E opening, whereupon he whipped out his cunningly concealed 6 metre transceiver and made contact with a station in East Timor who relayed his message to Darwin, who relayed.... Anyway, to cut a long story short, now Shane has worked out the answer for us we can radio it back to our man, thus securing his release. I don't know, though, maybe we should let him stew for a while....

K. Wallace of Nord's Wharf, NSW asks: A cup of coffee and a cup of tea, both of equal volume, are placed on a table. A teaspoon of coffee is put into the teacup and stirred thoroughly. Then a teaspoon of the mixture from the teacup is put back into the coffee cup. Does the coffee now have more tea in it than the tea has coffee, or vice versa?

Seal an empty envelope, write your answer on the back of it, with your name and address, and send it to: Unitrex Calculator Contest (March), ETI Magazine, 15 Boundary St, Rushcutters Bay, NSW 2011. The closing date is 21st April.

Errata

In the December issue 8080 Octal Monitor Program, a section of code was unfortunately omitted from page 95, between locations 234 and 250 of the second page. It is reproduced here with apologies to the many frustrated programmers who are out there, and thanks to the chap who brought it to our attention.

```
235-346 003       ANI 3       MASK OFF ALL BUT 3 BITS
237-366 260       ORI 260     FORM ASCII DIGIT
241-315 362 372   CALL PNT    PRINT FIRST OCTAL DIGIT
244-175           MOV A,L     MOVE L TO ACCUMULATOR
245-017           RRC         ROTATE RIGHT 3 TIMES
246-017           RRC
247-017           RRC
```

We were rather out of date with the addresses of the WIA divisional offices given in the January issue. The correct addresses are as follows: VIC – 412 Brunswick St, Fitzroy 3065; TAS – P.O. Box 1010, Launceston 7250; and ACT – P.O. Box 46, Canberra City 2601.

Project 136

Linear-Scale Capacitance Meter

If you want to find out what values those odd capacitors are, then here's the instrument for you.

ONE OF THE HANDIEST instruments for an electronics hobbyist, or to have around an electronics workshop, is a capacitance meter. Every multimeter has a resistance scale – and it gets used quite often. But there is often a requirement for measuring capacitance, and few multimeters have a capacitance range.

For example, measuring the value of a variable capacitor used to temporarily 'trim' a filter or oscillator that is to be replaced by a set of fixed capacitors. Or a bagful of 'bargain' unmarked capacitors may have been obtained or the color code or numeral code has disappeared and the value of a component needs to be determined.

Once you have a capacitance meter, you suddenly find uses for it!

This capacitance meter provides a linear scale readout of the value of unknown capacitors generally to within 5% or as good as 2% depending on the accuracy of the meter used.

Range

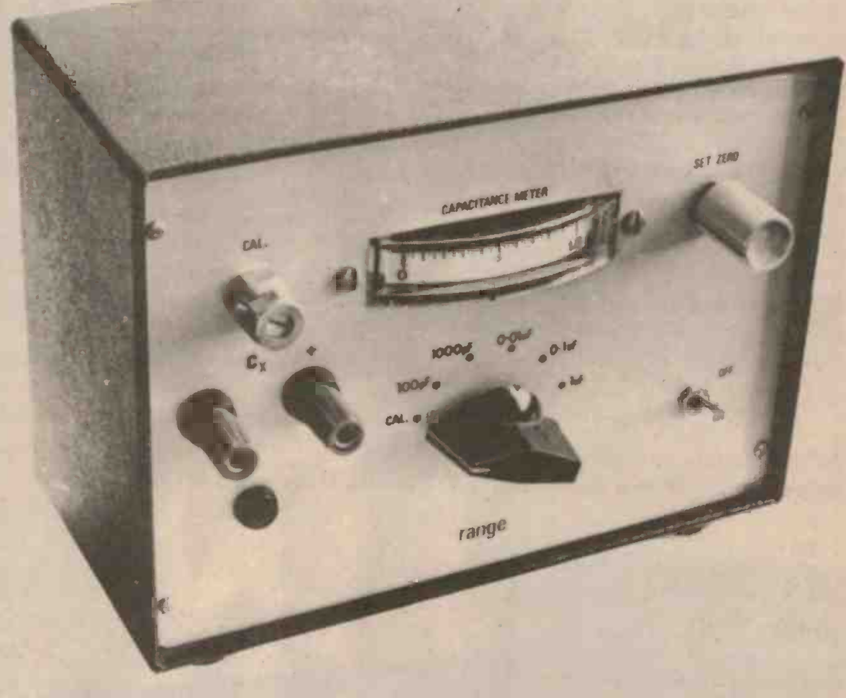
The meter will measure capacitance values down to 5 pF and up to 1 μF. Scale divisions on the model shown were at 2.5% intervals.

Five ranges are provided: 100 pF, 1 nF, 10 nF, 100 nF and 1 μF.

Different ranges can be provided by selecting different values for the range resistors R7 to R11. For example, five ranges from 47 pF to 0.47 μF could be included by changing R7 to 470 ohms, R8 to 4.7k etc. The meter scale would have to be hand-calibrated in this case.

Construction

The construction is quite straightforward. The majority of the small components are mounted on the printed circuit board. The range resistors are mounted on the switch lugs as illustrated in the photographs.



All the range resistors, R7 to R11, and R12 are high tolerance 1% or 2% resistors accurately measured to be within the tolerance required. If only 5% or 10% accuracy of capacitance value is required then standard 5% or 10% tolerance resistors may be used, obviating the need for selecting them, or buying the expensive high tolerance types.

SPECIFICATION – ETI 136

Capacitance ranges	100 pF, 1 nF, 10 nF, 100 nF, 1 μF.
Accuracy	5% or better (2% possible with component selection)
Calibration	by internal calibration capacitor
Power requirements	240 V AC or 2 x 9V No. 916 batteries

The printed circuit board, meter, range switch, potentiometers, pilot light measurement terminals and on/off switch are all mounted on the front panel as illustrated.

The power supply is mounted on the back panel, as is the mains/battery switch. The batteries (if used) may be mounted inside the case. Overall case size is 180 mm wide by 95 mm deep by 128 mm high.

A small tagstrip is used to terminate the mains input and transformer leads and the rectifier components. Both the back panel and the front panel should be connected to the mains earth which is terminated on the tagstrip, the strip's earth tag being secured under one of the transformer mounting bolts.

The calibration capacitor is a high tolerance (2% or better) polystyrene or, better still a silver mica type. This component is mounted from the appropriate switch lug to a suitable ground lug mounted on the front panel.

The printed circuit board has PC stakes (or pins) soldered in all the positions marked on the component overlay.

Two of these (marked E and Cx on the PC artwork) are used to mount the PCB directly on the back of the "Cx" terminals, as illustrated in the photographs. This avoids increasing the circuit stray capacitance.

Little difficulty should be experienced if the component overlay is followed and the photographs are referred to during construction.

Note that alternative panel layout is possible if a standard type of panel meter is used rather than the edgewise meter shown in the photographs.

The front panel was hand-lettered with Letraset on the prototype. A Scotchcal type front panel could also be prepared if desired.

The CAL. potentiometer is a screwdriver-adjust type and was mounted with a fixing collet. Knob-twiddlers can cause havoc.

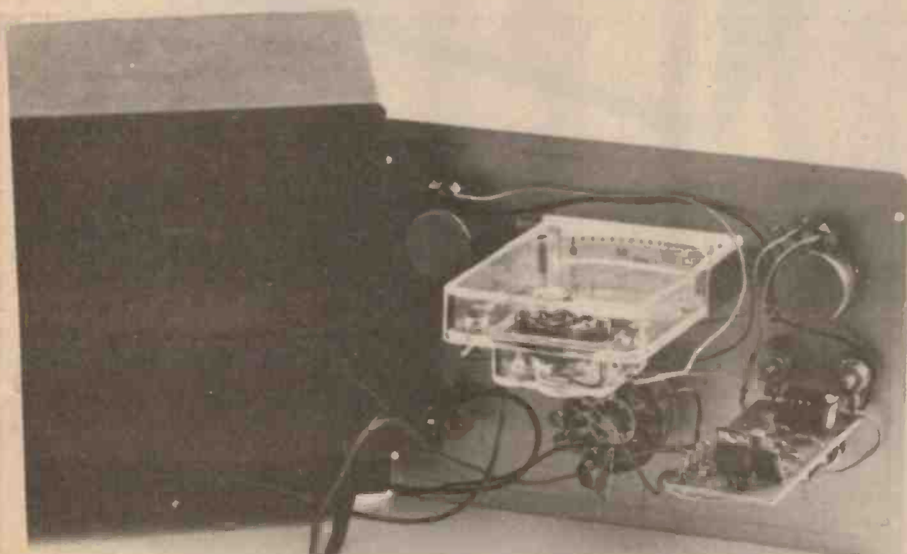
Using the Meter

Once the instrument has been tested and confirmed to be in working order, switch the range switch to the 100 pF position and turn the SET ZERO control so that the meter reads zero with no capacitor connected to the Cx terminals. Then switch to the CAL. position and adjust the CAL. potentiometer so that the meter reads full scale.

Now you are set to measure all those 'unknown' capacitors.

Any devices used to grip capacitors being measured, and plugged into the Cx terminals, will add stray capacitance and this will need to be compensated for by readjusting the zero set control.

Continued on page 14 . . .



Note: A suitable edge meter is available from Ham Radio Suppliers 323 Elizabeth St, Melbourne 3000 (67-7329, 67-4286). They have been advertised at $3.00 each (plus P & P if ordered by mail). The particular meters are 0–1 mA movements calibrated 0–5 ounces. The scale is easily removed and reversed to provide a blank scale which can be hand-calibrated (use a reg. voltage supply a good pot. and a mirror scale or digital meter to set the current points). This is best done with the meter mounted on the panel. Excellent accuracy can be obtained.

PARTS LIST – ETI 136

Resistors	
R1	560k, ¼W
R2	470 ohm. ¼W
R3, 6, 13	1k5. ¼W
R5	10k, ¼W
R7	1k, ½W. 2%
R8	10k, " " either use 2% tol.
R9	100k " " resistors or selected 5% or 10% tol. see text.
R10, 12	1M " "
R11	10M " "
RV1	10k/A panel mounted, screwdriver adjusted
RV2	500 ohm/A pot.
Capacitors	
C1	3n3, Philips polystyrene or silver mica
C2	10nF greencap or ceramic
C3	1nF Philips polystyrene (selected, 2%) or silver mica, 2%
C4	100nF greencap
C5	100nF greencap
C6	640 uF, 25V electrolytic
Semiconductors	
D1	EM401 or similar
S1	DPST or DPDT, 250 V AC rated min. toggle switch
S2	SPDT or ½-DPDT min, toggle switch
S3	single pole, six-position OAK switch
Q1	2N2646
Q2	BC107 or BC108, BC109 or equivalent
IC1	LM555 or NE555 timer IC.
IC2	78L12 (preferred) or 7812 or LM340-T12
Miscellaneous	
T1	PF2851 or M2851, 12.6 V C.T. @ 150 mA
Pilot	12 V, 20 mA bayonet lamp and holder.
Case	Instrument case, Australian Transistor Co. model 754 or similar
M1	0-1 mA meter, see text
Sundries	pk screws, wire, batteries, nuts, bolts, tagstrip, etc.

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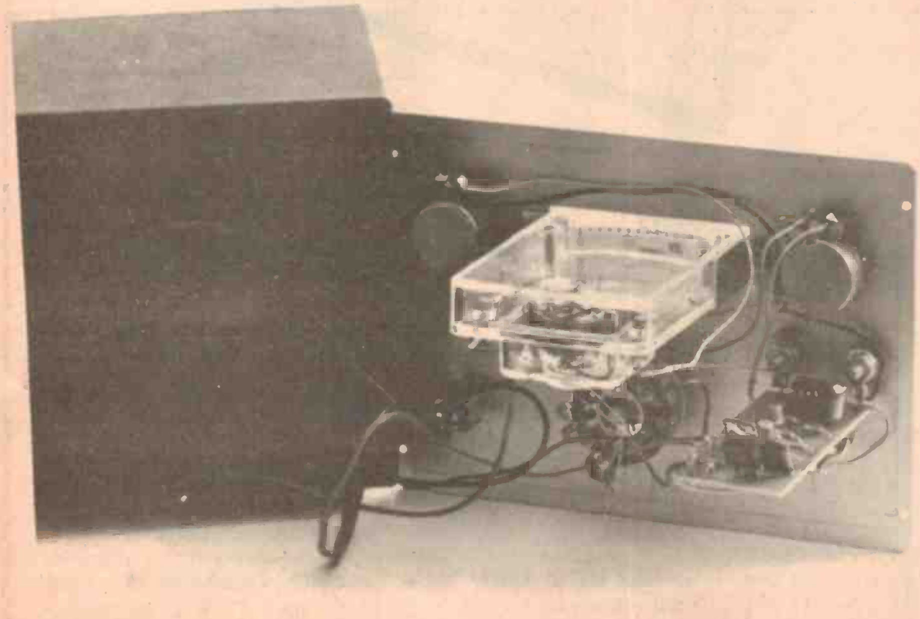
Any devices used to grip capacitors being measured, and plugged into the Cx terminals, will add stray capacitance and this will need to be compensated for by readjusting the zero set control.

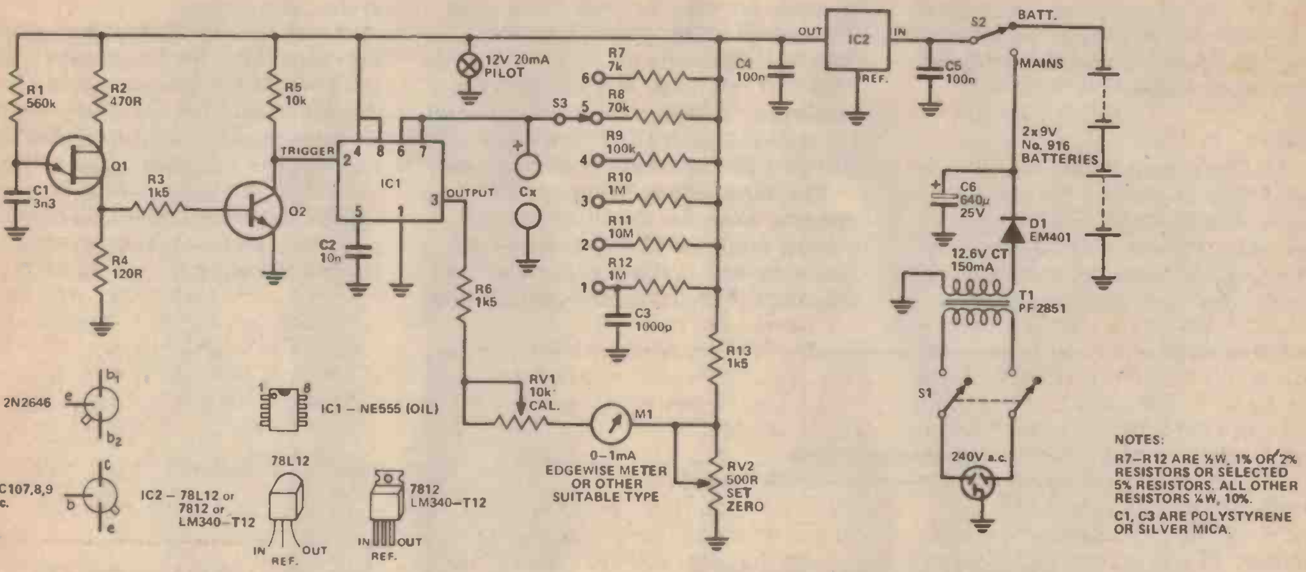
Continued on page 14 . . .

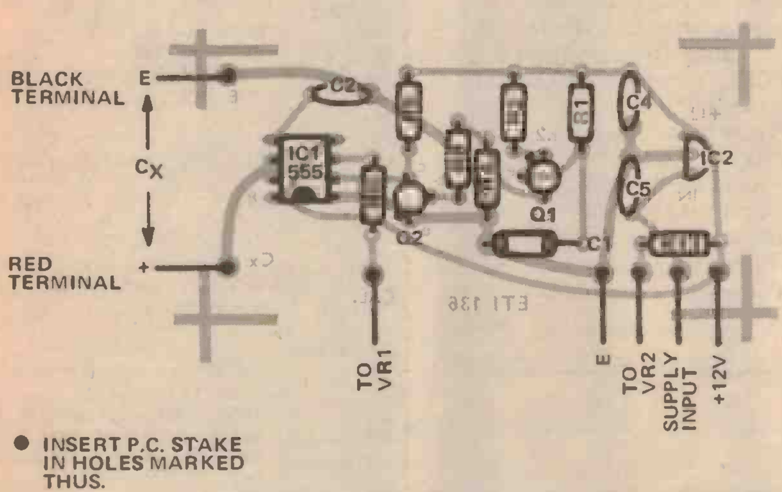
Note: A suitable edge meter is available from Ham Radio Suppliers 323 Elizabeth St, Melbourne 3000 (67-7329, 67-4286). They have been advertised at $3.00 each (plus P & P if ordered by mail). The particular meters are 0–1 mA movements calibrated 0–5 ounces. The scale is easily removed and reversed to provide a blank scale which can be hand-calibrated (use a reg. voltage supply a good pot. and a mirror scale or digital meter to set the current points). This is best done with the meter mounted on the panel. Excellent accuracy can be obtained.



PARTS LIST – ETI 136

Resistors	
R1	560k, ¼W
R2	470 ohm. ¼W
R3, 6, 13	1k5. ¼W
R5	10k, ¼W
R7	1k, ½W. 2%
R8	10k, " " either use 2% tol.
R9	100k " " resistors or selected 5% or 10% tol. see text.
R10, 12	1M " "
R11	10M " "
RV1	10k/A panel mounted, screwdriver adjusted
RV2	500 ohm/A pot.
Capacitors	
C1	3n3, Philips polystyrene or silver mica
C2	10nF greencap or ceramic
C3	1nF Philips polystyrene (selected, 2%) or silver mica, 2%
C4	100nF greencap
C5	100nF greencap
C6	640 uF, 25V electrolytic
Semiconductors	
D1	EM401 or similar
S1	DPST or DPDT, 250 V AC rated min. toggle switch
S2	SPDT or ½-DPDT min, toggle switch
S3	single pole, six-position OAK switch
Q1	2N2646
Q2	BC107 or BC108, BC109 or equivalent
IC1	LM555 or NE555 timer IC.
IC2	78L12 (preferred) or 7812 or LM340-T12
Miscellaneous	
T1	PF2851 or M2851, 12.6 V C.T. @ 150 mA
Pilot	12 V, 20 mA bayonet lamp and holder.
Case	Instrument case, Australian Transistor Co. model 754 or similar
M1	0-1 mA meter, see text
Sundries	pk screws, wire, batteries, nuts, bolts, tagstrip, etc.





R7-R12 and C3 are mounted on the rear of the range switch

HOW IT WORKS – ETI 136

A unijunction transistor, Q1, is connected as a relaxation oscillator with a frequency determined by R1-C1. The frequency of oscillation in this instance is about 1 kHz.

Pulses of about 1 μs duration are produced across R4 each time the UJT "fires". The resistance between b2 and b1 of the UJT reduces to a low value each time the emitter conducts. Much of the charge stored in C1 is "dumped" across R4 for the short duration that the c-b1 junction of Q1 conducts.

The narrow pulses across R4 drive the base of Q2 via R3, which serves as a base-current limiting resistor. The pulses cause Q2 to conduct for the same duration, that is, about 1 μs, and negative-going pulses from the collector of Q2 drive the "TRIGGER" input of the 555 timer, IC1. This is connected to operate as a monostable in this circuit.

When IC1 receives a trigger pulse at pin 2, the flip-flop is set, releasing the short circuit across Cx and driving the output, pin 3, high. The voltage across the capacitor then increases exponentially for a period that depends on the value of the unknown capacitance Cx. The period is determined according to the formula:

$t = 1.1\ RrCx$

At the end of the period, the comparator resets the flip-flop which in turn discharges the unknown capacitor, Cx, and drives the output to its low state.

This cycle is repeated each time a negative-going trigger pulse appears at pin 2 of IC1.

Thus as the range resistor value (Rr) is fixed, the ON/OFF ratio of the output voltage will be determined by the value of Cx. The ON/OFF ratio is independent of the relaxation oscillator frequency and trigger pulse duration.

The current measured through the 'load' resistor on the output (R6) of IC1 will thus be directly proportional to the value of the unknown capacitor Cx.

The meter, M1, measures the current through R6, the meter inertia 'averaging' the current.

As the voltage at the output pin swings between about 2/3 Vcc and less than 1/3 Vcc in its 'high' and 'low' states respectively the DC offset is compensated for by returning the 'load' current through an offset voltage developed across VR2 via R13 from the supply rail.

Zero-setting is accomplished by making VR2 variable. A calibration control is provided by making a portion of the 'load' resistance variable – VR1 here.

... from page 12

However, this will only have to be done on the 100 pF and 1000 pF ranges as the added capacitance will be negligible on the higher ranges.

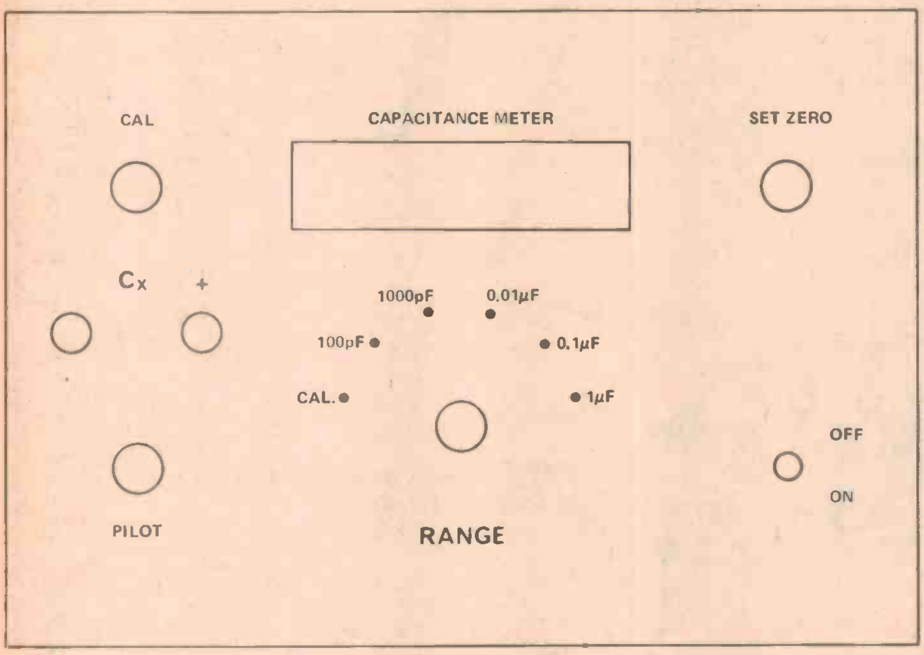
Meters

An edgewise-mounted panel meter was used in the prototype for several reasons. Firstly, we had one! Secondly, a scale nearly 50 cm long allowed us to calibrate the meter at very close intervals — 2.5% here, and still give accurate readout. Thirdly, the edge meter used little panel space, giving it a clean, uncluttered appearance.

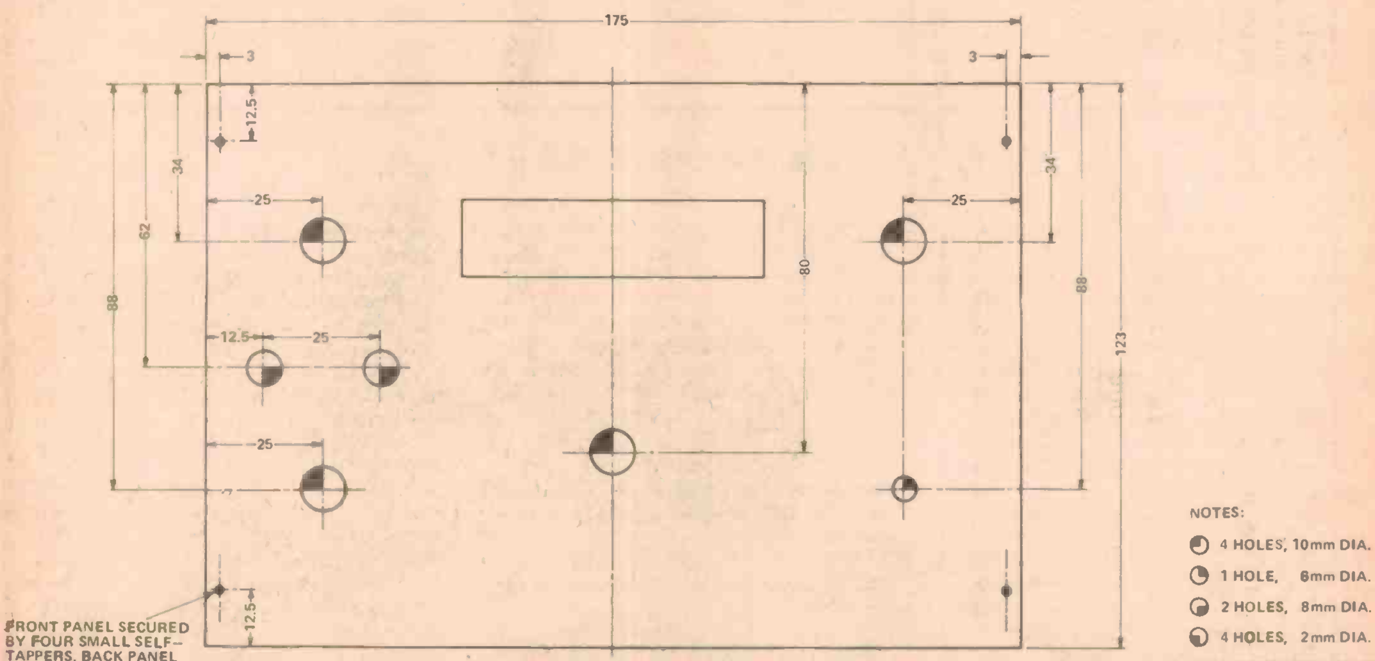
A 0–1 mA meter was used as it has a convenient scale. If you use a range with full-scale values of 47 pF to 0.47 μF a 500 μA FSD meter will have to be used.

The zero-set potentiometer, VR2, provides a small voltage offset as the output, pin 3, or IC1 does not go to zero volts and it also compensates for the effect of the small stray capacitance in the construction.

A calibration position is provided on the range switch for the sake of convenience. The original model did not have this refinement but we soon added it when we found out how useful it was! it also helps to maintain accuracy as a 'standard' capacitor does not have to be kept external to the instrument for this purpose — we kept losing ours until we put it in the circuit!



PANEL LETTERING



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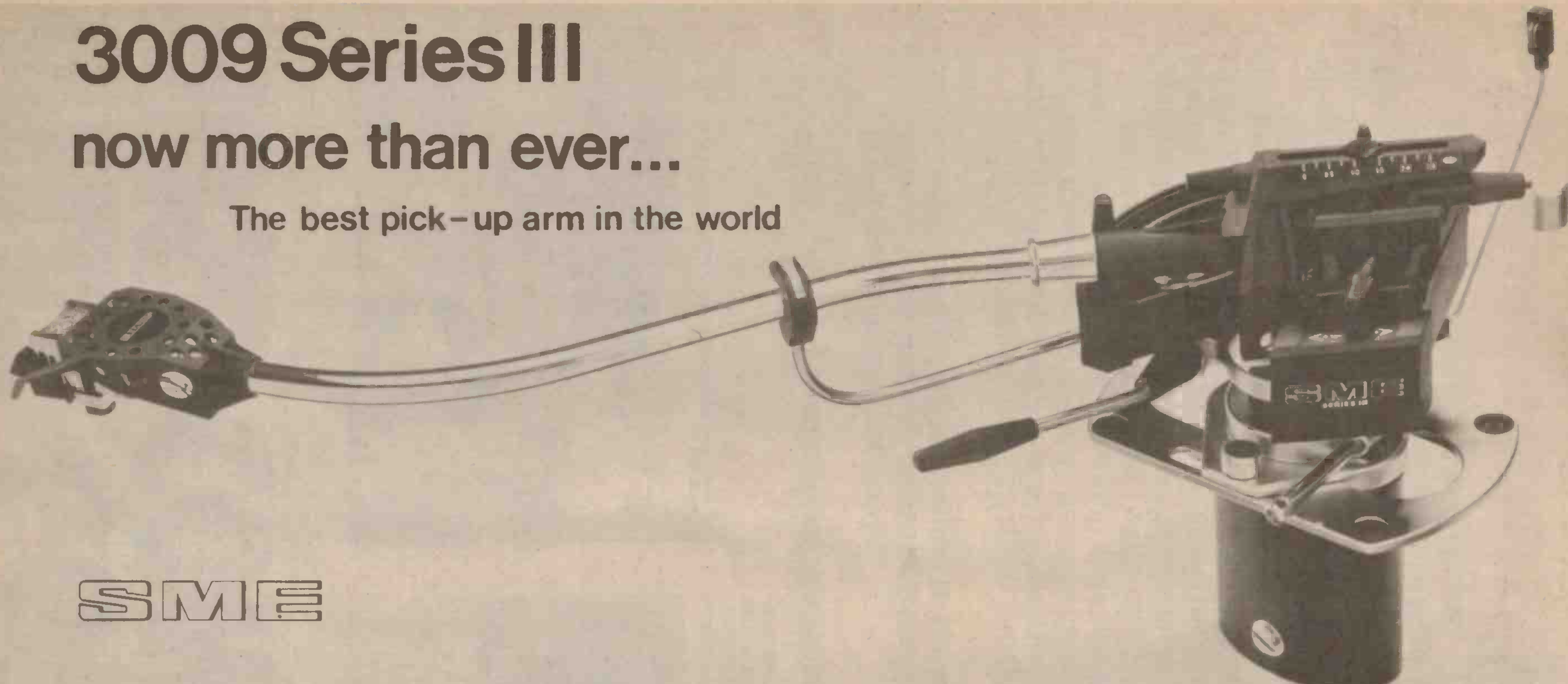
now more than ever...

The best pick-up arm in the world



SME

• Unique balance system to give minimum-inertia operation for cartridges weighing anything from 12g down to zero.
• Ingenious construction, with high-density metal cores in precision plastic mouldings.
• Conventional tone-arm and shell are replaced by an integral carrying arm which is interchangeable for multi-cartridge use. Carrying arm is formed of moulded carbon fibre and nitrogen-hardened titanium, achieving a rigidity many times that of aluminium or other conventional materials, and providing a natural loss of unwanted acoustic information.
• Viscous damping in both planes, with choice of three damping rates covering all cartridge compliances.
• Bias graduated from 0 to 2.5g with fine adjustment.
• Tracking force of 2.5g with 0-1.5g fine adjustment and 1g of coarse adjustment.
• Longitudinal and lateral balance with fine adjustment.
• Fluid-damped lowering and raising control.
• Output : twin gold-plated phono sockets plus separate ground.

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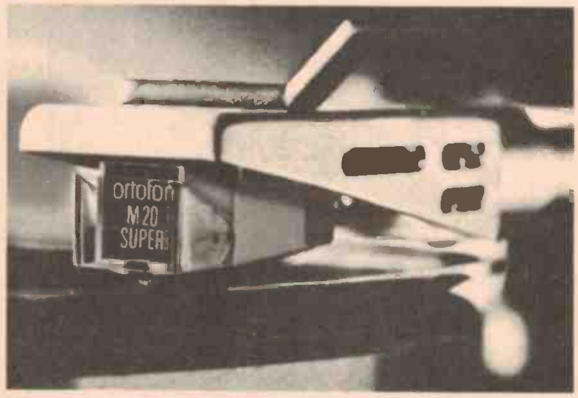
AE127/FP

WHAT GOES IN MUST COME OUT.

Ortofon professional cutter head type DSS 732 in action.



Latest from Ortofon is the M 20 Super—a unique magnetic stereo cartridge, based on our exclusive world-patented Variable Magnetic Shunt (VMS) principle.

When it comes to perfection in recorded sound the principle is as simple as this:

What goes in must come out.

Which means that the response from the groove of your favourite record should be as close as possible to the sound of the original master tape.

With this in mind, we at Ortofon concentrate our activities in two areas only: the production of sophisticated cutting equipment for making master records—and the manufacture of the finest pick-up cartridges to play the discs which they produce.

Most of the major record companies use Ortofon cutters. And because it is only natural that the manufacturer who knows most about making the records should also know most about playing them, our cartridges for many years have been the choice of professionals and discerning music lovers throughout the world.

Ortofon do not make turntables, amplifiers or loudspeakers. We put all our experience into developing advanced products to cover the two most critical sectors in sound reproduction: the cutting and the playback of records.

For us accuracy in sound is more than just a slogan.

It's our reason for being in business.

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SOUND

Arm/Cartridge Interface

It seems obvious that most of the new crop of moving-coil cartridges are capable of delivering very fine performance when correctly fitted to a suitable arm. The interesting thing here is that the ultra-low mass syndrome is no longer prevalent and that manufacturers of both arms and cartridges have come to grips with the idea that a moving-coil cartridge, by virtue of its low compliance, needs at least a medium mass arm (say 15 gm or so effective mass less cartridge) to avoid serious resonance problems in the low frequency band. The mass will obviously have a stabilising effect on the pickup system enabling the stylus to follow the groove modulations without the entire pickup system attempting to trace very low frequencies. Our own experiments so far indicate that arms such as the Formula 4, whilst providing first class conditions for high-compliance cartridges, do give low-frequency problems with items like the Denon DL103, the Ortofon MC20 and our regular Decca 6E.

Of course, low effective mass is most needed in the vertical plane to avoid loss of contact between stylus and groove on warped and rippled record surfaced, whilst stability (by virtue of mass) is most needed in the lateral plane, since bass modulations on records are almost invariably lateral with minimal vertical elements. One solution to the conflicting demands of low vertical mass and high horizontal mass is the excellent Dynavector (Onlife) arm which must currently take the cake for innovative and practical design. This arm is based on a massive pedestal which also enables it to be used free-standing (i.e. not secured to the turntable) and the main carrying arm, also very massive, pivots only in the horizontal plane. This main arm supports an offset sub arm which, whilst of adequate rigidity and total mass relative to its size, has very low effective vertical mass. The sub arm, which carries the headshell and, beyond its pivot (which allows only vertical motion) a very small counterweight, is unlikely to allow series resonances to develop in the audible band. The only possible penalties arising from the use of the short sub arm are, first, that greater distortion due to vertical tracking angle changes is likely by comparison with arms having longer effective length in the vertical plane — although this is probably of less consequence than the mistracking distortion resulting from a high-mass arm playing a warped record; and secondly, the pivots for the sub arm must be very carefully made and maintained, for friction so close to the stylus would obviously have greater influence than the same amount of friction in a longer arm.

So far, we've heard a Dynavector 20B in this unusual looking arm and can only confirm that the cartridge gives a distinct performance improvement thus used. After our initial, rather disappointing acquaintance with the 20B, as used in JH and SME arms, we were, of course, agreeably surprised. But it doesn't end there. Read on for more news on the 20B.

Cartridge/Amplifier Interface

The 20B has displayed certain problems with the majority of preamps, resulting in noticeable bass-shyness and a rather prominent high treble brightness. These effects are due to modification of the 20B's frequency response by reactive components in the equalisation section of the preamp.

To overcome this problem, *Modular Electronics, P.O. Box 245, Narrabeen, NSW, 2101,* has introduced a 'black box' (it's actually grey hammer finish but we'll let that pass) based on a first stage buffer amp interfacing with the cartridge, a precise RIAA equalisation stage, and then a further buffer amplifier which feeds direct to the line-level inputs of the majority of preamps. (The aux. input will normally be used). Used with the 'black box', the 20B sounds vastly improved, giving a very detailed and beautifully balanced result. One thing in favour of the 20B is its first class tracking performance, which has made it a cartridge well worth considering in any event.

Modular Electronics can also supply equalisation cards suitable for the Decca 6E (at last!) and the next subject for treatment is the Garrott P77, which we wouldn't have thought needed much doing to it to judge from our experience. The P77, fitted with a Weinz stylus, a parabolic type from W. Germany, looks like being a big favourite and if its performance can be even further improved using the Modular Electronics unit, a lot of listeners will be very happy indeed. The 'black box' can be ordered direct from Modular Electronics and expected RRP is $149.

Jordan-Watts Flagon

The Jordan-Watts Flagon loudspeaker, using a single Jordan-Watts drive unit module (we shall describe this in greater detail in the next issue) is based on a ceramic enclosure which looks like a traditional wine flagon. The drive-unit, a full-range device with a metal diaphragm, is sealed into the enclosure and covered at the front with a rather garish grille made of wooden strips glued to a gauze backing. A lead-out cable is provided for input connection.

● *Continued overleaf*

The inside of the enclosure appears to be stuffed with foam plastic, and the cork stopper is hollow in the middle to provide reflex loading. The speaker system combines a number of important desiderata — a non-resonant enclosure material, for example, of irregular shape. Most people refuse to take the Flagons seriously, which is a pity since for size they sound exceptionally good, the main drawback being a lack of genuine bass output (which one would expect anyway from a compact loudspeaker) and a deep nasal colouration giving certain male speakers the effect that they have mild sinusitis. Even so, we found the sound very satisfying indeed, with a dramatic impression of perspective and wide dynamics, first class definition, extremely stable stereo imaging and good coherency of complex sounds.

Well, we can live with the colouration which was by no means unpleasant, for the other qualities of the samples illustrated very clearly the benefits of a really good single-diaphragm full range drive unit. We're sure we haven't heard the last of Jordan-Watts and look forward to hearing others in the range — samples are to hand but as yet we've not had the opportunity to set them up.

Spectrum Planning Plea

INCREASING PUBLIC DEMAND for high quality stereo FM radio broadcasts is underlining the appalling state of frequency allocation in Australia. In a situation where a major television channel has been allocated a frequency hardly suitable for TV transmissions (channel 0); where TV transmissions occupy part of the spectrum used overseas for FM radio; where communications for air traffic control use frequencies different to those employed internationally (thus necessitating duplicate radio equipment for aircraft flying into Australia from overseas), it is clear that effective long term planning is overdue.

Even though some of the decisions contributing to this woeful situation could, under prevailing circumstances, have been justified at the times they were made, other decisions — such as the UHF/FM radio idea, mooted by major industrial interests and fortunately scotched before UHF sound broadcasting was forced upon us — have definitely been against the public interest and are now causing enormous problems to the authorities and broadcasting licensees involved. This is the view of Grahame Wilson, spokesperson for the Public Broadcasting Association of Australia.

Mr. Wilson discussed the situation with us at some length and pointed out that, with the Geneva World Administrative Radio Conference taking place in 1979, an enquuiry into radio frequency spectrum management in Australia was immediately necessary for the formulation of future broadcasting policy. The enquiry should:

— review the demands for radio services
— review recent technical developments which might alter the use of the radio spectrum
— recommend long term policies on radio spectrum use
— show how long and short term use of the radio spectrum can be balanced
— declare what research could help make better use of the radio spectrum
— consider the implications of the International Telecommunications Union's policy
— consider the immediate needs of Australian radio broadcasters and
— determine the role in spectrum planning of the Post and Telecommunications Department.

Mr. Wilson believes such an enquiry, resulting in concrete proposals and actions for sorting out Australia's broadcasting mess, could save Australia from the sort of problem referred to by McLean in his 1975 report — 'The non-standard use in Australia of the Band 88 — 108 MHz has given rise to a large part of the problem on which we have been called in to make

recommendations. The introduction of FM (sound broadcasting) into the UHF band would also be contrary to international practice and could consequently give rise to similar embarrassment in the future'.

The result of the McLean report was introduction of experimental broadcasts in Sydney, Melbourne and Brisbane, later giving way in Sydney to a full stereo service on 92.1 MHz by 2MBS-FM.

Political Plaything

We asked Mr. Wilson whether yet another enquiry into broadcasting was likely to return any successful result, and he informed us that this particular enquiry was essential to avoid embarrassment for Australia at the 1979 WAR conference. The main problem seemed to be that no rigid policy for future planning was currently available and this was the real cause for concern. Mr Wilson pointed out that broadcasting as a whole was really a political plaything, with very few people seeming to realise the tremendous importance of proper management and planning. He urged the introduction, as soon as practicable, of UHF TV broadcasting, ideal for Australian conditions where terrain and community virtually dictated use of local broadcasting stations rather than fewer VHF stations covering wide service areas. And with a large number of domestic TV receivers now equipped with UHF tuners, such a changeover would seem to be a logical move, especially in regions where existing VHF services (channels 3, 4 and 5) overlapped internationally used FM sound broadcast frequencies.

This particular problem arose from a request in 1961 to increase the number of VHF TV channels from 10 to 13, and in response to this the Huxley Committee recommended direct departures from the ITU (International Telecommunications Union) preferred usages of spectrum space.

Other TV channels cause other problems. Channel 5A was placed in an international satellite and space research band, currently still in use. Part of Channel 0 falls into the amateur radio band (50 – 54 MHz) preferred for ITU region 3, which includes Australia. This particular channel is technically barely suitable for TV broadcasting! Another unusual feature of the Australian allocation is the existence of a space, 6/7ths of a TV channel wide, left between channels 9 and 10 for use by domestic aviation.

In a press release drawn up for the Public Broadcasting Association of Australia, Mr. Wilson attributes these anomalies to the need for quick, high powered penetration of television services. The cost is now being felt with the development in Australia of FM radio some 25 years behind the rest of the world.

Timetable

The extreme difficulty being experienced in allocating FM services now needs to be emphasised, says Mr. Wilson. It is time for a definite timetable for overall frequency spectrum management reform to be drawn up. The effect of changing frequency allocations in the FM band will be felt by all UHF and VHF spectrum users, not only television services. The radio spectrum, if properly managed, will provide ample space (Washington DC has over 40 FM services in the 88 – 108 MHz band!) for everyone; broadcasters, communicators and the general public. There should be clear separation between user bodies and the allocating authority. The latter should be charged with looking at the entire radio spectrum, with clear instructions for forward planning and evaluation of competing uses on the basis of cost/benefit analysis.

Had this been carried out in the 1950's and 1960's it is possible we might not have gone directly to UHF TV as a solution to our needs, as was done in the UK for the introduction of colour television – no VHF colour telecasts were made and VHF monochrome receivers are no longer available, the simultaneous VHF mono broadcasts gradually being phased out. Thus the present difficulties caused by our non-standard use of the VHF band might never have occurred.

Mr. Wilson emphasised that the time to introduce planning policies was now, for the situation, left to the compromise now being advocated to enable establishment of a small number (up to seven in Sydney) of new FM radio stations, would certainly not improve. Apart from anything else, concrete proposals for more efficient use of the radio spectrum would save Australia from acute embarrassment at the 1979 WAR conference – to say nothing of the improvement and increase of all broadcast services for the community as a whole.

Further details and background information can be obtained from the *Public Broadcasting Association of Australia, P.O. Box 578, North Sydney, NSW 2060.*

SHURE OCTAVE ANALYSER

TO HI-FI ENTHUSIASTS, Shure Brothers of the USA is best known for its range of pickup cartridges and its association with the specialist British pickup-arm maker, SME.

But in the recording and broadcasting field, Shure is known mainly for its microphones and other products aimed at the professional user.

Among the electronic components produced by the company is an equalisation analysis system, consisting basically of a 'black box' model M615, fitted with a random noise generator for use as a signal source, the unit also being provided with a LED indicator system for measuring relative level in each of ten octave bands. Auxiliary to this unit is model ES615 analyser microphone, featuring a response tailored specifically for use with the M615.

The purpose of the system is to analyse the overall frequency response of an auditorium and to optimise, using an anti-feedback filter system or octave equaliser, the frequency frequency response of a public address or sound reproducing facility within it. Whilst the system has potential to give useful measurements of a hi-fi system in a domestic setting, our experience with this and other systems leads us to believe that a compensated frequency response in such a listening situation does not always give improved subjective performance. There are several possible explanations here, and one of these is the influence of the ordinary living room on audio frequencies due to its small size. Compensating for the severely undulating bass response in smaller rooms is the chief problem, particularly since response varies dramatically in different parts of the room – as listeners of wide-response hi-fi systems will be aware. Thus a response might feasibly be improved, actually and subjectively, for a very small listening area but can easily degrade performance elsewhere.

Regardless of the problems of performing subjectively acceptable equalisation, and the foregoing is not to say that PA equalisation is necessarily a simple process, Shure appears to have done everything possible to ensure rapid and effective use of graphic — or more correctly, octave — equalisers in a sound system. We received samples of the complete equalisation analyser, complete with microphone and all accessories, neatly and safely contained in a tough lightweight suitcase type carrying case. We also received Shure's SR107 mono octave equaliser which had been sent for assessment by Hi-Fi Review magazine.

Different operating procedures are employed for P.A. work and hi-fi system analysis. But the fundamental procedure is the same. Basically the idea is to equalise the system using an octave equaliser while reducing the range of the 'hi-lo' envelope, this being defined by the appropriate rotary control on the analyser front panel, and indication of response peaks or dips using the LED indicators. By reducing the size of the envelope by degrees, it is possible to identify very rapidly where response deviations occur and to take appropriate action with the octave equaliser.

There's no doubt the system is very effective indeed. We were able to equalise our hi-fi system in less than three or four minutes after a little practice, and that involved treatment of each stereo channel individually.

The equipment was a joy to use — including Shure's SR107 equaliser whose rotary controls were, to us, easier to operate than the slider normally found on such equipment. Sliders, in our view, are only useful in applications where several controls are likely to be manipulated at the same time and where instant indication of their position is necessary. Mixing desk faders are the obvious application.

We won't go into great details of the equipment. Excellent descriptive material is available from Shure. We will say that it is extremely flexible and is usefully provided with both XLR and standard tip-and-sleeve jack connectors for interface with just about any installation.

No doubt more accurate equalisation would be available using a third-octave system but this would obviously be more complex, both in design and operation. Shure's octave system provides a very effective and economical answer to the problem it solves and its portability offers great convenience. We can imagine any number of useful possibilities for the system and anyone who is professionally involved in sound reproduction should at least check it out.

SOUND BRIEFS

Meridian

Designed by Lecson originators Alan Boothroyd and Bob Stuart, the Meridian range consists of an amplifier based on 'black box' type units with minimal controls. A loudspeaker system has also been introduced.

Audio Technica

Completely new Audio Technica ranges, including cartridges and headphones, are in production and should soon be freely available.

Decca International Arm

Latest Decca problem to be solved is incorrect lateral balance of most production samples. Solution involves enlarging the headshell plug grubscrew hole at the front end of the aluminium tube to a slot enabling the headshell to be twisted to give correct alignment.

Garrard Impulse NR Unit

Presumably based on bucket-brigade electronic time delay circuitry similar to that used in the SAE 5000 impulse noise reduction unit, Garrard's new box of tricks has been released in the U.K. and should soon be available here.

Headshells

Coral, the Japanese speaker people, have introduced a complex alloy 'special metal' headshell of tremendous rigidity. Though fairly massive, the sample we've received from Garrott Bros. in Melbourne seems to give improved performance especially with moving-coil cartridges.

Sub Woofers

With JR, Chartwell, JBL and Phase Linear (amongst others) all introducing sub-woofer systems recently, either as part of complete stereo speaker systems or as separate add-on units, it will be interesting to discover whether centre bass affects stereo performance and whether the interference effects of conventional pairs of full-range woofers might be more tolerable.

More Speaker Trends

Seems probably that more and more speakers will be equipped with active crossovers and integral power amplifiers before long. The Boothroyd-Stuart Meridian, the JBL L212 and several other new designs are either fully or partly self powered.

Linn Isobarik Speakers

Although we've indicated that Lin Isobarik speakers might soon be available in Australia, the likelihood is now remote. The reason, we understand, is high cost of the speakers themselves in addition to the three Naim 250 power amps, active crossover and preamp needed. With a Linn-Sondek turntable, this little system costs more than £4,000 in the U.K. which, with tariffs, tax and so forth would bring the local price to a minimum of $10,000!

Ultimately It's Marantz. Go For It.

Now, professional 3-head monitoring in a cassette deck.

Up to now you had to choose between a cassette deck for convenience. Or, reel-to-reel for professional recording features. Now have it both ways in the Marantz 5030 cassette deck.

Here's how:

The Marantz 5030 has separate record and playback heads... the same as reel-to-reel. This gives you an instant check of the quality of your recording as you record. And, like some of the most expensive reel-to-reel decks, the record and playback heads on the Model 5030 are super-hard permalloy—a long-lasting metal alloy that gives better frequency response and signal to noise ratio than Ferrite material.

For precise azimuth alignment, both the playback/monitoring and record heads are set side-by-side within a single metal enclosure. They can't go out of tracking alignment.

Complementing this outstanding "head-technology" is Full-Process Dolby* Noise Reduction Circuitry. It not only functions during record and playback... but during monitoring as well.

What drives the tape past the heads is every bit as important as the heads themselves. For this reason the Model 5030 has a DC-Servo Motor System. The steadiest, most accurate tape-transport method. Speed accuracy is superb, with Wow and Flutter below 0.08% (WRMS).

To adapt the Model 5030 to any of the three most popular tape formulations, press one of the three buttons marked "Tape EQ and BIAS." There are settings for standard Ferric-Oxide, Chromium Dioxide (CrO_2) or Ferri-Chrome (FeCr) tape.

With Mic/Line Mixing, two sources can be recorded at the same time, combining line and microphone inputs. The Master Gain Control lets you increase or decrease the overall volume of the total mix.

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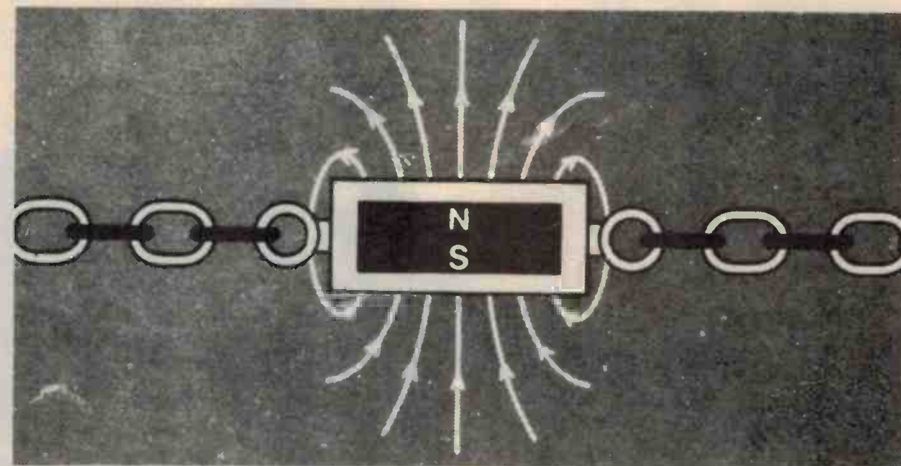
Necklace Offer!



VERY many people suffer from so-called 'stiff shoulders' or 'stiff necks'. It is generally believed that these unpleasant symptoms are caused by mental or bodily stress but the exact cause is not apparently really known.

The TDK Electronics Corporation have produced a magnetic necklace which they state has proven effective in relieving such symptoms for a very high proportion of sufferers.

The Japanese Government's Ministry of Health and Welfare has given its approval (NO. 51B-614) to this necklace and we have read four fully documented reports from independent authorities (such as the University of Tokyo's Medical Faculty) to support TDK's statements.

The necklaces are made in two basic forms. Gold-plated 430mm long and rhodium-plated 560mm long — these, TDK suggest, would suit men or women. respectively. Both are sold at the same price.

The necklaces contain extremely powerful rare earth cobalt magnets which were originally developed for the NASA space programme. The magnets are permanent. Necklaces are supplied complete with two connecting rings, one hook and one length of chain as spares.

TDK advise users to wear the necklace in direct contact with the skin. It should be worn continuously including whilst asleep, removing it only whilst taking a shower or bath.

Most people find it effective after two to three days.

The TDK magnetic necklace is handled in Australia by the Caldor Corporation and they have made arrangements for our readers to obtain either type at the same price — $49.95 including postage and packing.

Necklaces should be ordered via this magazine using the form (or replica thereof) published on this page.

Please make cheques payable to 'Necklace offer' and send C/- Hi-Fi Review, 15 Boundary St, Rushcutters Bay NSW, 2011.

Please allow at least three to four weeks for delivery — there really are mail delays — particularly of parcels!

Thousands of people have used these necklaces and claimed they have experienced relieve of 'stiffness'. Nevertheless we would like to make it absolutely clear that all papers published so far show that the devices vary in their effect from one person to another and that in some cases they have no effect at all. There is no totally tangible scientific evidence to support or refute any claims or statements made although research is continuing worldwide. Therefore as no claims can currently be substantiated (and of course no claims are made by us or Caldor) the ultimate decision and experience must be yours.

Nevertheless, the necklaces are made by TDK and that must mean something.

Manufactured by,

TDK

TDK ELECTRONICS CO., LTD.

The problems of PIRATED RECORDING

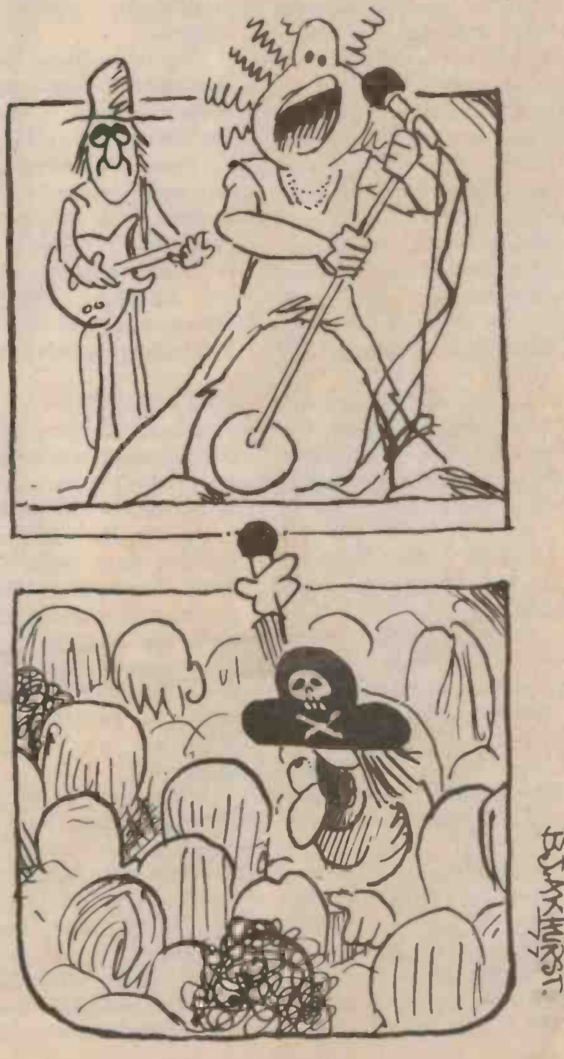
How record manufacturers are planning to beat the bootleggers. By Roger Harrison.

IT WAS ONLY a few years ago that pirate or 'bootleg' versions of Bob Dylan's Basement Tapes and Pink Floyd's Dark Side of the Moon, sold like the proverbial hotcakes, along with a host of others.

These recordings blatantly advertised the fact that they were pirated, and thus of illegal origin — transgressing not only performer's rights but also copyright. Many people were attracted to pirate recordings for there seemed to be something rather exciting about owning a recording which the artist did not approve. Often, the pirate recordings contained material not released on genuine recordings, or were of concert performances which often differ markedly from studio performances. Quality was almost inevitably low-fi!

Through a combination of circumstances, these bootleg recordings gradually disappeared from the market. Groups employed stewards to hunt through audiences looking for tape recorders, legal prosecutions were brought against bootleg distributors etc. Finally, high prices for low-fi killed the market.

Recently, however, the pirates have changed tack and are presenting recordings that are either made to mimic legitmate releases on well known labels or to appear like legitimate competition. For example, a recording stolen from EMI may either be packaged to look like an EMI recording, or packaged in a sleeve with an authentic-sounding company label, but not that of an authorised EMI trader. In neither case does the



The problems of PIRATED RECORDING

artist, EMI or anyone else (save the bootlegger and his outlets) receive any reward.

Those recordings that mimic legitimate releases are usually a straight, undoctored copy of the original, with slightly reduced fidelity. When released on a phony label, often the recording is altered in the transfer to disguise its origin, usually by dubbing applause or extra instruments onto the copy.

The problem arises here in that both these techniques are far harder to detect and prove as bootleg than the previous methods. The British Phonographic Industry (the UK recording industry trade association) have taken numerous court actions, with some success, resulting from pure detective work.

SELF-DESTRUCT

However, the final solution to professional piracy relics on technological aids. This can be achieved by either making the physical act of illegitimate copying technically impossible, or to make the technical detection of such copying unambiguous. Unfortunately, despite considerable efforts, little real practical headway has yet been made in either of these directions.

If record companies had their way, each disc or pre-recorded tape released and sold to the public, would self-destruct, refuse to play or produce unacceptable sounds if copying was attempted.

To date, anti-copy remains an impossible dream. Inventors still tackle the problem, the cash rewards for a workable system would be enormous. Inevitably, one red-herring scheme keeps being re-invented.

Back in 1967/68, the Beatles' Electronics Company, Apple, leaked a story about three patent applications on a new anti-copy system. Any attempt at recording a disc pressed according to this system would result in a high-pitched whistle they claimed. The idea attracted a certain amount of attention, but, in time, the patent applications were allowed to die, along with the publicity and Apple Electronics disintegrated.

Although details of the idea remain a secret, the system probably involved recording an ultrasonic carrier frequency on the disc. Thus, at any attempt to put the disc material on tape the carrier on the disc would beat with the tape recorder's ultrasonic bias signal and impress an audible signal on the tape.

In this way, two inaudible frequencies are combined to produce an audible frequency which destroys the recording attempt.

A little thought shows the snags in the system. To produce an audible beat with the very high bias frequency used on tape recorders (around 70 kHz or higher) requires that a similar signal be recorded on the disc. The studio cutting machine won't cut it, the factory pressing machines won't press it and the would-be-recordist's cartridge wouldn't reproduce it.

It is also easily filtered out at any stage of the production chain, either intentionally or otherwise, with no loss of quality, because the carrier signal is inaudible anyway. Different tape recorders have widely different bias frequencies which also defeats the system.

The drawbacks are enough to discourage further reinvention of this system and doubtless account for the demise of the Apple patents.

There is another daunting aspect to anti-copy systems. It is likely that if anyone does devise a system that will prevent the copying of a disc or tape onto existing tape recording machines, the recorder manufactures will soon devise a defeat button or circuit to make copying possible again.

WATERMARKS

Anti-copy systems appear defeated for the moment. However, the concept of an indelible watermark on the recorded sound appears somewhat less fanciful.

As with anti-copy, watermark systems have gone through numerous futile reinventions. The aim is to record an inaudible identification signal along with the recorded sound. The watermark signal is inaudible to the listener when the disc or tape is played on conventional equipment, but it can be identified or decoded by special equipment.

Ultrasonic (high frequency) and infrasonic (very low frequency) watermarks have similar limitations to the anti-copy schemes. For this reason, it is essential to adopt a sledge-hammer approach to prove the origin of copied material. One such attempt, by Capital Radio (UK) who recently broadcast some previously unpublished Beatles tapes, involved putting a loud station ident ('194') over the recording every few seconds. Thus, if ever a bootleg recording is issued, its origin will be audibly stamped all over it! With the station ident so loudly intrusive there would likely be little incentive anyway.

In recent years, EMI's proposed system for identifying the source of a recording has often been discussed in the popular press. But there is much confusion over just what it is that EMI have succeeded in doing to curb piracy.

Briefly, the system involves putting a digital code on the recorded material at a very low level which can be recognised by specially designed decoding machines. It is extremely difficult to evaluate and thus prevents forging or replication of the code.

Unfortunately, the EMI system is usable only to prove that a recording did *not* originate from EMI. In the case of mimic recordings, which would look like a genuine EMI release, the lack of any EMI watermark code would be good grounds to believe that the recording did not come from EMI. But courts do not like *negative* proof — where the absence of something is regarded as positively proving something else. There is also the argument that unless all EMI plants around the world were using the system at the time, and there were no old stocks of unwatermarked tapes, then it is unreasonable to say that just because a tape has no watermark that it is not from EMI. Then again, why shouldn't an EMI watermarked tape find its way into pirate hands?

NOTCHES

There is another approach which a number of recording companies are seriously considering. This is the *Audicom* system invented by Murray Crosby.

It was originally intended for collating automatically the number of times a commercial was transmitted on a radio or TV station, for accounting and statistical purposes.

The system works like this: At a frequency around 2·3 kHz, a tight notch filter with a very narrow bandwidth (around 100 Hz) bites a small chunk out of the audio spectrum. At the same time a binary code watermark signal is modulated onto an audio frequency subcarrier of the corresponding frequency and bandwidth so that it fits neatly into the window left by the notch filter. The amplitude of the subcarrier frequency is varied so that it tracks the audio level of the surrounding programme. In this way, the coded identification signal is always submerged by the programme, but it is still recognisable by a decoder tuned to the

narrow band notch frequency and designed to interpret the digital information modulated on the sub-carrier.

Sound like a great system for discs and tapes. However, several difficulties arise. If, for instance, the coded sub-carrier is at such a low level, might it not be lost in noise after transmission or the copying process? This is one area which EMI, RIAA and others are investigating. Even if they get results, we are not likely to read or hear about it. Because, if the system is adopted, it would not be prudent for the record companies to indicate the level at which noise destroys the code.

One set of technical specifications indicates that when the programme audio level is zero, the subcarrier coded signal will be 55 dB below the peak level the carrier would be at peak audio programme level. When the programme audio is at peak level then the audio subcarrier in the notch will be 40 dB below the programme level. Thus, the subcarrier is always submerged by the programme but would still be detectable by a decoder tuned to the narrow band notch frequency so that the digital watermark code is recognisable by the digital decoder.

The encoding system is illustrated in figure 1. The notch and coded sub-carrier are switched in at intervals according to the periods of the timers. As the frequency and position of the notch and the code on the subcarrier can be programmed by the encoder operator, only a decoder set up to recognise that code could detect its presence. The system is applicable to broadcasting, tapes and records.

Does the 100 Hz notch missing from the audible frequency spectrum affect the sound? Experiments have shown that, in fact, such a notch will largely go unnoticed. This leads to the possibility of just using a notch to watermark a recording.

A 12 dB dip in the mid-band frequency range, between 2 kHz and 4 kHz, can be introduced intermittently with surprisingly little audible effect. While a notch of higher or lower frequency may be relatively inaudible while consistently maintained, any attempt at intermittent notching outside the 2-4 kHz range produces highly offensive sounds.

Below 2 kHz a notch intrudes into the fundamental frequencies of musical notes from many instruments. Above 4 kHz intermittent notching results in modulation of high frequency background noise and intrudes into the upper harmonic range of musical tones.

By careful selection of where a notch is introduced into a recording, its presence can be made unobtrusive. It thus seems likely that a notch 'filled' with a coded carrier like the Crosby system could be placed on a recording without the listener being aware of its presence.

The presence of a notch in a recording can be simply detected with a spectrum analyser. A notch filled with a code requires a decoder to identify the origin of the recording.

The placing of a notch, or code-filled notch, on a recording would need to be dictated by the characteristics of the material recorded, in order that the presence of the watermark is masked. The notch characteristics may need tailoring to suit the programme material. Any system of indiscriminate notching would produce audible effects on the material and thus would be rejected by hi-fi listeners.

There is no reason why the characteristics of the notch introduced on any commercial recording should not depend solely on the nature of that recording, with regard to location, frequency and duration. Provided the recording company accurately logs the position of the coding windows it will have no future difficulties in detecting the coding. This in itself would prove a deterrent to pirates.

When illegitimately copying a recording, the pirate will be faced with the knowledge that interspersed with the material will be a notch of unknown frequency and bandwidth, at unknown locations on the recording, including an indentification signal which can be positively identified by the owner of the copyright. Secondly, even if you know where the notch is, it is well-nigh impossible to repair.

Such a situation allows the copyright owner to point, albeit electronically, to a watermark in the sound on an illegitimate recording and thereby identify, positively, its source.

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*HFIA Survey figures Sept. 1977.

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HA109/78

Project 714

VHF LOG-PERIODIC ANTENNA Part 2

By Roger Harrison, VK2ZTB, who still swears (SWR's?) the prototype hasn't fallen down yet!

Balun Construction

THE BALUN TRANSFORMER consists of a trifilar winding on a ferrite balun core, Neosid type 1050/2/F14. Alternatively, a similar core could be stripped from a standard 4 - 1 TV balun and rewound. Construction is relatively non-critical, and details are illustrated in Fig. Fig. 7.

The winding wire is any convenient small-gauge hookup wire, preferably in three different colours to identify the different strands and assist construction. Alternatively, ordinary enamelled copper wire, about 22 gauge to 28 gauge B & S, would be satisfactory, although the three separate wires would have to be identified in some way, for example, by knotting wire 'b' once at each end, and wire 'c' twice at each end.

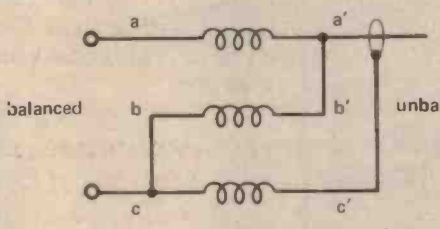
The three wires need to be about 150 mm long and should be lightly twisted together before commencing the winding. Wind 6½ turns through the two holes, around the outside of the balun core as illustrated in Figure 7.

The wound core is then glued to a small square of matrix board, about 25 mm long per side, using a small amount of five-minute epoxy or one of the 'super' glues. The windings are terminated to two pins on either side of the board, as illustrated in Figure 7. Two lengths of hookup wire should be soldered to the 'balanced' terminals, sufficient to reach from the mounting point of the balun to the feedpoint of dipole 10. A short length of coax, terminated in a Belling-Lee line socket, is then attached to the 'unbalanced' terminals as indicated.

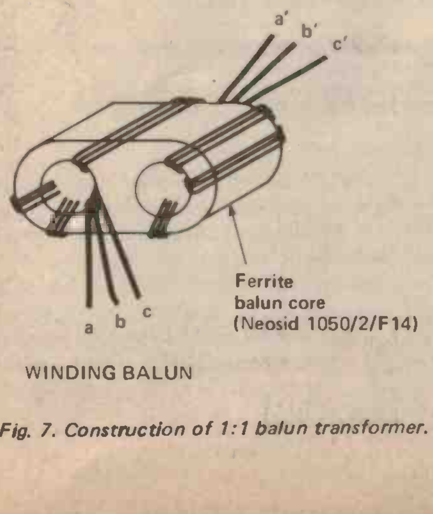
The balun assembly can be conveniently 'potted', using five-minute epoxy, to weatherproof it.

Mount the balun on the antenna boom, near or underneath, dipole 10, and connect the two 'balanced' connection leads to the feedpoint of dipole 10. Tape the assembly to the boom using weatherproof tape or plastic ties. Even string could be used, or the assembly glued in position using some more five-minute epoxy.

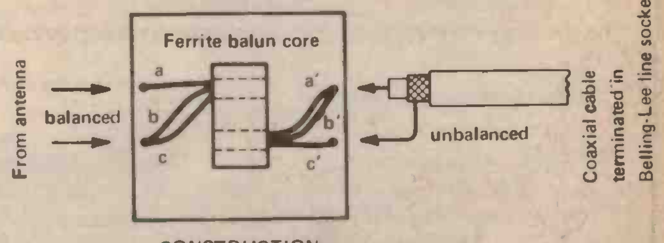
An alternative balun system would be to use standard 4 - 1 TV baluns. These perform a 300 ohm to 75 ohm transformation. With the type of construction employed, they can be used for a balanced-to-balanced or a balanced-to-unbalanced transformation.



CIRCUIT



WINDING BALUN



CONSTRUCTION

Fig. 7. Construction of 1:1 balun transformer.

Project 714

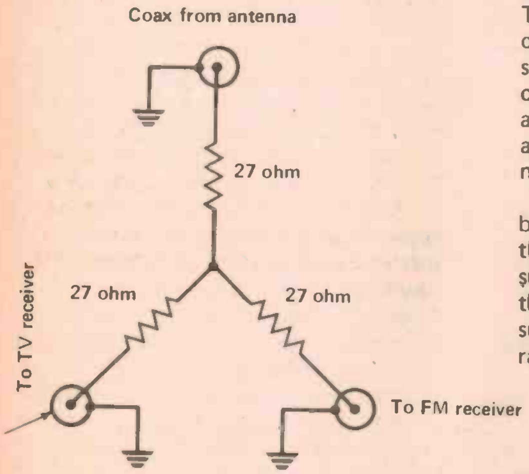
VHF LOG-PERIODIC ANTENNA

If using these baluns, connect the 75 ohm side to the feedpoint of dipole 10 and run ordinary 300 ohm ribbon to your receiver installations from the 300 ohm balun connections. Be sure to take all the required precautions necessary with this sort of feedline installation as for TV feeder, to prevent signal 'suckout' by nearby metal structures and by line imbalance.

Splitters

To run two different receivers from a common antenna a device called a splitter is necessary. The two receivers cannot simply be connected in parallel as they will interact with each other, apart from causing an impedance mismatch with the antenna feedline.

Two different kinds of splitters can be constructed — the resistive type and the transformer type. Alternatively, a suitable splitter may be purchased. As they are wideband devices they are suited for operation over the entire range from 40 MHz to 250 MHz.



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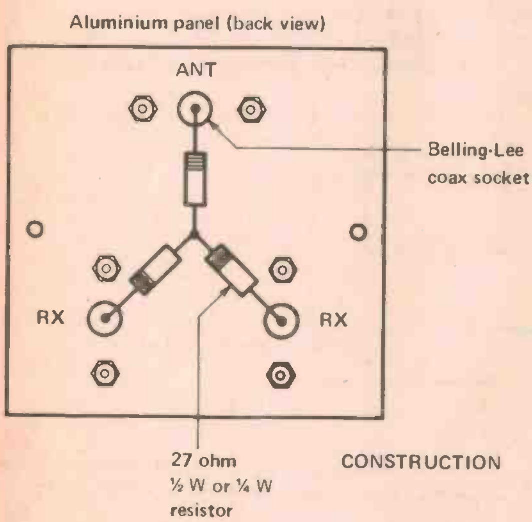
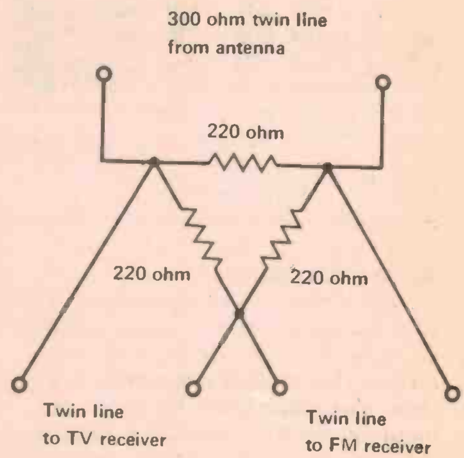


75 OHM SYSTEM SPLITTER



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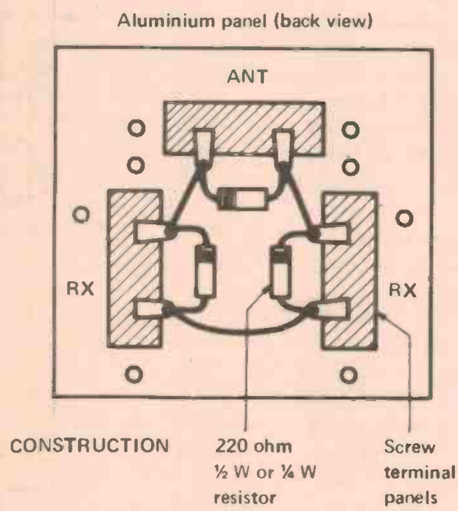


300 OHM SYSTEM SPLITTER

Fig. 8. a) Circuit of 75 ohm resistive splitter.
b) Layout of 75 ohm resistive splitter.
c) Circuit of 300 ohm resistive splitter.
d) Layout of 300 ohm resistive splitter.

Resistive Splitters

Two resistive-type splitters are illustrated in Fig. 8. That on the left is for unbalanced, 75 ohm coaxial cable feedline systems; the one on the right is for 300 ohm systems. Both of these splitters are compromise solutions and are only recommended for TV & FM receiver installations in strong signal areas. If you are after DX, then the loss these splitters introduce will reduce receiver sensitivity.

Either type may be constructed on a small square or rectangular aluminium plate. Size is unimportant providing the feedline connectors are mounted reasonably close together so that the lead-length of the resistors and interconnections is kept short. Solder all connections.

Note that any terminal may be used as an input and the other two terminals may be used as the outputs.

When the splitter construction is completed, it can be mounted in a convenient place such as a cutout in a wall, shelf, or equipment cabinet.

Transformer Splitter

The best splitter is a transformer-type as it introduces a minimal loss, and can be constructed in a similar way to the balun previously described.

Commence by winding three wires on a Neosid balun core type 1050/2/F14 as illustrated in Fig. 7 and wind on 6½ turns, trifilar as described for the balun. The connections and construction are as illustrated in Fig. 9.

Once the transformer is completed, secure the windings, if necessary, with a small application of super glue. Then glue the transformer to a small scrap of plain phenolic board or matrix board. This assembly is glued to a small aluminium panel on which are mounted three Belling-Lee sockets as illustrated in Fig. 9. Carefully separate and identify the three leads at each end of the transformer windings and connect them as shown. Carefully solder all joints.

When the construction of the splitter is complete it can be mounted as described for the resistive splitters.

Feedline Systems

There are two alternatives for your feedline system: a 75 ohm coaxial cable system, or a 300 ohm twin-line system.

The coaxial cable system is recommended for a number of reasons: the coax may be run anywhere convenient as it is unaffected by wall material, metal objects and power cords. Most VHF receivers, TV sets and FM tuners these days have a coax connector antenna fitting to suit, and no interference can be picked up on the coax feedline as it is effectively shielded.

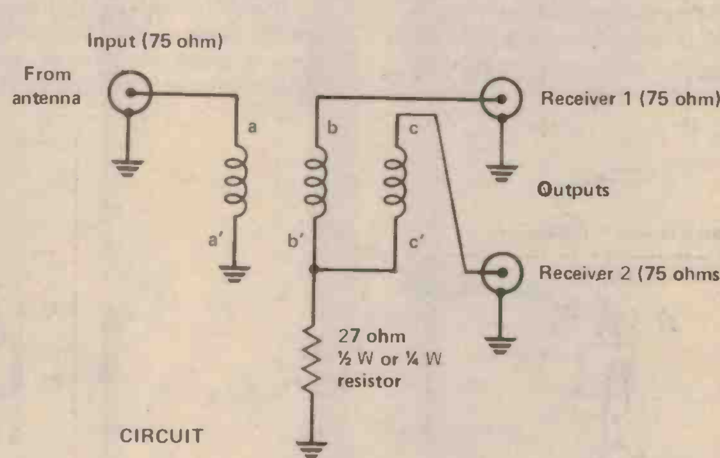
A 300 ohm twin-line feeder has the advantage of being inexpensive, but it must be correctly installed with stand-off supports and twists in the line to aid in maintaining 'balance'. It cannot be run as conveniently as coax, and noise and multi-path signals may be picked up on the feeder.

The required use of bàluns and splitters in the system is illustrated in Fig. 10 for both systems. The 75 ohm coaxial cable system is illustrated on the left and the 300 ohm twin-line system on the right.

The coax required depends on the exact details of your installation. If a short run of coax is possible then a 6.5 mm diameter cable such as RG59 (variously designated as RG59/U or RG59/CU etc.), which is a 75 ohm characteristic cable, is suitable. If this cannot be obtained, then 50 ohm cable such as RG58 may be substituted, although a slight mismatch will result. The effect will be unnoticeable on a VHF or FM receiver but slight 'ringing' may be apparent on high contrast areas on a TV picture. This may not be visible at normal viewing distances.

For maximum sensitivity on reception or if you have to run the feedline more than 15-20 metres, then a low loss 75 ohm cable is recommended, such as type ET13M or PT13M with black, weatherproof outer jacket. It is made by Cablemakers Australia and is about 10mm diameter. There is a version of this type of cable with a grey plastic outer sheath. This is meant for community antenna installations, such as in flats and units, and the sheath deteriorates rapidly when exposed to the weather.

If you wish to use a 300 ohm feeder system, any of the commonly available TV ribbon feeders should suffice, depending on your requirements. Solid dielectric type is adequate in strong signal areas and is the least expensive. If you want the maximum in sensitivity a low-loss type should be installed. There are various versions of low-loss 300 ohm feeder. Some types are similar to the solid dielectric type and simply have cutouts in the dielectric. 'Open wire' types have small spacers supporting the two wires at intervals. Another type has a continuous dielectric of foam material encased in a thin plastic 'shell'.



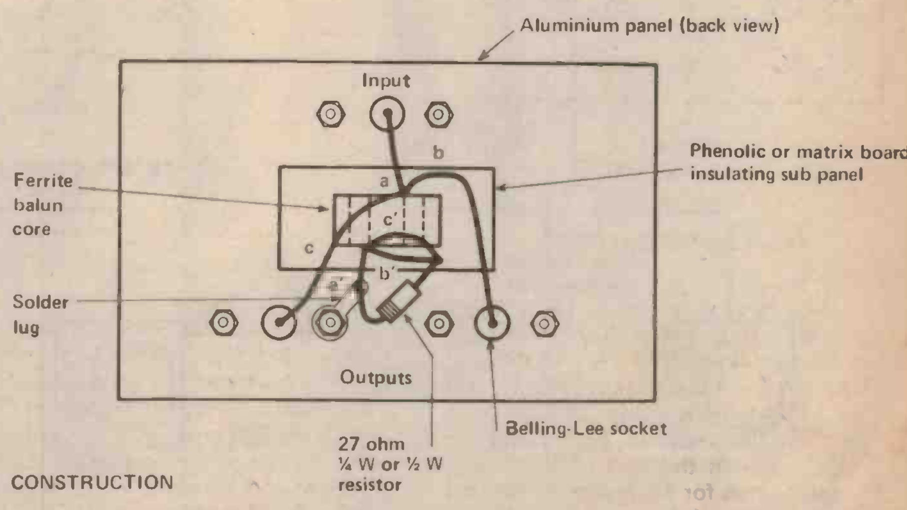


Fig. 9. a) Circuit of transformer-type splitter.
b) Construction of transformer-type splitter.

VHF LOG-PERIODIC ANTENNA

Antenna Performance

The beamwidth of the antenna is about 50° (between the -3dB points). There were no discernable sidelobes in the forward direction which reduces problems with multi-path signals on FM and TV reception which are the cause of distortion on FM stereo and ghosting on TV signals.

The gain of the antenna is around eight to nine dB and the front to back ratio (rejection of signals behind the antenna) around 30 dB.

The broad beamwidth allows reception over a wide range of angles in the forward direction, very handy when the DX starts pouring in from all over the place as it saves a great deal of rotating the antenna. If you are using it for TV/FM reception the beamwidth should prove adequate for most capital city locations. However, if you live in the Balmain-Leichhardt-Annandale-Glebe area of Sydney as I do, you may think that you will have problems with a fixed antenna. The TV transmitters are to the north (Gore Hill area) and 2MBS-FM is to move to the AMP building site in the city, to the east. However, their 'technical rep.' assures me that their 10 kW transmitter will put such a strong signal into those areas that an antenna will not be necessary!

Installed at a height of roughly six metres above ground level, the antenna gave a good account of itself. Admittedly, as far as the local TV and FM transmitters are concerned I live in a strong signal area, although we have in the past suffered from ghosting on TV signals from the south. The good front-to-back ratio improved this problem considerably.

Listening to a variety of VHF signals with a general coverage VHF receiver produced good strong signals on the aircraft frequencies from Bankstown light aircraft aerodrome — much as expected. Quite readable signals from as far away as Wollongong were also copied. Video and sound from channel 0 in Wagga were audible, sometimes at quite good strength, in Sydney on the 60 — 250 MHz model!

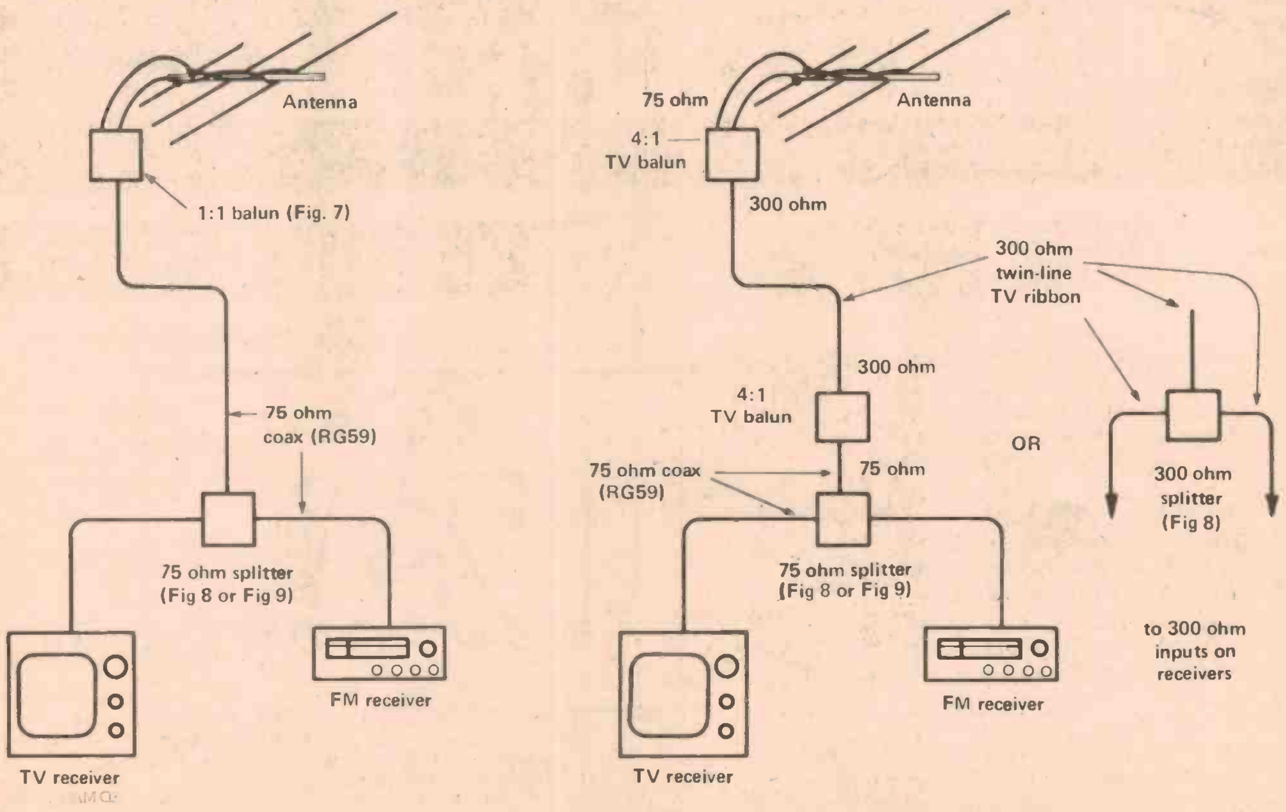


Fig. 10. Feedline and splitter systems installation.

THE ADC CARTRIDGE CAUSES NO PERCEIVABLE WEAR OVER THE LIFE OF A RECORD.

A series of tests conducted by a leading independent audio-testing laboratory prove it.*

The tests show that the ADC XLM-MKII cartridge causes no perceivable wear until after 60 plays. Industry sources estimate the "life of a record" (the average number of times a record is played) to be 40 to 50 plays.

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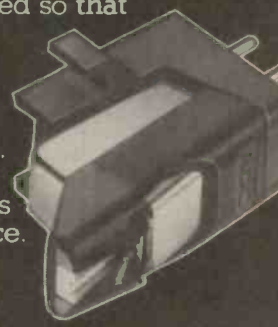

The ADC XLM-MKII is different, because our engineers found a way to detach the magnet and reposition it above the stylus, so the stylus applies less pressure against the groove.

Less pressure means less wear.

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The XLM frequency response is exceptionally flat, from 15Hz to 24KHz ± 1.5dB. And for the ultimate in stereo reproduction, it has a minimum of 28dB of channel separation.

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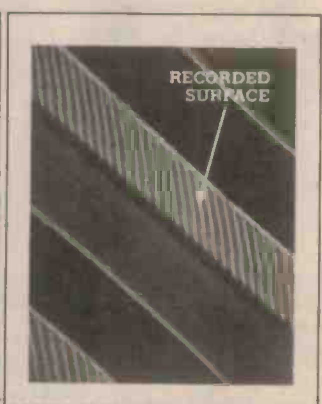
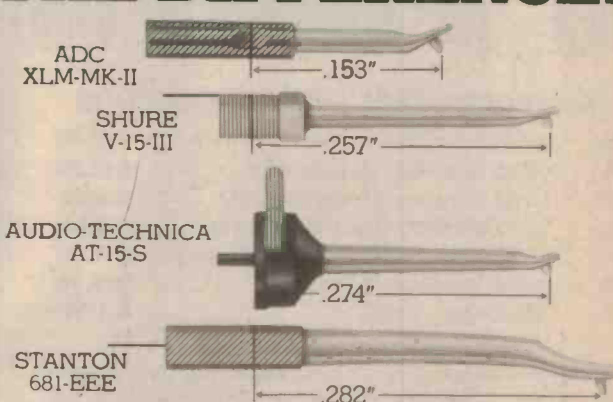
THE PROOF:

This is a photomicrograph of a 20kHz record groove that has never been played before.



This is a photomicrograph of a similar 20kHz record groove played 75 times with an ADC XLM-MKII cartridge. As you can see there is no difference.

THE DIFFERENCE:



The way to get the most accurate reproduction of sound is to lower the total effective mass of the moving parts of the stylus. And that's exactly what our engineers did. In fact, of all the leading brands, ADC cartridges have the lowest mass moving system you can buy.

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* CBS Technology Center Project 1108: Record Wear Test Program. Performed for Audio Dynamics Corporation. December 1976.

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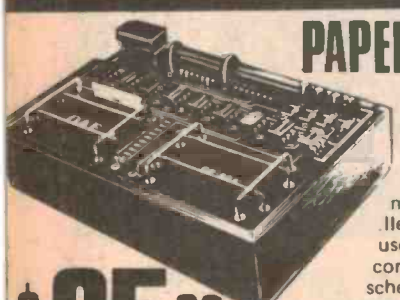

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S1883/MM5303N/TMS6011 UART (universal asynchronous receiver transmitter) IC for above encoder if required.
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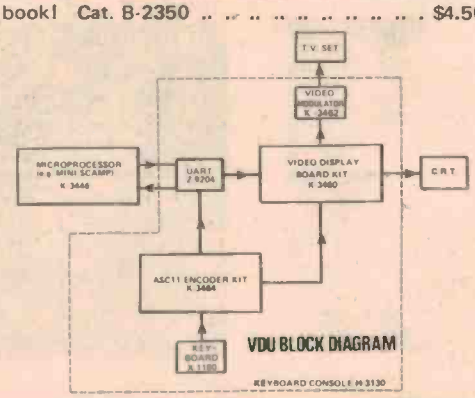

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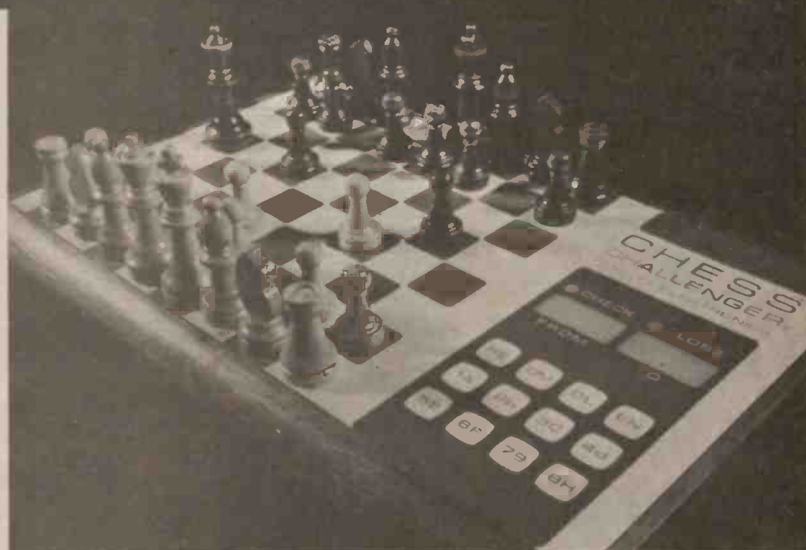

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Inside information from ultrasound

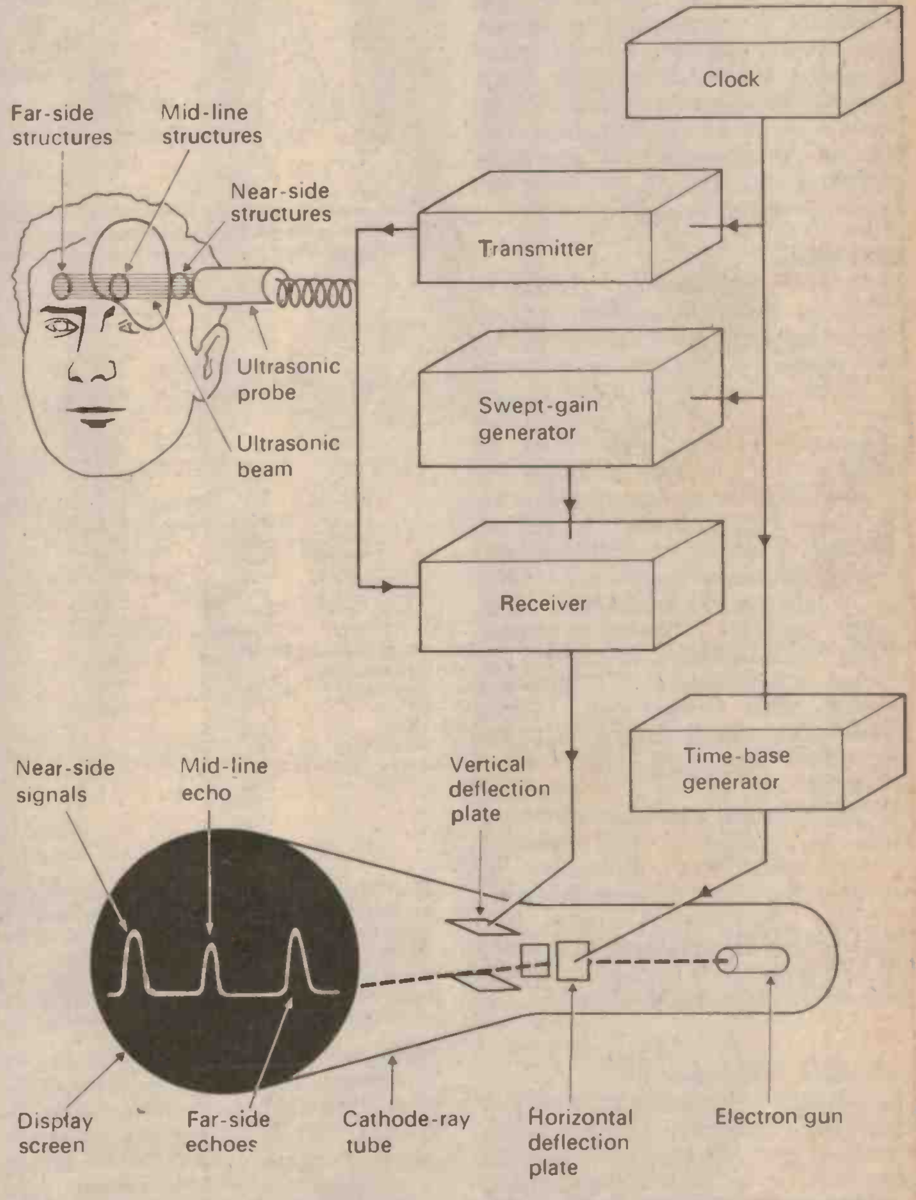
Ultrasonic sound is being used increasingly in medical diagnosis. By Dr P. N. T. Wells, Bristol General Hospital.

THE importance of ultrasonic diagnostic methods lies in the fundmental differences between them and other techniques such as radiology and radioisotope scanning. The symptoms of some diseases, and of natural conditions such as pregnancy, are best investigated by ultrasound. It maps out anatomical cross-sections, measures the performance of the heart and the flow of blood, and identifies many kinds of abnormality, including several types of cancer, all without encroaching into the body in any way.

Twenty-five years ago, doctors seeking to investigate the structures of the body had no alternative to X-rays. Injections of substances to give better contrast were often necessary to obtain information about soft tissues. Nowadays, ultrasonic methods have replaced radiology in helping to solve many clinical problems: doctors depend on ultrasonic diagnosis, and patients demand this kind of investigation. The procedures are rapid and painless and nothing enters the body other than ultrasound waves. Unlike ionizing radiations, ultrasound at diagnostic exposure levels seems to be harmless.

Basic Principles

Most diagnostic applications of ultrasound depend on the reflection of ultrasonic waves at surfaces between tissue structures which differ in their so-called characteristic impedance. The characteristic impedance of a material is equal to the product of its density and the velocity of ultrasound within it. The densities of soft tissues, about 10^3 kg m^{-3} (kilograms per cubic metre), and the velocities of ultrasound within them, about 1500 m s^{-1} (metres per second), are similar to those for water. When an ultrasonic wave strikes the boundary between tissues that differ in characteristic impedance, a proportion of the energy in the wave is reflected in much the same way that light is reflected when it meets a change in reflectivity at a surface.

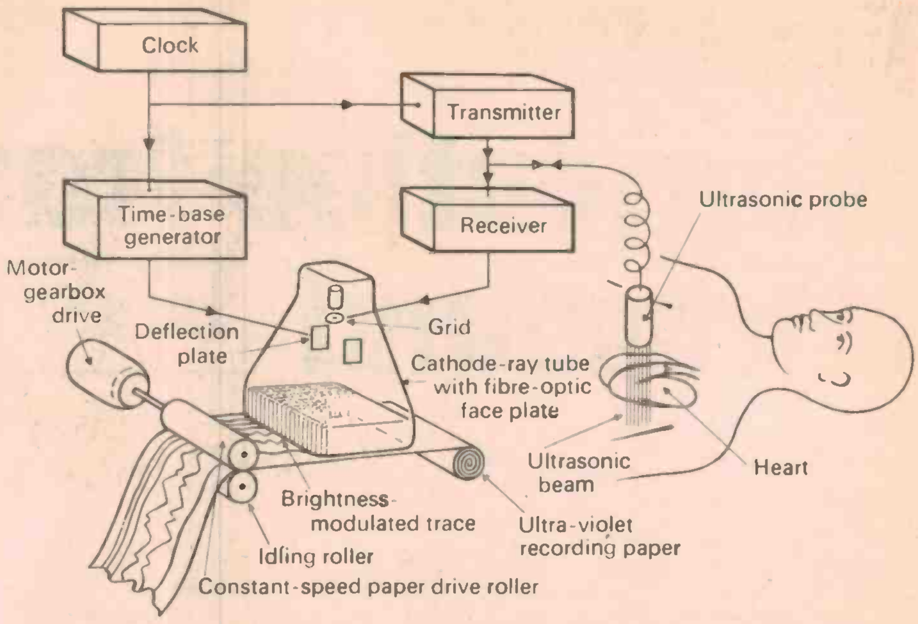


Basic arrangement of the A-scope system, in use in this instance to show the mid-line structures of the brain in their relative position half way between the sides of the skull, as indicated by symmetry of the deflections of the cathode-ray tube trace. Asymmetrical spacing of the deflections may mean that disease has brought about a physical change such as a tumour on one side of the brain. The swept-gain generator gradually increases the receiver amplification over each sweep of the time base to compensate for the attentuation of the deeper echoes by intervening tissues.

Inside information from ultrasound

The characteristic impedances of soft tissues are similar, so the echoes from their boundaries are very small. For example, only about 0.5 per cent of the energy striking the boundary between kidney and fat is reflected. Such echoes are largh enough to be detected by a sensitive receiver. But almost all the energy crosses the boundary and is available for reflection by deeper structures.

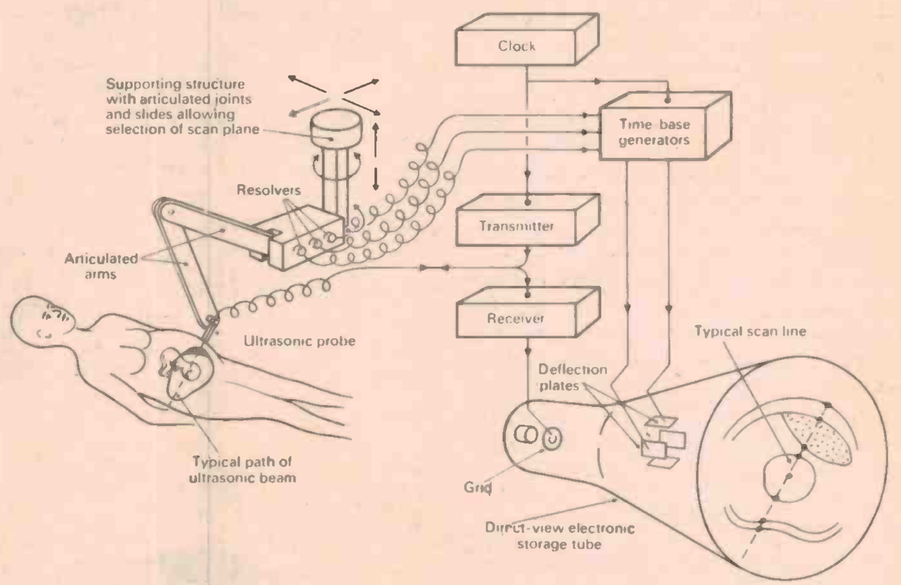
Much larger reflections occur at boundaries between soft tissues and either bone or gas, because of large differences in characteristic impedance. These large reflections restrict the use of ultrasound in medical diagnosis. Moreover, it is necessary to exclude air from between the probe and the patient. This may be done either by examining through a water bath or through a film of oil smeared on the patient's skin.



Time-position recording system based on the B-scope display, shown in use for echocardiography. The fibre-optic face plate of the cathode-ray tube collects enough light to produce a self-developing trace on ultra-violet recording paper.

Resolution

Ultrasonic echo-ranging techniques depend on the measurement of the time interval between the transmission of a brief pulse of energy and the reception of its echo, just as in radar. In any imaging system, whether using light, ultrasound or any other kind of radiation, the resolution is limited by the wavelength of the radiation. It is for this reason that ultrasound, as opposed to sound, is used in medical diagnosis. We need to visualize structures of only a few millimetres in size, so that wavelength has to be around a millimetre or less. In soft tissues, it is about 1.5 1.5 mm at a frequency of 1 MHz and proportionately less at higher frequencies. The highest audible frequency, about 20 kHz, has a wavelength of 75 mm. In principle, the performance might appear likely likely to improve as the frequency is increased. But ultrasound is attenuated as it travels through tissues and the rate of attentuation also increases with the frequency, so we have to compromise between better resolution and reduced penetration.

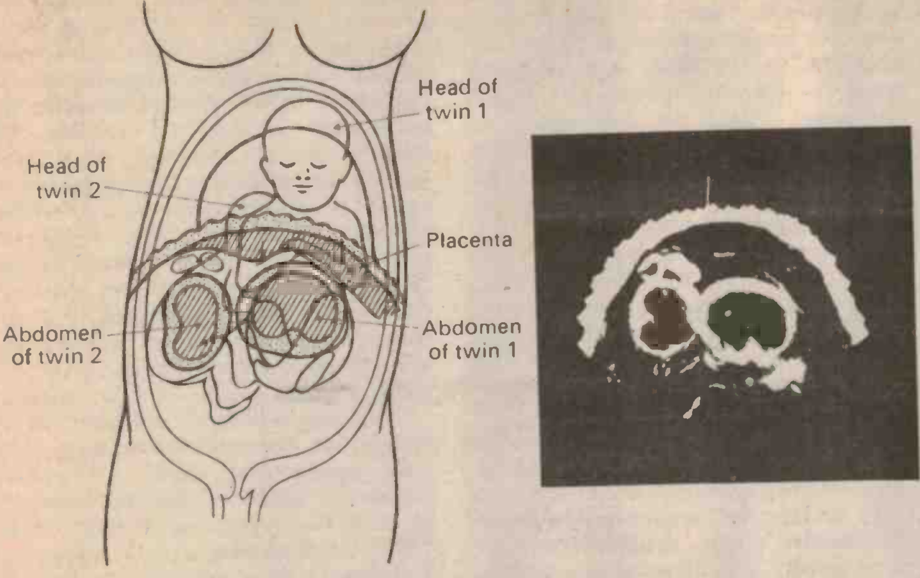


Two-dimensional scanner and B-scope display system studying a foetus. The time-base generators are driven by electrical outputs from a series of resolvers that measure the position of the ultrasonic beam as it moves across the patient. Horizontal and vertical time-bases combine to deflect the spot in such a way that its movement across the display corresponds to the movement of the beam. Echoes received as the probe moves over the patient produce a cross-sectional image in a plane corresponding to that of the scan. In this example, the image is built up on the screen of an electronic storage tube for direct viewing.

Pulse-Echo Techniques

In an ultrasonic instrument for diagnosis, a probe containing a piezoelectric transducer converts electrical signal into ultrasound waves for transmission into the patient. It does the opposite for echoes.

The simplest type of ultrasonic pulse-echo diagnostic system is called the A-scope. (See Fig. 1). The clock triggers the transmitter, which feeds a brief pulse with a large amplitude to the transducer. Echoes return to the probe from those reflecting surfaces inside the patient that lie along the ultrasonic beam. Electrical signals from the echoes are amplified by the receiver and applied to the vertical deflection plates of the cathod-ray tube; the time-base generator, which is triggered into operation by the clock at the instant the ultrasonic pulse is transmitted by the probe, is connected to the horizontal deflection plates to drive the spot on the display at constant speed from left to right. In this way the beam sweeping across the display is deflected vertically at intervals along the horizontal axis, corresponding, in distance from the start of the sweep, to echo-producing surfaces at various distances along the ultrasonic beam. A special circuit in the receiver increases the amplification of the deeper echoes to compensate for their attentuation by



A two-dimensional scan (right) reveals twins at about 25 weeks of pregnancy. The placenta on the anterior wall of the uterus is clearly defined while the abdomens of the twins, identified in the explanatory diagram, appear in section.

intervening tissues. The clock operates at a repetition rate fast enough to give a flicker-free trace on the display.

The A-scope has clinical applications in neurology, ophthalmology and internal medicine. It allows the depths of echo-producing surfaces to be measured, and the characteristics of echoes from within structures to be studied.

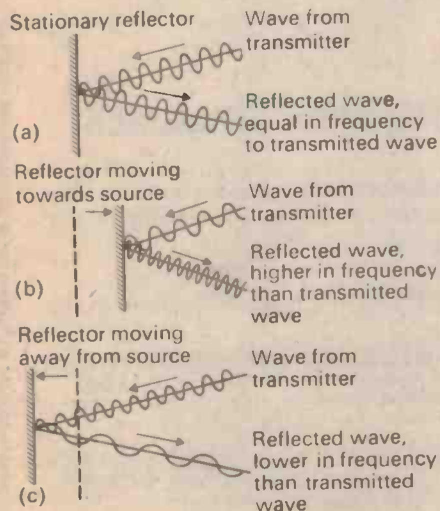
Echoes from moving structures, such as the valves of the heart, oscillate in position along the horizontal axis, or time base, of the display. In cardiology particularly, patterns of movement can give diagnostic information. They can be studied by making recordings with the aid of a B-scope display (see Fig 2). In the B-scope, the time-base sweep is normally invisible, but it is brightened by returning echoes to produce spots of light on the display in places where, on an A-scope, there would be deflections of the beam. The positions of the spots of light correspond to echo-producing structures in the patient, and the pattern of their movements can be permanently recorded.

Cross-Sectional Images

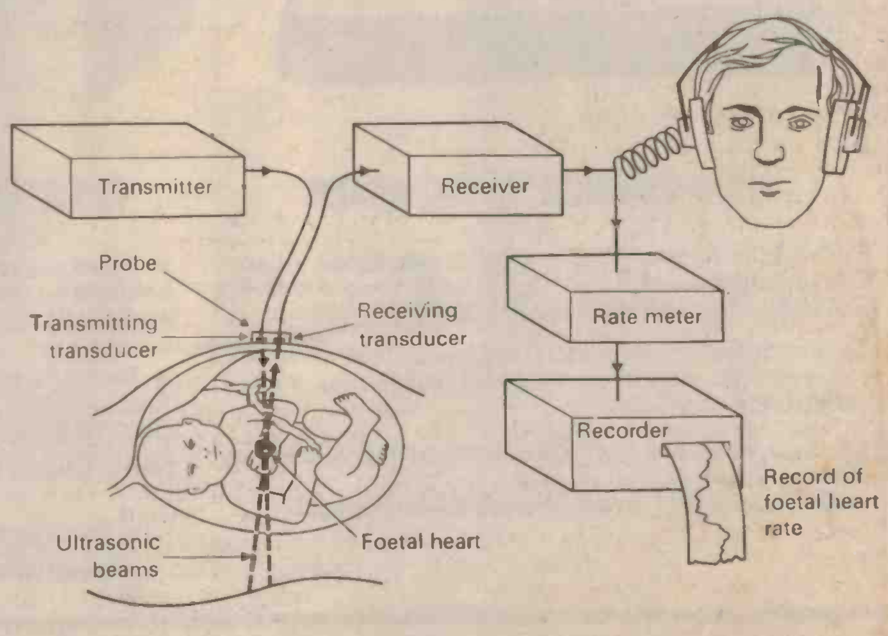
The B-scope forms the basis of another display method, the two-dimensional ultrasonic scanner (see Fig. 3). The ultrasonic probe, instead of being held in the hand, is mounted on a scanner. It can be moved to any position in a two-dimensional plane. In this way it is possible to arrange for the beam to pass through structures lying in a chosen plane within the patient, while the position of the probe and the direction of the beam are measured continuously by 'resolvers' mounted in the scanner. The electrical signals from the resolvers control two time-base generators, driving the vertical and horizontal beam deflection plates of a cathode-ray tube. The direction and position of the ultrasonic beam across the patient controls the position of the cathode-ray beam showing up on the display, related to the positions of the echo-producing surface.

A cross-sectional image of the surfaces can be built up photographically by a camera with an open shutter that records the bright spots on the display while the patient is being scanned. The echo information can also be stored electronically.

Two-dimensional scanners in which the probe is moved in contact with the patient produce individual images in scanning times of about 10 seconds, Images can be produced at a much faster rate by moving the probe mechanically. Images in rapid succession allow physiological movements to be studied; their main importance is in cardiological diagnosis. But although these rapid mechanical scanners produce so-called real-time images, they lack flexibility. This difficulty can be overcome by using ultrasonic probes containing many separate transducer elements, operated



The Doppler effect occurs when a wave is reflected from a moving surface, giving an upward or downward 'shift' in frequency as in (b) and (c).



One use of the Doppler 'shift' is to monitor the foetal heart. The echoes usually fall in the range of audible frequencies.

Inside information from ultrasound

separately or in groups, which can produce ultrasonic scans made up of parallel lines or of lines arranged in a fan shape, at frame rates of tens per second.

As well as making it possible to study rapidly moving structures, real-time scanners can also be used to explore large volumes of anatomy in a short time. A doctor using one can examine a patient in about a quarter of the time it takes with a 'conventional' two-dimensional scanner.

The frequency of an ultrasonic wave reflected from a stationary structure is equal to that of the incident wave. If the beam is reflected by a surface which is moving towards the ultrasonic source, the reflected wave is compressed into a shorter space. This means that the wavelength is reduced. It shows as an upward 'shift' in its frequency. Reflection by a surface moving away from the source gives a downward shift. This phenomenon, the well-known interactions between ultrasound and Doppler effect, conveniently gives shift frequencies that fall in the audible range when ultrasound is reflected by moving structures in the body such as heart valves or flowing blood. A simple instrument based on this makes it possible to detect the movement of the foetal heart. Similar instruments to measure blood flow allow peripheral arterial disease to be assessed.

Because Doppler shifted signals are received only from structures that move, two-dimensional maps of them can be built up by using a Doppler probe to scan the patient. In this way the distribution of blood vessels close to the surface can be studied. Such information may be obviate the need for X-ray angiography, which is a dangerous and expensive procedure.

It can also be combined with other information about structure position obtained by the pulse-echo method, making it possible to map out blood vessels within the body and measure the rate of blood flow at the same time.

Work being done to improve the performance of the instruments now in use includes basic studies on the bilogical materials, the development of real-time scanners and investigations of techniques for displaying the information. The ultrasonic signals from different tissues may be characteristic of the tissues themselves and in some circumstances it may be possible to identify them. Improved techniques include colour-coding to demonstrate various tissue characteristics, and storing ultrasonic data in a three-dimensional matrix so that any two-dimensional plane can be selected for display. Analysis of Doppler signals from blood flow is another promising field; it may soon be possible to assess the effect of drugs on the cardiovascular system.

The clinical value of ultrasonic techniques has already been proved, but their spread into general, everyday service will depend on the development of instruments that are simple to use. These, paradoxically, may be more complicated than the ones we already have. It will also mean training doctors and technicians to obtain and interpret results. But it is clear that ultrasonic diagnosis is, in many instances, the best and most economical way of getting the information essential to proper care of the patient. ●

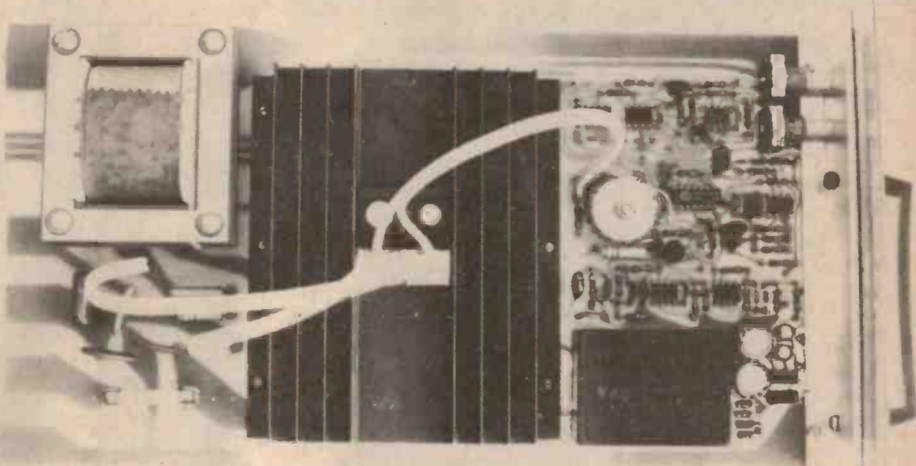
THEATRICAL LIGHTING CONTROLLER

Pt.4 Final Details

THIS MONTH WE FINALISE the series on dimmers with the mechanical description of the control desk. Although the mechanical drawings of the rack are too large and complex to reproduce here, and some parts, like the 20A edge connector, are specially made, we have made arrangements with Nebula Electronics Pty. Ltd. to supply these items. If the dimmer modules are not required to be connected through sockets, the total cost can be reduced by connecting directly to the modules and mounting them in a box. In the 20A unit the heavy wires, should be bolted on to the appropriate pads to ensure contact to both sides of the board.

One modification we have made to the control desk is the addition of a black-out switch which allows all lights to be blacked out without moving the master control. This is simply done by switching the supply voltage on the master potentiometers from the -8V supply as set by RV3 to 0V. RV3 should be adjusted such that with one master at maximum, the second at minimum and one individual control at maximum that its output voltage should be + 10 volts.

With the dimmer module the trim potentiometer has to be adjusted so that the output pulse from IC7 occurs at the very end of each half cycle as shown in Fig. 3 (page 69, Dec 77). This is easiest set using an oscilloscope although an approximate setting can be made without one.



If the dimmer is connected up to a reasonably heavy load and adjusted for about 1/3 level it will probably be found that with RV3 at one end the light level is not stable and tends to flash. This is caused by the sync pulse occuring after the end of the half cycle and the trigger pulses from the previous half cycle triggering the next. The trim potentiometer RV3 should be turned back about ¼ turn from the position at which this effect stops.

When adjusting the maximum and minimum levels the minimum should be adjusted first. Note that the control potentiometer must be slightly up off zero to get any light and minimum should be adjusted at this point. The maximum should be adjusted with both the master and individual control at maximum and set to the point where the light level is just starting to drop.

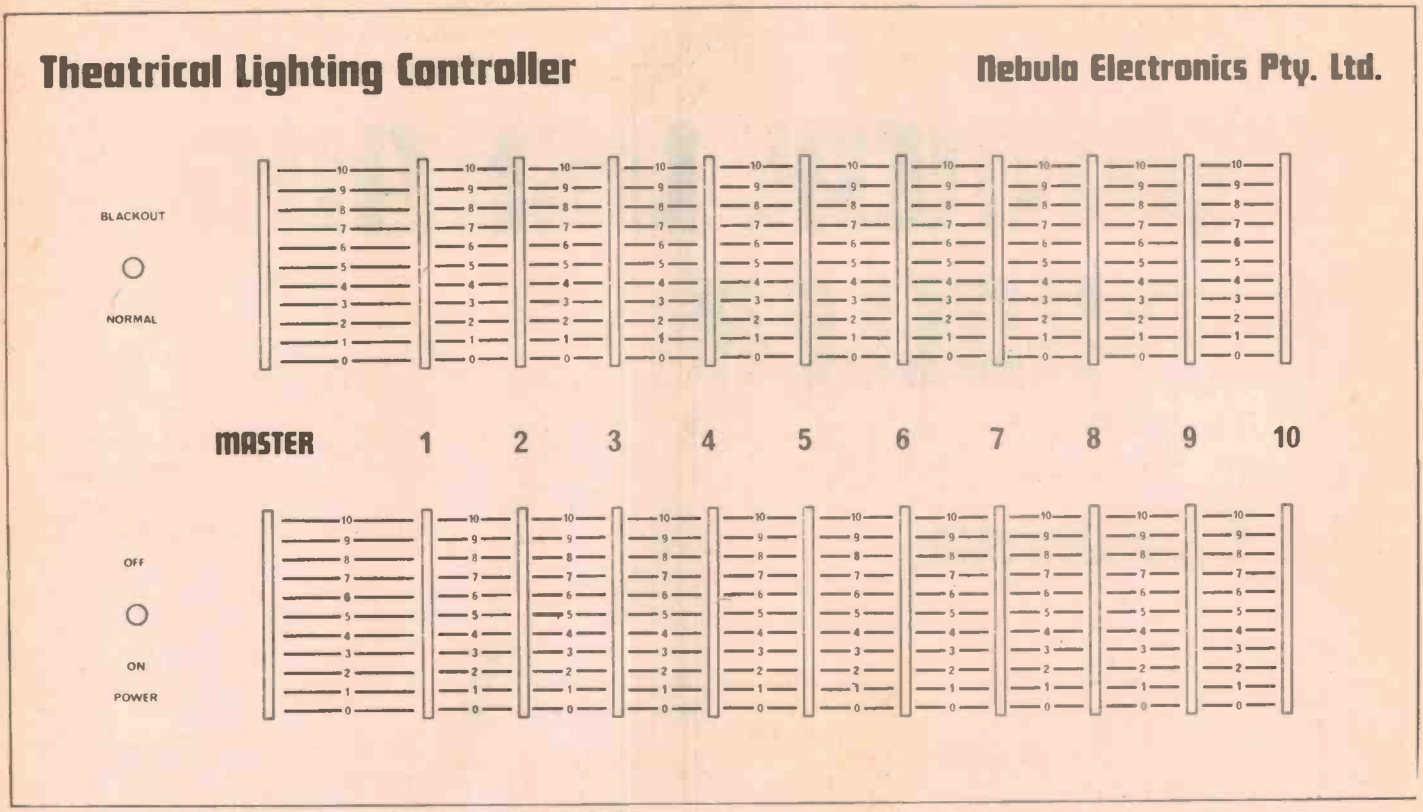


Fig. 1. The front panel artwork for the 10 way control desk. Full size is 440 mm x 250 mm.

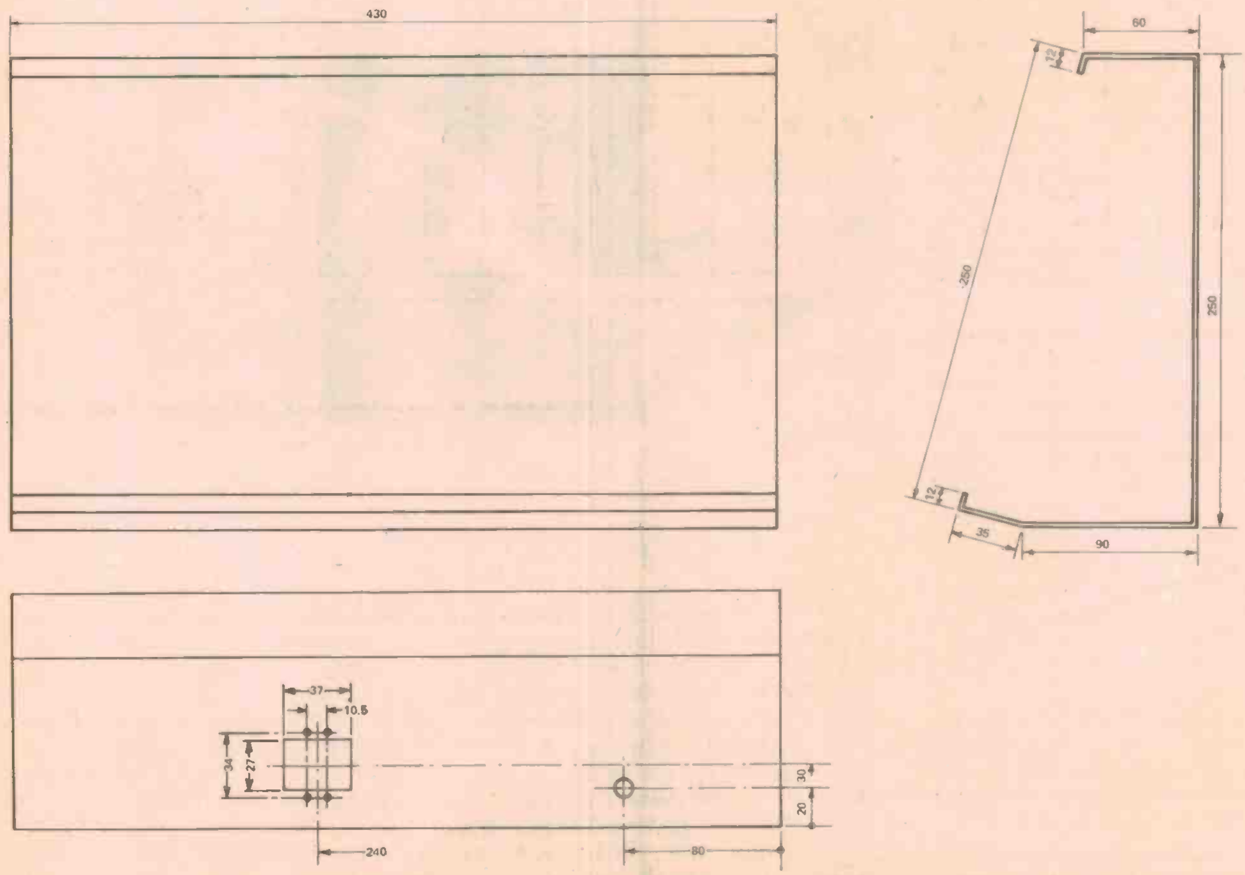
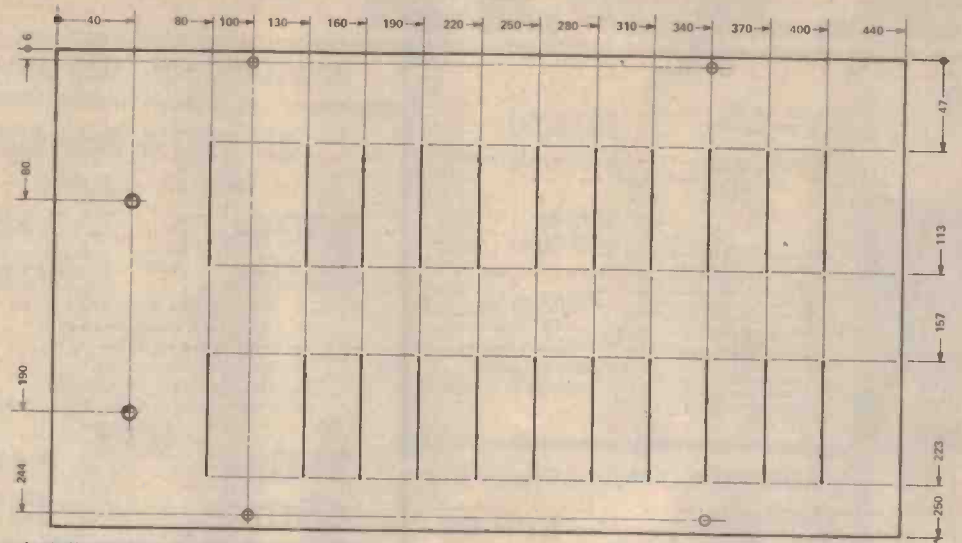


Fig. 3. The control desk box dimensions.



NOTES:

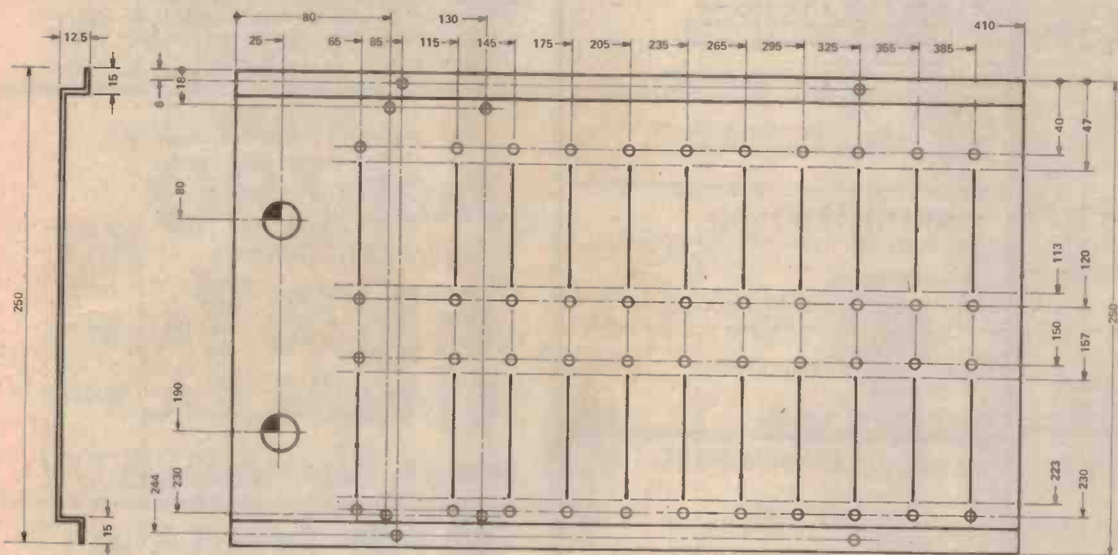
2 HOLES 6.4mm DIA.

O 4 HOLES 3.5mm DIA.

22 SLOTS 66mm x 3mm

MATERIAL: 1.6mm ALUM. SATIN ANODISED

Fig. 2. The mechanical dimensions for the front panel.



NOTES:

2 HOLES 19mm DIA.

O 56 HOLES 3.5mm DIA.

22 SLOTS 66mm x 3mm

MATERIAL: 1mm STEEL, PLATED

Fig. 5. The potentiometer support panel.

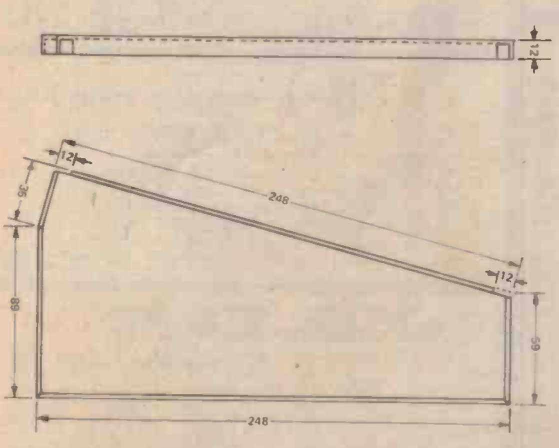


Fig. 4. The end pieces for the box. These should be fitted into the ends of the box as shown in Fig. 3. The two ends should be of opposite hands.

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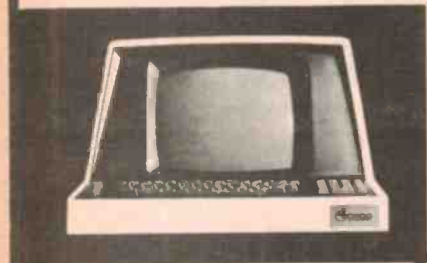

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6834P	16 95
6850P	9 95
6852P	11 95
6860P	14 95
6862P	17 95
6880P	2 70

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3882	12 95

F-8 SUPPORT DEVICES

3851	14 95
3853	14 95

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MCM6575	14 75

STATIC RAMS

STATIC RAMS		1-24	25-99	100
21L02	(450)	1 50	1 40	1 25
21L02	(250)	1 95	1 80	1 50
21L11		4 25	4 10	3.95
1101A		1 49	1 29	1 10
2101 1		2 95	2 75	2.60
2102		1 25	1 15	1 00
2102 1		1 50	1 30	1.15
2111 1		4.00	3.50	3.25
2112 1		3 00	2 80	2 69
2114		17 95	16.95	16 50
4200A		12 95	12 50	11.95
5101C-E		11.95	11 25	10.25

WAVEFORM GENERATOR

8038	4 00
MC4024	2 50
566	1 75

KEYBOARD CHIPS

AY5-2376	13 95
AY5 3600	13 95

PROM'S

1702A	5 00
2704	15 00
2708	13 00
2716	38 00
3601	4 50
5203AQ	4 00
5204AQ	6 00
6834	16 95
6834 1	14 95
82S23B	4 00
82218	2 70

DYNAMIC RAMS

1103	1 50
2104	4 50
2107A	3 75
2107B	4 50
2107B-4	4 00
TMS4050	4 50
TMS4060	4 50
4096	4 50
4116	42 00
MM5270	5 00
MM5280	6 00
MCM6605	6.00

UART'S

AY5 1013A	5 50
AY5 1014A	8 95
TR-1602A	5.50
TMS 6011	6 95
IM 6402	10.80
IM-6403	10 80

MISC. OTHER COMPONENTS

NH0025CN	1 70
NH0026CN	2.50
NBT 20	3 50
NBT 26	2.45
74367	.90
DM8098	.90
1488	1.95
1489	1.95
D-3207A	2.00
C-3404	3.95
P-3408A	5.00
P-4201	4.95
MM-5320	7.50
MM-5369	1.90
DM 8130	2.90
DM8131	2 75
DM 8831	2.50
DM 8833	2.50
DM-8835	2.50
SN74LS367	90
SN74LS368	90

KIM

KIM 1	245 00
6502	12 95
6520	9 00
6522	9 25
6530-002	15 95
6530-003	15 95
6530 004	15 95
6530-005	15 95

USRT

S 2350	10 95

LATE ADDITIONS

TMS 4044	$14.00
TMS 5501	$24.95

FLOPPY DISC CONTROLLER

17718	55 95
17718-01	59.95

TV-1 VIDEO INTERFACE

You will want to know about the TV-1 Video to Televisior Interface Kit.
No need to buy a separate Video Monitor if you already own a TV set. Just connect the TV-1 between your system video output and the TV set antenna terminals - that's all there is to it - to convert your TV set to a Video Monitor, and at a much lower cost! PRICE $8.95

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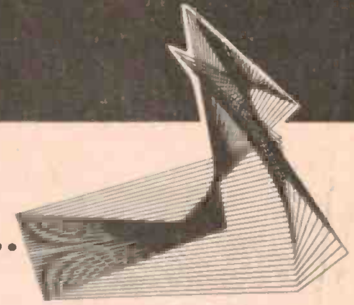
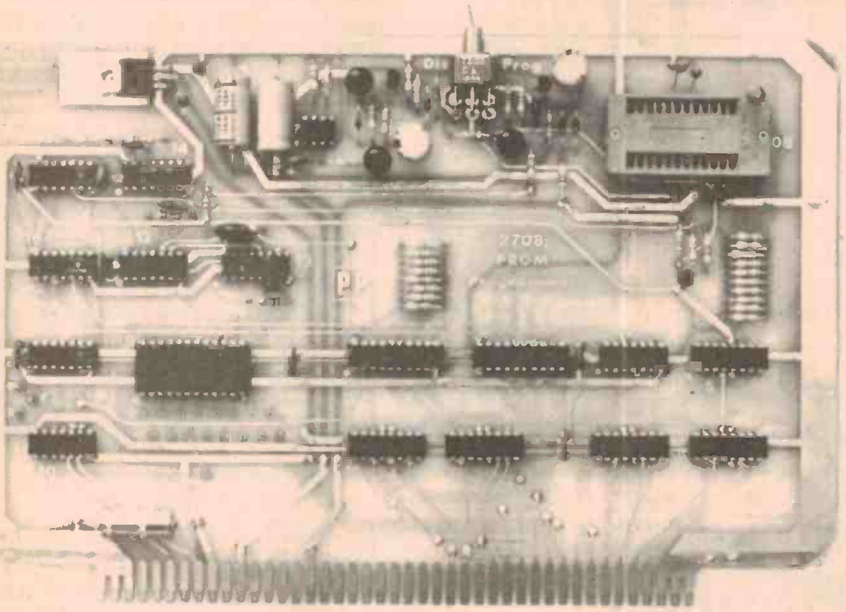
PRINTOUT

ETI's COMPUTER SECTION

NEWS





2708 Programmer

Pennywise Peripherals have just released an economical PROM programmer for 2708 EPROMs.

The programmer is built on a single printed circuit board which plugs directly into the motorola bus. Due to its novel design, the programmer is particularly easy to use. It looks, to the microprocessor, just like ordinary memory. Reading simply reads out of PROM. Writing feeds the data to the addressed location in the EPROM and applies a programming pulse; the correct setup and hold times are automatically inserted and a busy flag indicates when pulsing of the location has been completed.

Thus to program an EPROM the microprocessor simply block moves data to it from RAM or another EPROM.

The programmer allows the EPROM to be test read at any time during programming. Also, a program can be executed from an EPROM when plugged into the programmer. The EPROM plugs into a zero insertion force socket and a write disable switch protects the EPROM from accidental programming. The supply voltages required are +5, +12 and -12. All others are generated on board.

NEC 64 K RAM

Nippon Electric Company are in the process of shrinking a two-level poly-silicon 64 K dynamic RAM to a size that will make economic volume production feasible. Release is tentatively scheduled for 1979 of two versions: one a 64 K by 1 version in a 16-pin pack and the other a 22-pin 16 K by 4.

Blowing Bubbles Smaller

IBM is reported to have fabricated a bubble memory which is up to an order of magnitude denser than previous devices. Their 1 K experimental chip uses the magnetic bubble lattice concept – this is the first time it has been tested in a working device.

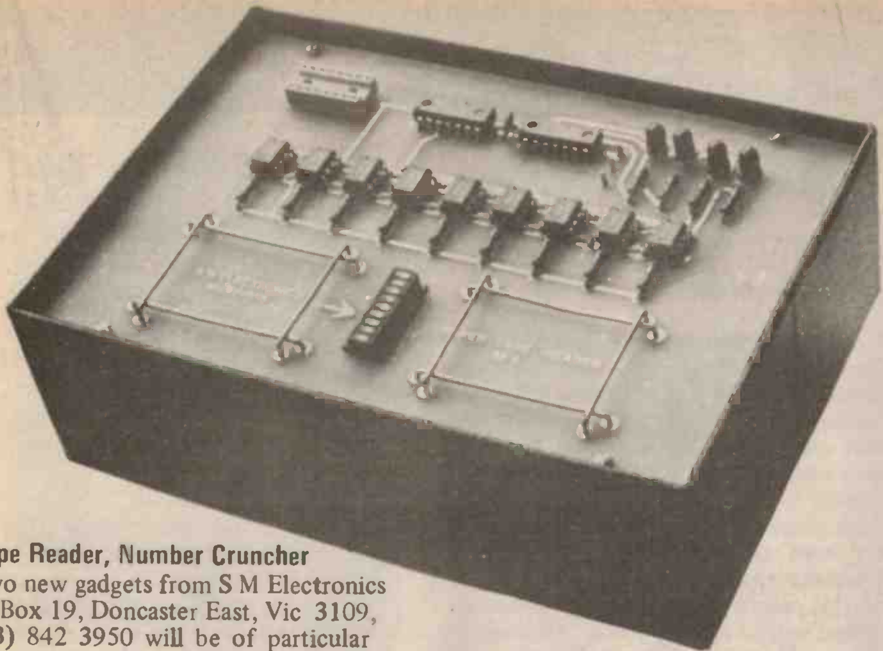
More on Z8, Z8000

Zilog have released more information on the Z8 single chip microcomputer. Featuring 130 instruction combinations (against the Z80's 158), the Z8 runs at 4 MHz and packs 144 registers, four 8-bit I/O ports, 2 Kbytes of ROM and 128 bytes of RAM onto the chip, as well as two counter/timers, four hand-shaking lines, and a UART (not two pins attached to the accumulator, but a genuine UART). The Z8 can also address another 62 Kbytes externally. How it gets all that I/O, control, address and data signals through 40 pins is a mystery yet to be revealed.

The Z8000 16-bit microprocessor lies at the top end of the market. Addressing up to 8 Mbytes directly, the Z8000 can be teamed up with a matching memory management chip which will provide relocation and memory protection. Its 418 instructions include 16-bit multiply and divide, as well as powerful string manipulation functions. All 16 16-bit registers can be used as accumulators, and all but one can be index registers. Among its other tricks is the ability to handle 32-bit words, plus all the usual trap and interrupt handling. Since the Z8000 is bus-compatible with the Z8, it can use that micro as a general-purpose peripheral controller. No pricing info yet, but I'll bet a lot of computer hobbyists are preparing to hock themselves to the eyeballs!

32K EPROMs Emerge

Texas Instruments have started sampling 32K EPROMs in a 24-pin package, type number 2532, and have sparked off a debate in the industry regarding standard pinouts. Intel are apparently proceeding with a different pinout on their 2732, although both were on the JEDEC committee to standardise 32K EPROM pinouts. Intel claim their pinout is more compatible with upcoming microprocessors. We'll just have to wait and see which part becomes the industry standard. Early indications are that it will be the TI part.



Tape Reader, Number Cruncher
Two new gadgets from S M Electronics of Box 19, Doncaster East, Vic 3109, (03) 842 3950 will be of particular interest to readers of this column. Their high speed paper tape reader is of the 'pull-through-and-run' variety, which interfaces to an 8-bit parallel port. Supplied with 8080 or 6800 software, the tape reader uses available light shining through the tape holes to drive a sensor array. Correct operation is monitored by 4 status LEDs and interfacing is through a flat cable and plug which are supplied with the unit. Kit price is $75.00 and assembled it's $95.00, post free in Australia. Handy when dealing with people who supply software on paper tape, whereas you use CUTS.

The other new goody from S M Electronics is their Number Cruncher Kit, which puts a National Semiconductor MM57109 Number Cruncher IC onto a PCB along with the necessary interface electronics to get it to work with a micro. The kit is supplied complete with an Application Note and Data Notes, so that the user knows how to use it, and assembly looks darn near fool-proof. The edge connector is a 24-pin type, which fits no computer bus that we've ever heard of, but it should work with most processors with only slight modifications, if any. So if you want to do some decimal arithmetic, here's the board you want.

CRT Controller IC
Fifth away from the start in the great CRT controller race, National Semiconductor is powering up the straight with the DP8350, now being sampled to customers in the US and Europe. According to National, the device is unique in having an on-chip crystal-controlled clock oscillator and on-chip character generator.

iCOM Attache
iCOM, a division of Pertec Computer Corp., who own MITS (remember MITS?), have announced a new desktop personal computer. The Attache looks remarkably like a Sol built into a fibre-glass attache case, and is S100 based. More details as soon as we get them.

COMPUTER CLUB DIRECTORY

Sydney: Microcomputer Enthusiasts Group, P.O. Box 3, St. Leonards, 2065. Meets at WIA Hall, 14. Atchison St., St. Leonards on the 1st and 3rd Mondays of the month.
Melbourne: Microcomputer Club of Melbourne, meets at the Model Railways Hall, opposite Glen Iris Railway Station on the third Saturday of the month at 2 p.m.
Canberra: MICSIG, P.O. Box 118, Mawson, ACT 2607 or contact Peter Harris on 72 2237. Meets at Building 9 of CCAE, 2nd Tuesday of month at 7.30 p.m.
Newcastle: contact Peter Moylan, Dept. of Electrical Engineering, University of Newcastle, NSW 2308. (049) 68–5256 (work), (049) 52–3267 (home).
Brisbane: contact Norman Wilson, VK4NP, P.O. Box 81, Albion, Queensland, 4010. Tel. 262 1351.
New England: New England Computer Club, c/- Union, University of New England, Armidale, NSW 2351. (New club; not restricted to students)
Auckland: Auckland Computer Club, P.O. Box 27206, Auckland, N.Z.

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

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

PRINT OUT

Radio Shack TRS-80

Probably the big news this month as far as Print Out is concerned is the Australian release of the Radio Shack TRS-80 microcomputer, which will be marketed through Tandy stores. We'll be bringing you a full, in-depth report in the next issue (we'll also have some good stuff on PET 2001), but meanwhile, here's some info on TRS-80, based on initial impressions after a few days' use.

Better than we expected. The TRS-80 isn't a hobby computer, (although an S100 adapter will be available later in the year), it's a home computer, and so is quite docile and tame. The 4K BASIC supplied in ROM is surprisingly powerful (this may be due to the compactness of Z-80 code) and includes a pretty full complement of BASIC commands, functions and statements. String handling is a bit weak, with only two string variables, A$ and B$ (just enough to hold two names for a game). In addition, I'm darned if I can get 'IF A$ = 'YES' THEN 50' - type statements to work!

On the other hand, it does have DATA statements, GOSUB, ON N GOTO, PRINT AT, TAB, INT, ABS, RND, a bunch of relational operation and logical operators. A number of graphic statements are also included to set or reset a graphics location on the screen or to test its status (on or off). All in all, it's quite good for a 4K BASIC, though it doesn't offer the same facilities as more advanced BASIC's, obviously.

The User's Manual seems pretty good, written in a light, humorous style. If you already know BASIC, it's a bit difficult to be patient with all the short examples, though. Anyway, a full report of what we discovered will follow next month. In the meantime, for anyone who's already got a TRS-80 and is looking for a user's group, try sending a self-addressed envelope and IRC (International Reply Coupon) to: R Gordon Lloyd, 7554 Southgate Road, Fayetteville, NC 28304, USA, who is (we hear) forming a group in the US. Don't know of anyone in Australia yet, perhaps will let us know if something's brewing?

Book Reviews

This month we look at two books and a magazine, which were supplied by Computerland, 55 Clarence St, Sydney. So if you want to buy them, now you know where to go.

Your Home Computer, *by James White, Dymax, $9.95.* This book is aimed at the computer tyro – the person who knows nothing about home computers, but has seen one and is very curious, perhaps even wanting to buy one already. After reading Your Home Computer, even the most sceptical will be converted – it's the kind of book that's filled with infectious enthusiasm.

The approach the book takes is almost totally non-technical, although it does discuss microprocesoors in considerable detail and introduces terms like RAM and ROM before really intrducing the home computer proper. The hardware describer is mainly oriented to the American market, but is discussed in general terms, and many of the units are now available in Australia.

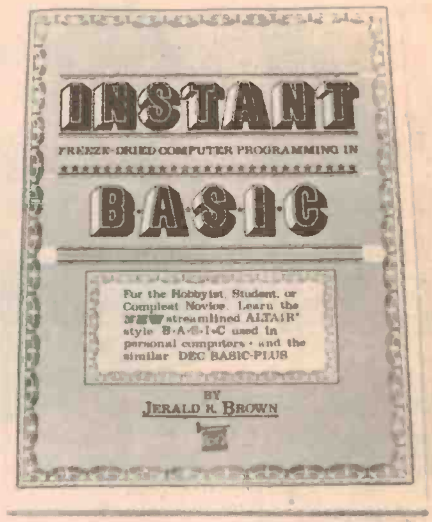
There is very little on the subject of software, but there are plenty of other books on the subject, and in any case, a computer is a necessity when learning programming, whereas most readers of this book will not yet own one.

The book really comes alive for me towards the end, where Mr. White starts to discuss various applications for home computers, including games, fine arts, education, amateur radio, robots, electric trains, financial record keeping, stock market analysis, home environment control and many more. Once you've got your computer, and are wondering what to do with it, this is just the kind of stimulus that will make you a computer user, and not a computer builder.

The book finishes with lists of useful (US) addresses, including periodicals, clubs and computer stores. If you are titillated by home computing, but not yet galvanised into action, this is the book to do it. Highly recommended for the beginner.

Instant Freeze-dried Computer Programming in BASIC, *by Jerald R. Brown, Dymax. Subtitled: For the Hobbyist, Student, ot Compleat Novice. Learn the NEW streamlined ALTAIR style BASIC used in personal computers and the similar DEC BASIC PLUS.*

Well, you've bought your computer, some RAM, tape interface, terminal and now you've got a BASIC interpreter. Where do you go from here? This book



provides the answer, in the form of an 'active participation' workbook, which will take you from scratch right up to subscripted variables, arrays and subroutines with no pain.

The style of this book is virtually indescribable, a kind of Whole Earth/ Cole's Funny Picture Book / People's Computer Company / What to Do After You Hit Return mixture. This is used to good effect with all kind os crazy graphics which exhort the reader to 'READ' when he should read, and 'DO IT' when he should attempt an example. And do it he must – this book is designed to be used with a computer. There are lots of little program examples to try out.

Most BASICs come with a manual, and some are very good for beginners, but if you haven't got a manual, or it's not very good, or you're just interested, Instant BASIC gives good value.

Calculators/Computers Magazine, *edited by Don Inman, Dymax, $4.50 per copy.* Dedicated to the application of calculators and computers in the classroom, this magazine is aimed mainly at teachers, although a large proportion of it is suitable for duplication and distribution to classes. The style is rather like 'Instant BASIC', with lots of graphic designs and large arrows saying 'COPY ME'. Amongst the articles in Vol 1, No. 2 are ones on classroom computer games, introducing calculators to junior school classes, Simpson's rule on a hand calculator, the computer game UPS, BASIC subscripted variables, teaching using computers and PET.

Although the slant is mainly to education, Calculators/Computers is well worth having for the computer games alone. Teachers and educators just can't afford to be without it.

PRINTOUT

Extra M6800 Instructions

This useful hint was sent to us by David Craig of Holland Park, Brisbane. All you 6800 users out there can have hours of fun trying these out!

The Motorola M6800 provides 72 executable instructions. These require 197 different op-codes when all the allowable addressing modes for each instruction are taken into account. To provide this number of op-codes the 6800 uses an 8-bit word length which can specify two to the eighth (i.e. 256) op-codes. Motorola's literature says that only 197 are valid, and that the other 59 are 'unimplemented'. But are they?

The answer to this question is a definite no! It appears that only four of the 59 op-codes that Motorola does not define are actually invalid. The other 55 are executed quite happily by the 6800 and produce well defined results. 26 of these op-codes simply provide alternative codes for already defined operations. The remaining 29 provide operations which have not been defined by Motorola. Some of these extra instructions which are available are potentially quite useful.

In particular, a number of additional test instructions form a useful supplememt to the Bit Test and Test Zero or Minus instructions of the 6800. For example, the op-code 45 which performs a test logical right shift of the A accumulator can be used to test whether the contents of A are odd or even by examining the carry bit (C) after executing the test instruction. The test instructions perform the operation on the data in the nominated registers and alter the condition codes accordingly, but leave the original registers unchanged.

The op-codes 14 and 1A which provide the logical AND and OR respectively of accumulators A and B should also prove useful.

It is doubtful that most of the other extra instructions are particularly useful, though in certain circumstances they could find use in saving an instruction or two. The group of op-codes 87, C7, 8F, CF, 3A would require extreme care in their use because of their somewhat odd results.

For the benefit of 6800 users the 55 'unimplemented' op-codes and their definitions are listed below. All the op-codes are in hexadecimal.

A. Actual invalid op-codes: 3C, 3D, DD, 9D — stops processor operation, reset required to regain control.

B. Alternative op-codes for existing defined operations:.

NOP	00, 02, 03, 04, 05, 38, 4E, 5E
DAA	18
TBA	1E
BCS	21
COMA	42
COMB	52
COM	62 (Indexed), 72 (Extended)
NEG	61 (Indexed), 71 (Extended)
LSR	65 (Indexed), 75 (Extended)
CPX	EC (Indexed), DC (Direct), CC (Immediate), FC (Extended)
BSR	CD
JSR	ED (Indexed), FD (Extended)

C. Additional executable op-codes:

Op Code	Addressing Mode	Boolean/Arith Operation	H	I	N	Z	V	C	
			Cond. Code Reg.						
Logic Ops									
14	Implied	A.B → A	.	.	↕	↕	R	.	
1A	Implied	A+B → A (OR)	.	.	↕	↕	R	.	
1F	Implied	B → A	.	.	↕	↕	R	S	*
Arith Ops									
12,13	Implied	A−B−1 → A	.	.	↕	↕	↕	↕	
83	Immediate	A−M−1 → A	.	.	↕	↕	↕	↕	
93	Direct								
A3	Index								
B3	Extended								
C3	Immediate	B−M−1 → B	.	.	↕	↕	↕	↕	
D3	Direct								
E3	Index								
F3	Extended								
10	Implied	A+B → A	.	.	↕	↕	↕	↕	*
1C	Implied	A+B+1 → A	.	.	↕	↕	↕	.	*
48	Implied	A−1 → A	.	.	↕	↕	4	5	*
58	Implied	B−1 → B	.	.	↕	↕	4	5	*
68	Index	M−1 → M	.	.	↕	↕	4	5	*
78	Extended								
Misc Ops									
87	Implied	A → (PC)+2 (PC)+3 → PC	.	.	↕	↕	R	.	
C7	Implied	B → (PC)+2 (PC)+3 → PC	.	.	↕	↕	R	.	
8F	Implied	SP_H → (PC)+2 SP_L → (PC)+3 (PC)+4 → PC	.	.	↕	↕	R	.	
CF	Implied	X_H → (PC)+2 X_L → (PC)+3 (PC)+4 → PC	.	.	↕	↕	R	.	

Op Code	Addressing Mode	Boolean/Arith Operation	H	I	N	Z	V	C
			Cond. Code Reg.					
3A	Implied	(SP+2) → B (SP+3) → A (SP+4) → X_H (SP+5) → X_L (SP+6) → PC_H (SP+7) → PC_L (SP)+1 → SP	.	.	.	.	.	.

Op Code	Addressing Mode	Boolean/Arith Operation	H	I	N	Z	V	C
			Cond. Code Reg.					
Test ops								
15	Implied	A.B	.	.	↕	↕	R	.
41	Implied	00−A	.	.	↕	↕	1	2
51	Implied	00−B	.	.	↕	↕	1	2
45	Implied	A: 0 → [b7 … b0] → C	.	.	R	↕	3	↕
55	Implied	B: 0 → [b7 … b0] → C	.	.	R	↕	3	↕

NOTE: Condition code symbols

- ↕ Test and set if true, cleared otherwise
- . Not affected
- R Reset always
- S Set always
- 1 Set if result = 10000000
- 2 Set if result= = 00000000
- 3 Set equal to result of N + C after shift has occured
- 4 Set if operand = 10000000 before execution
- 5 Set if operand = 00000000 before execution
- * Condition code result differs from similar existing operation

Project 639

Computerised Musical Doorbell

Every home should have one — so make it a good one, say T. Long and T. Wooller of Applied Technology.

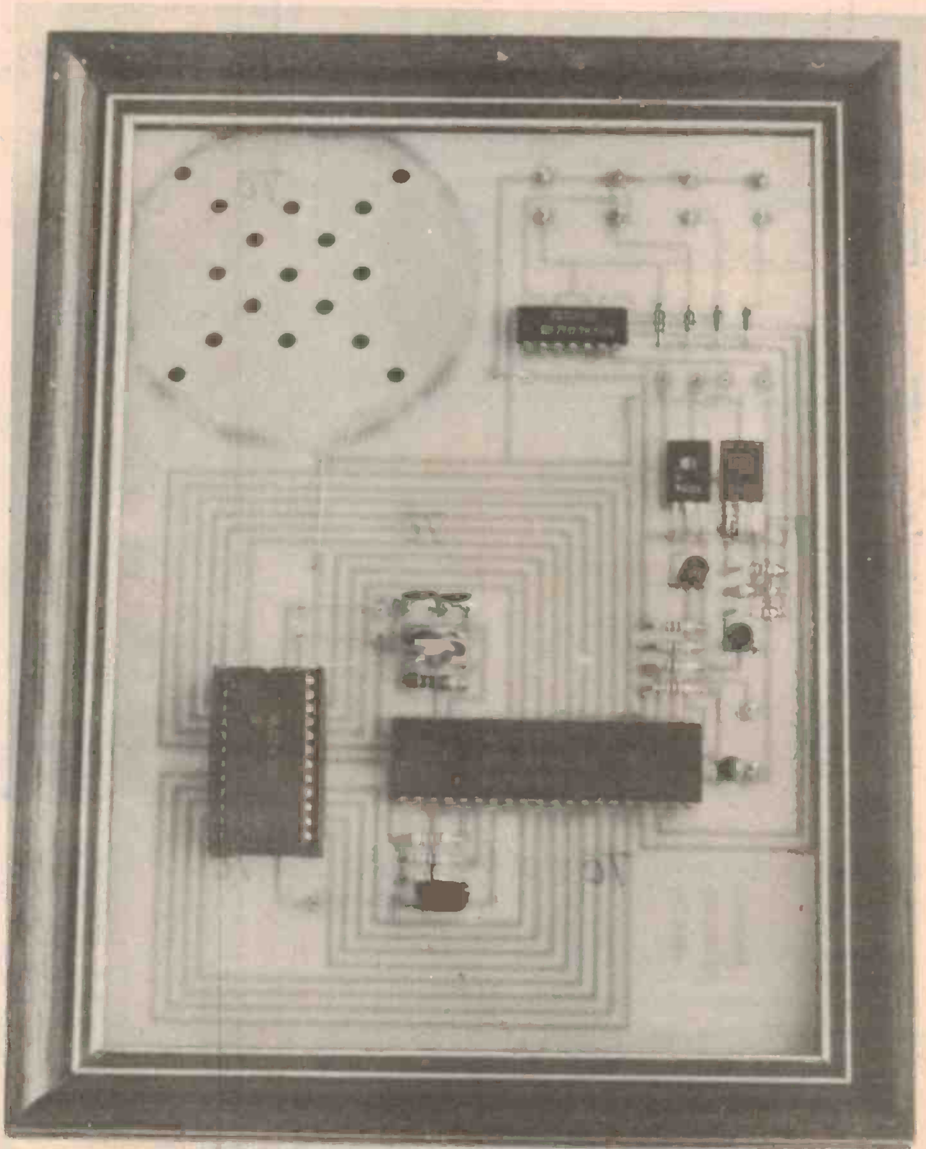
THE ADVENT of the microprocessor is more than just a remarkable technological achievement, it is destined to impact all our lives in the very near future. Instead of large, incredibly expensive computer installations these remarkable devices offer complex computing power at a low cost that is still diminishing.

This article shows how a microprocessor can be used as the basis of a relatively simple device such as a musical doorbell. The finished product is elegantly simple, yet costs little more than the current top-of-the-range electromechanical doorbell on the market today.

From a functional point of view, the doorbell consists of a PCB containing a SC/MP microprocessor, preprogrammed 512 byte ROM, a TTL quad gate package, a handful of resistors, capacitors and transistors and a speaker and battery pack which attach to the back of the board.

The doorbell is programmed to play eight tunes which are selected with various push-buttons and one wire link on the PCB.

The tunes are:
Waltzing Matilda
Greensleeves
Can Can
Rule Britannia
Trumpet Voluntary
Twinkle Twinkle Little Star
Colonel Bogey March
Computer Music



Basic Design Approach

The ETI Microprocessor Doorbell has been designed to demonstrate how effectively a microprocessor can carry out even the most simple tasks. In this

HOW IT WORKS – ETI 639

When a pushbutton is pressed the 74LS00 gate tests which sense inputs of the SC/MP chip are activated. Simultaneously the operation of the pushbutton initialises the SC/MP chip and program execution starts from location 0001. This action also applies temporary power to the SC/MP and the ROM.

The first step carried out by the SC/MP is to set the output at the SERIAL OUT (SOUT) pin to high, which in turn ensures that power remains on when the pushbutton is released.

Next the SC/MP tests the SENSE A and SENSE B inputs and decides which tune has been selected. At this point the tune is played.

On completion of the tune the SC/MP sets the SERIAL OUT pin low and turns the battery supply off. If the pushbutton is still pressed the tune will start again.

Refer to the complete circuit diagram for an indication of how the actual operation is achieved. For those software oriented types the program listing on page 60 could be analysed as a flow chart with assembly listings or suitable description for the machine code.

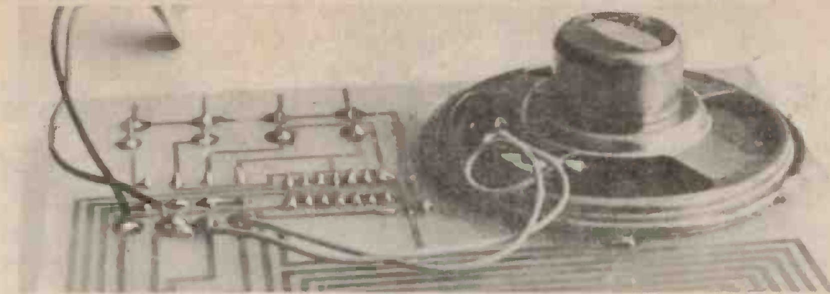


Fig. 1. Speaker Mounting on rear of PCB.

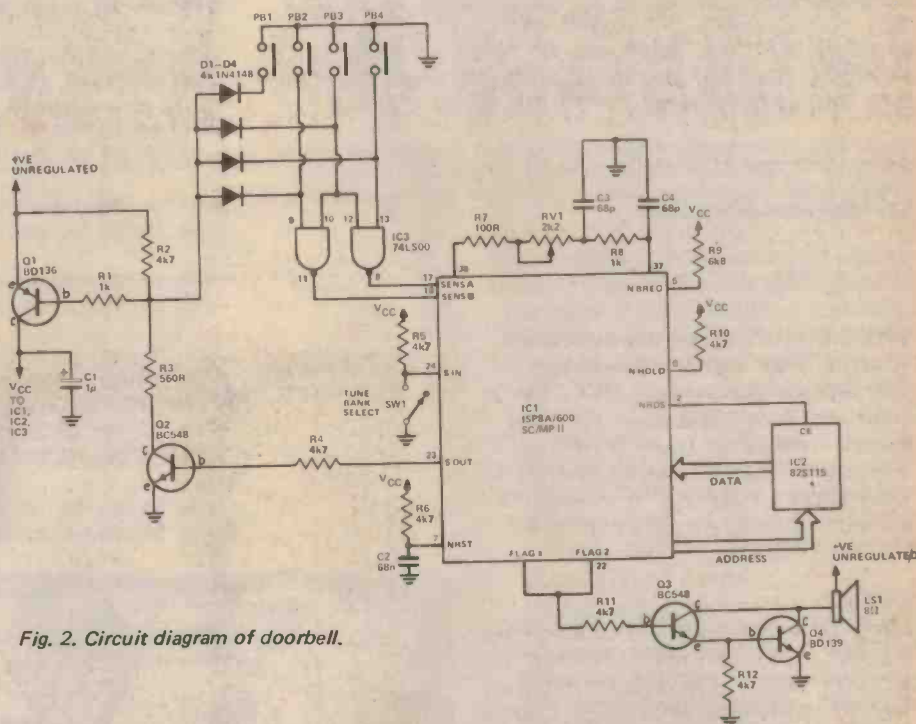


Fig. 2. Circuit diagram of doorbell.

PARTS LIST – ETI 639

Resistors — all ¼W, 5% unless stated

R1	1k
R2	4k7
R3	560R
R4-R6	4k7
R7	100R
R8	1k
R9	6k8
R10-R12	4k7
RV1	2k2

Capacitors

C1	1μ, electrolytic
C2	68n
C3,4	68p

Semiconductors

IC1	ISP8A/600 (SC/MP II)
IC2	82S115 PROM (pre-programmed)
IC3	74LS00
D1-D4	1N4148
Q1	BD136
Q2,3	BC548
Q4	BD139

Miscellaneous

PCB	ETI 639
LS1	8 ohm speaker

10 solder pins, 6V battery, battery connector, picture frame for mounting.

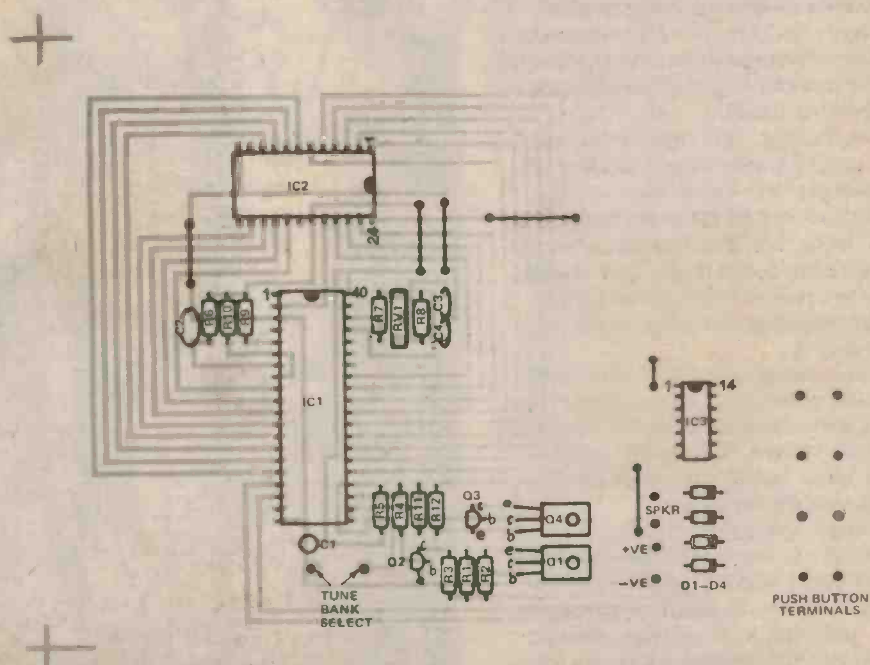


Fig. 3. Component overlay.

```
08, C4, 01, 01, 19, 06, 1C, 1C, 1C, 1C, 01, 1C, 1C, 1C, 1C, 1C,
08, 58, D4, 07, 01, C4, 58, 32. 40, 98, 0D, C6, 01, E4, FF, 9C,

FA, 40, F4, FF, 02, 01, 90, F0, C2, 01, 35, C2, 00, 98, 12, E4,
FF, 98, D0, C4, 07, 07, C4, 00, 8F, 00, C2, 00, F4, FF, 02, 9C,

FB, 07, C2, 00, F4, FF, 02, 9C, FB, 35, F4, FF, 02, 98, 03, 35,
90, D9, C6, 02, 8F, 10, 90, D0, 44, 4F, 44, 4F, 2C, 77, 2C, 77,

27, 85, 27, 85, 2C, EC, 32, 69, 32, 69, 35, 64, 35, 64, 3C, 59,
3C, 59, 44, 9D, FF, 35, 64, 2C, EC, 27, 85, 22, E1, 20, 50, 22,

96, 27, 00, 2F, 70, 3C, 85, FF, 3C, AF, 35, 94, 3C, 16, 35, 19,
2F, A6. 2C, 3B, 2F, 6F, 35, 63, 3C, 58, 35, 63, 2F, 6F, 35, 31,

3C, 2C, 35, 63, 50, 32, 00, 07, 50, 43, FF, 2C, 77, 35, 64, 00,
81, 35, 64, 32, 69, 2C, 77, 19, C6, 00, 2B, 19, C6, 00, 2B, 20,

00, FF, 3C, 59, 3C, 43, 3C, 17, 3C, 59, 48, 4B, 2C, 77, 2C, 59,
2C, 1E, 2F, 6F, 35, 64, 3C, 59, 3C, 43, 3C, 17, 35, 64, 3C, 43,

3C, 17, 3C, 59, 44, 3B, 48, 13, 50, 66, FF, 27, C6, 27, 43, 24,
48, 24, 8F, 27, 43, 24, 48, 27, 43, 2C, 3C, 32, 35, 35, C7, 20,

9F, 24, 8F, 27, 22, 32, 1B, 24, 24, 2C, 1E, 20, 60, 24, 48, 27,
85, 2C, 77, 32, 3C, 32, B1, FF, 2C, 3C, 2C, 3B, 27, 22, 20, 28,

22, 26, 27, 22, 1C, 5A, 1C, 5A, 1C, 2D, 19, 32, 22, 26, 20, 28,
27, 43, 27, 43, 27, 22, 20, 28, 22, 26, 27, 22, 2C, 54, FF, FE,

80, 01, 08, 02, 08, 03, 08, 04, 08, 05, 08, 06, 08, 07, 08, 08,
08, 09, 08, 0A, 08, 0B, 08, 0C, 08, 0D, 08, 0E, 08, 0F, 08, 10,

08, 11, 08, 12, 08, 13, 08, 14, 08, 15, 08, 16, 08, 17, 08, 18,
08, 19, 08, 1A, 08, 1B, 08, 1C, 08, 1D, 08, 1E, 08, 1F, 08, 20,

08, 21, 08, 22, 08, 23, 08, 24, 08, 25, 08, 26, 08, 27, 08, 28,
08, 29, 08, 2A, 08, 2B, 08, 2C, 08, 2D, 08, 2E, 08, 2F, 08, 30,

08, 31, 08, 32, 08, 33, 08, 34, 08, 35, 08, 36, 08, 37, 08, 38,
08, 39, 08, 3A, 08, 3B, 08, 3C, 08, 3D, 08, 3E, 08, 3F, 08, 40,

08, 41, 08, 42, 08, 43, 08, 44, 08, 45, 08, 46, 08, 47, 08, 48,
08, 49, 08, 4A, 08, 4B, 08, 4C, 08, 4D, 08, 4E, 08, 4F, 08, 50

08, 51, 08, 52, 08, 53, 08, 54, 08, 55, 08, 56, 08, 57, 08, 58,
08, 59, 08, 5A, 08, 5B, 08, 5C, 08, 5E, 08, 5E, 08, 5F, 08, FF,
```

Fig. 4. This object code listing of the doorbell program will enable owners of SC/MP based microcomputers to generate tunes. This program is not the same as the one in the PROM as the address lines to the PROM are swapped about.

case the microcomputer is designed to select and play any one of eight tunes; it controls the actual program sequence, turns the battery supply off after every tune and mathematically determines the pitch and duration of each note. The output is monophonic and consists of a square wave driven into a speaker. The actual program and the tunes played are contained in a separate ROM, and other tunes could readily be programmed by selecting a different ROM.

Assembly

Assembly of the doorbell is very straightforward. To minimise costs no sockets are provided and the microprocessor and ROM solder directly into the PCB.

Refer to the PCB overlay drawing and study the location of every component before starting assembly. Start with the resistors and capacitors. Next insert the diodes, watching carefully that the cathode ends of the diodes are correctly oriented.

Now mount the microprocessor, ROM and TTL gate as well as each of the transistors. Take the usual precautions not to overheat individual joints. Note that the microprocessor is fully protected internally and is not nearly as prone to damage as CMOS (but it should be handled carefully just in case!).

Next solder PC pins as indicated for the loudspeaker, battery and pushbutton connections. Now glue the loudspeaker to the rear of the PCB, using epoxy or similar glue. Solder the leads to the correct pins on the PCB.

Recheck the wiring thoroughly and connect the power to the board (taking care to avoid reverse polarity). Now short one of the pushbutton terminals and a tune should be played. Adjust RV1 to give the desired pitch and your doorbell is ready for use.

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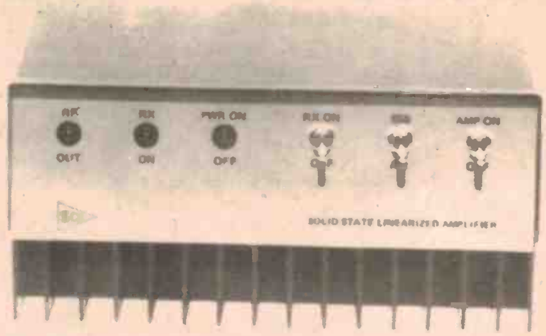

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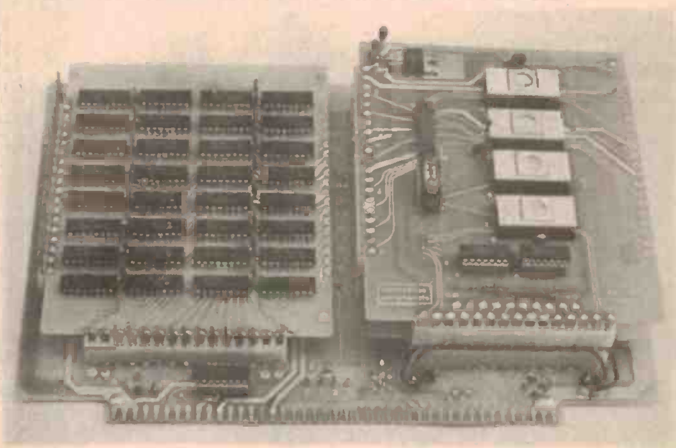

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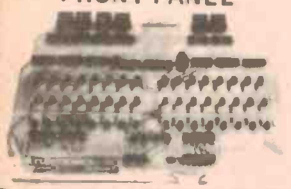

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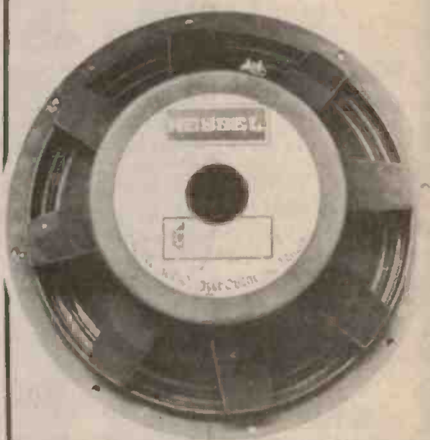

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These characteristics provide several advantages. Unloaded TTL gates provide enough voltage, in either high or low states, to directly drive the universal indicator. Size and weight can be saved in instruments with a number of indicator lights by reducing the size of filter capacitors or voltage regulators. The NSL4944 can operate on unfiltered DC or at somewhat reduced intensity on 3 to 12 VAC. Since the IC within the regulated LED blocks reverse voltage, the device can be used as a low voltage rectifier or polarity indicator.

Equivalent Circuit

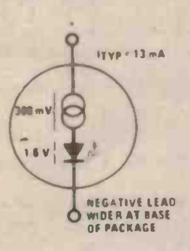

FIGURE 1. Equivalent Circuit

The LED and its current source, as illustrated in Fig. 1, both fit within a standard LED package. The typical operating voltages shown allow the device to operate with lower supplies and take up less room than an LED and resistor.

Features
- Supply range 2 V to 18 V
- Reverse polarity protection
- Constant light output over 3 V
- No larger than normal LED
- 12mA to 14 mA current
- 300 mW dissipation
- Low cost per unit

Schematic

Figure 2 shows how some of the operating features of the device are achieved. The rectifying characteristic occurs because the only input to the device passes through the IC's PNP emitters. These have a high reverse voltage in standard linear processing The voltage reference and comparison amplifier operate from the same low voltage that the LED does. The big PNP transistor which passes both I_{LED} and I_{REF} can be operated almost in saturation since the comparison amplifier can pull the PNP base down to only one volt from common.

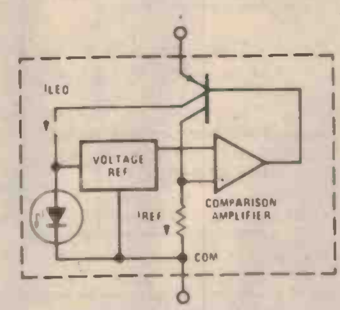

FIGURE 2 Schematic Diagram.

Unfiltered AC

Power and parts count is minimized by powering the indicator from a low voltage transformer winding as shown in Fig. 3. This method, however, provides only half intensity light, but the apparent visual decrease is not as great. Some flicker occurs if the observer moves his head rapidly. The supply of Fig. 4 will provide up to 87% of maximum light output. The bulk of a filter capacitor is still not needed, and at 12 VAC in, flicker will be almost imperceptible since the LED "off" periods will be less than a millisecond. In both situations, the indicator may be switched a number of ways, including bipolar transistors, since only DC can pass through the indicator.

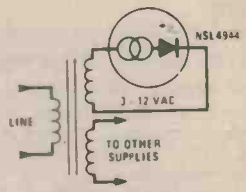

FIGURE 3. AC Power

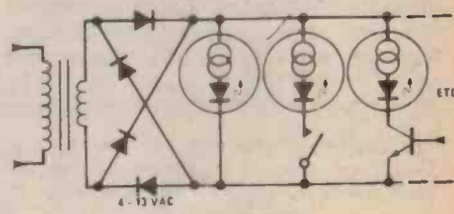

FIGURE 4. Unfiltered DC Power

Full Intensity

As shown in Fig. 5, full intensity and zero possible flicker are achieved by minimal DC filtering. The small capacitor shown operates with 10 V p-p ripple and only about 8 V average DC, while the constant current drain characteristics of the NSL 4944 allow only a few percent change in light intensity. If a system or instrument with a regulated supply has a number of LED indicators, regulator size and dissipation can be minimized by powering the regulated LEDs from the unregulated voltage.

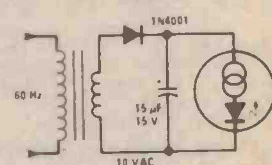

FIGURE 5. Minimizing DC Filtering

Reduced Intensity

The low operating voltage and constant current characteristics make the regulated LED an ideal status indicator for digital circuitry. An interesting fact to keep in mind is that

ETI data sheet

full regulator current is not needed to light the LED. If, for example, only 8 mA is available (from a voltage of 1.6 to 1.9 V) the LED will light at a somewhat reduced intensity. The regulator will be switched full on instead of current limiting . . . but in such a situation it doesn't matter.

TTL Drive

Any circuit capable of supplying 10 to 20 mA and a voltage swing of at least 1 V can switch the NSL4944 from an off to an on state Fig 6a, b. Within 25°C of room temperature, an input voltage of 1.3V will produce little or no light, and 2.3 V will produce 70% to 90% of full output. However, with a small signal change, the pre-existing biases must be correct. The output swing of a TTL stage goes much closer to ground than to the 5 V supply.

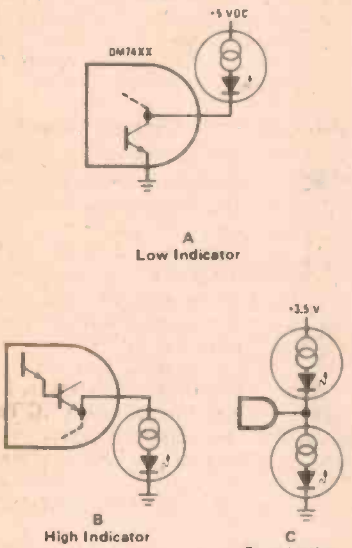

FIGURE 6. TTL Indicators

Therefore, Fig. 6-C requires a 3.5 V supply for the indicators to have complete off-on switching.

Replacing FETs

In many circuits or small instruments the need for a constant current source or current limiter arises. FETs can generally only be used as low current sources, so for 10 mA or more parts. If an indicator or pilot light is also needed, the regulated LED may be a very economical source of the needed constant current.

The examples below illustrate all three characteristics of the NSL4944. It is a combined rectifier, constant current source, and pilot light.

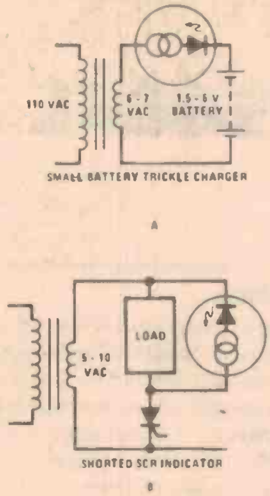

FIGURE 7.

Shortproof Circuit

A current source can also be a current limiter. Fig. 8 shows an NSL4944 put in the collector of an emitter follower such as might be used in a pre-amp or mike mixer cable driver.

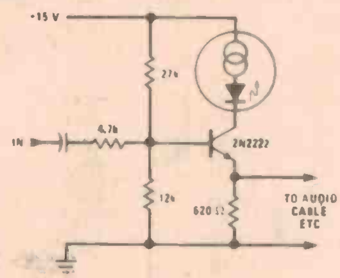

FIGURE 8. Current Limiting and Short Protection

Normally voltage across the LED is only 2 V, allowing almost full supply-to-supply swing of the emitter follower output. In comparison a limiting resistor would either greatly increase output impedance, or severely limit output swing. However, if the output cable is accidentally shorted, only a little more than the rated current of the LED will flow. Output transistor dissipation actually decreases under emitter short conditions.

Delay Tactics

Logically, a constant current source is helpful in designing time delay circuits. If the circuit of Fig. 9 were built with a resistor, the timing period would only be half the amount shown, and timing would vary over 50% with the supply variations shown.

Instead, the current regulated LED is still drawing within 10% of full

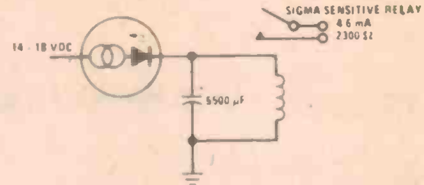

FIGURE 9. Six Second Time Delay

current when the relay reaches its 11 V pull-in voltage. The 14 to 18 V supply variation will produce only about a 3% timing variation, a considerable improvement. Variations due to temperature and electrolytic capacitor tolerances will remain however.

A number of LEDs can "share" a single constant current LED. Further, any of the ordinary LEDs can be turned on and off by a shunting switch without affecting operation of any of the others.

Active Loads

The lamp-driver Schmitt of Fig 10 illustrates a still further use of the NSL4944's constant current source. Substituting a current source for the collector resistor increases the useful voltage gain of Q_1. Further, almost full base current remains available to Q_2, even when supplying 12 V output, which would not be possible using a resistor. When the lamp and Q_2 are off, most of the LED current flows in

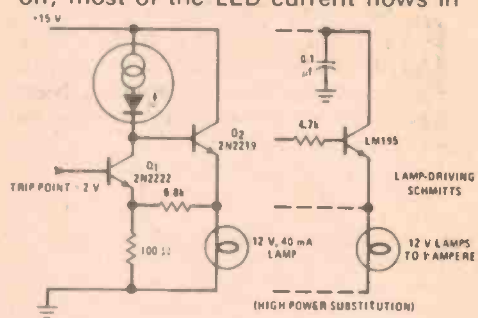

FIGURE 10. Use as Active Load

the 100 R resistor, thus determining the circuit's switching or trip point of 2 V.

With Q_1 saturated, Q_2 still provides a volt to the bulb, contributing some preheating and reducing the bulb's starting current surge. On, Q_2 provides the bulb with 12 V due to the minimum voltage drop in the constant current LED. The 6k8 feedback resistor sets hysteresis at a measured 50 mV at the input. This can be varied without having to change the rest of the circuit. 10k provides almost "0" hysteresis (undesirable and unstable) while 2k sets a hysteresis of 0.5 V.

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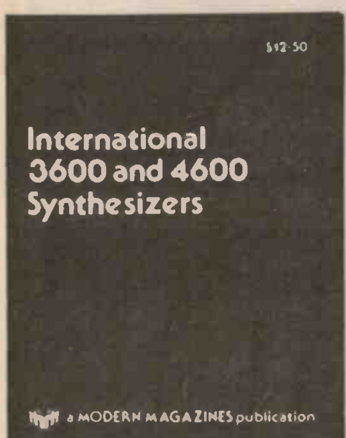

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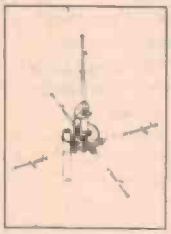

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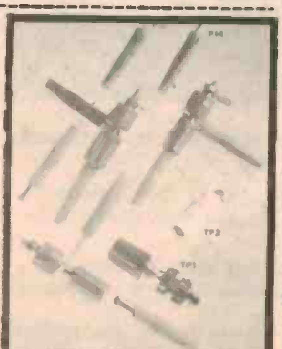

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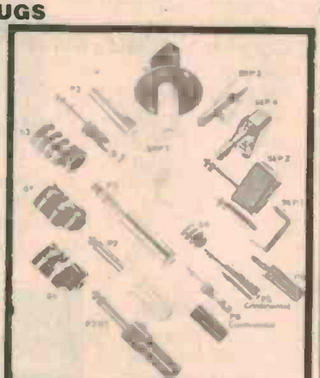

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Digital Electronics By Experiment

IAN SINCLAIR'S NEW SERIES IS DESIGNED TO IMPART THEORETICAL KNOWLEDGE THROUGH SIMPLE PRACTICAL EXPERIMENTS

MANY EXPERIENCED Constructors with several acres of transistor circuits behind them still fight a little shy of using digital integrated circuits. The reasons for this are not difficult to see. Most of the transistor circuits with which an experimenter learns his trade are fairly simple and show rather well how a transistor works, giving a feeling of confidence to the user.

The many excellent projects using digital integrated circuits which have been published do not give any such help to the constructor, however. They may be comparatively easy to build on a prepared PCB, they may even be reasonably easy to understand, but they do not give the constructor the experience which enables him to design confidently with ICs.

This series is intended to remedy that deficiency, so that the reader will gain a firm grasp of the principles of digital IC behaviour, how they work, and also a considerable amount of "hands-on" experience on a board designed to make experimenting with digital ICs particularly easy. We shall confine ourselves to the smaller scale ICs so that nothing as involved as a microprocessor will be used — the components however are chosen so that they give a good range of experience with some useful devices.

One and none

We can assume that any reader of ETI will already have some knowledge of what digital circuits are about, but perhaps a very brief reminder may be of some use. Digital ICs are made up from transistor circuits of very high gain, designed to run with inputs and outputs which take up one of two states which we call 1 and 0. In most applications, 0 will mean a voltage very near to earth potential, and 1 near to the full supply rail.

The ICs we shall use in this course will be from the well-known TTL series, developed by Texas, and also available from several other manufacturers. There are several reasons for this: the devices are readily available at very low prices, advertised in ETI and they are much less easily damaged electrically than the alternative CMOS.

O/C Inputs

When an input of a TTL gate is left open-circuit it automatically reverts to a "1". The reason for this is that the input to TTL gates is to one emitter of a multiple-emitter transistor whose base is connected through a limiting resistor to the +5 V line. Leaving an input o/c means that the emitter terminal will take up the same voltage as the base terminal. This cannot be done when CMOS devices are used.

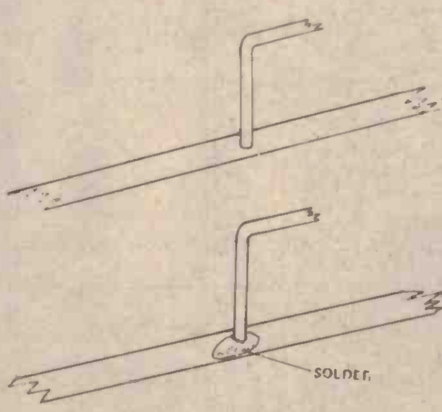

Fig.1. The method of attaching components to the Blob Boards. The 'leg' can be simply bent to one side and then soldered 'blobed' over the lead to hold it. Since the boards are tinned, and the leg ought to be, a sound joint is usually obtained.

For our course on digital electronics we shall need seven digital ICs and one "jumbo" display, a full inventory of semiconductors being shown in Table 1, and in addition we shall also need a few other assorted components. Where a 5 V supply is not available, a stabiliser can be included on the board, so that the experiments can be carried out using a car battery or any DC supply in the 6 V to 12 V range. Note that the current taken will be up to 350 mA.

Breadboard

The heart of the whole project is the circuit board on which the ICs and all other components can be mounted. This is one of the series of "Blob Boards" advertised in ETI — in this case the ZB-8-IC. Blob Boards consist of wide strips of tinned copper on the usual insulating board, and their main feature is that components are mounted on the same side of the board as the strips.

This, of course, is not a new principle in digital IC construction, since this method has been used for some time where digital ICs are mounted on double-sided boards.

The ZB-8-IC as its name suggests, has mounting pads for eight ICs, including the display which we have specified. The suggested layout for the ICs is shown in Fig. 3, where we can see that the top left hand corner houses the 7414 Schmitt inverter, and the 7400 Nand gate; the top right hand corner has the two 7476 J-K flip-flops. At the bottom left hand corner, we have a 7494 shift register and the 7490 decade counter. The bottom right hand corner contains the 7447 BCD-7 segment decoder-driver and the display. All of the ICs have conventional DIL fourteen or sixteen pin bases, but the display has a base which is an eighteen pin type

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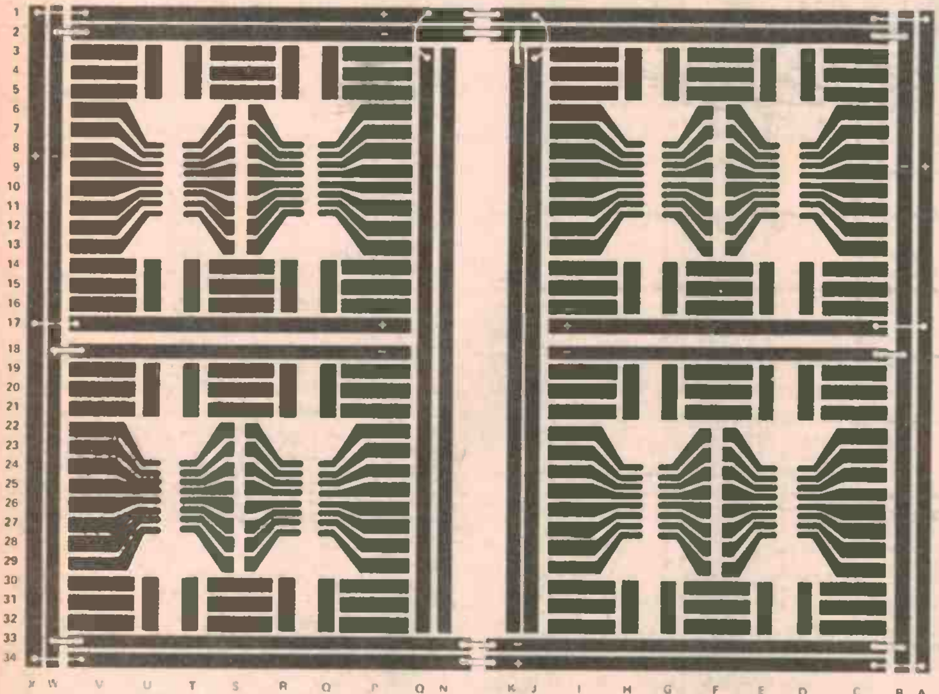
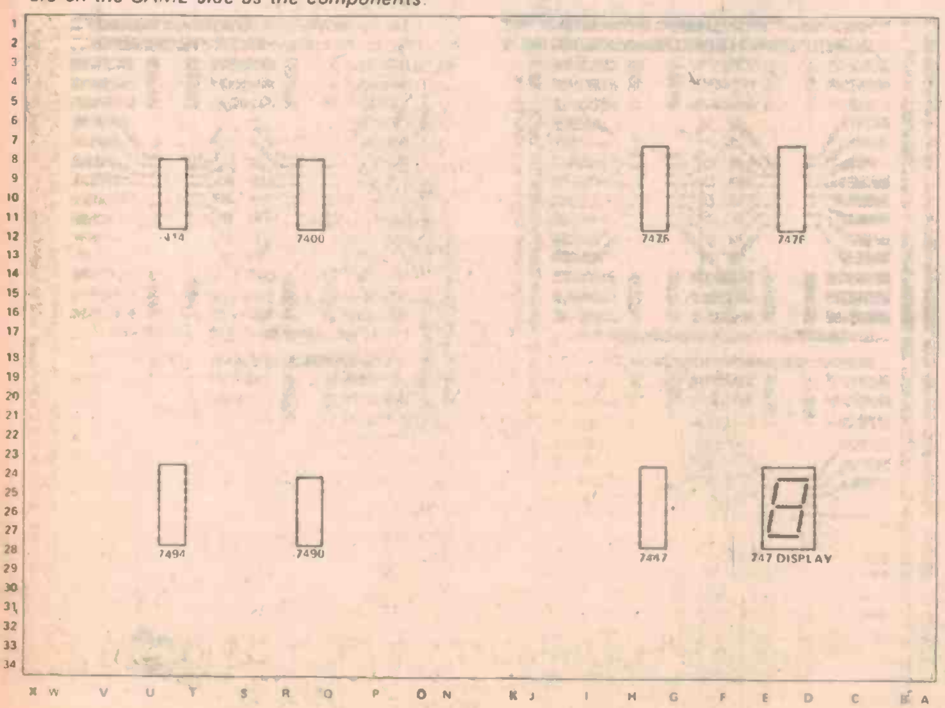


Fig. 2. Above: This is the track pattern for the ZB-B-IC used in this series. Note the wire links which need to be made in order more easily facilitate application.

Fig. 3. Below: Components in place on the board. Note that unlike our usual overlays, the tracks are on the SAME side as the components.



with several pins omitted, so that this will just fit the pads on the board. The spacing between the lines of pins (0.6") is a little on the large side compared to the other ICs, but with care it can be accommodated. In the circuits which we are using we shall not normally need the decimal point on the display, but its connection may as well be made just in case.

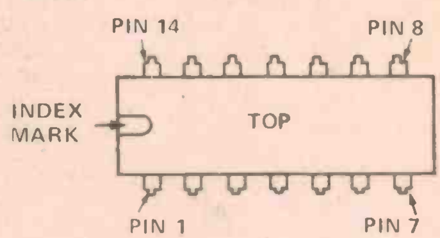
Before any experiments are started then, it is advisable to solder all the ICs and the display on to the board, so that this does not have to be done when it becomes cluttered by other components. Since each circuit mounts on to pads which are isolated unless other connections are made, no harm is done by leaving an IC soldered on to the board.

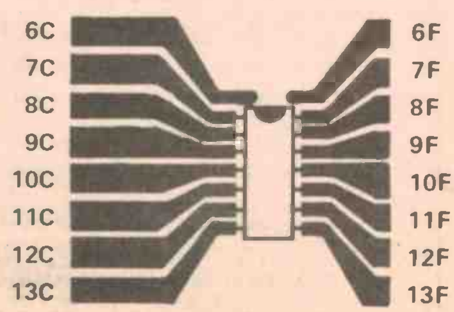
It is for this reason, incidentally, that it is not desirable to use CMOS circuits in such a project, since the protection diodes built into CMOS ICs will operate only when the power supplies are connected.

In the prototype, the lines running round the edge of the Blob-board were used for supplies, the outer line taken as the positive 5 V line, and the inner as earth. It is quite convenient also if the shorter lines running across the board between each pair of IC pads are also used as 1 and 0 lines as well. The vertical lines at the centre of the board may also be used. If a regulated 5 V supply is available for operating the board then little else needs to be done other than connecting the power pack to the lines at the edge of the board.

Fig.4. The layout for the digital TTL series. This is looking down at the device from above. Usually, but NOT always power is applied to pin 14 and pin 7 is earthed.

Fig.5. Bottom: Positioning the ICs onto Blob-Board pads. Make shure the legs line up.





Regulation

If a regulated supply is not available, however a regulator can be constructed, either on a separate board, or onto the Blob-board itself. A 7805 monolithic regulator IC, with 10 μF tantalum capacitors from input to ground and output to ground, can easily be mounted on the centre tracks J, K, and N (with N as input).

It is extremely important that TTL circuits should not be operated at voltages above 5.25 V AT ANY TIME, since the inputs to TTL circuits are to the emitters of transistors, with the bases connected to the positive supply. If the inputs to the emitters are earthed, too much current will flow in the base-emitter junctions, though if all the inputs are earthed, over-voltage is much less likely to cause damage.

Led about the board

Above and below each mounting pad there are several short pads, usually three horizontal and two vertical, and these are very useful for mounting components such as LEDs, which are used to indicate the state (0 or 1) of any output. Note that on most LEDs there is a flat portion of the plastic case near the leadout wires which indicates which leadout wire is the cathode. Since we are using the LEDs to light on a "1" state, the cathode of each LED is connected to earth, and the anode through a limiting resistor to the IC output. This resistor value is higher than we would normally use, but suits this application, as we do not want the LEDS to draw too much current from the IC outputs. When we come to use the display, we shall also use large value limiting resistors.

With all the ICs mounted in place, we are ready to start our work on Digital Electronics By Experiment, with the first set of experiments in next month's issue.

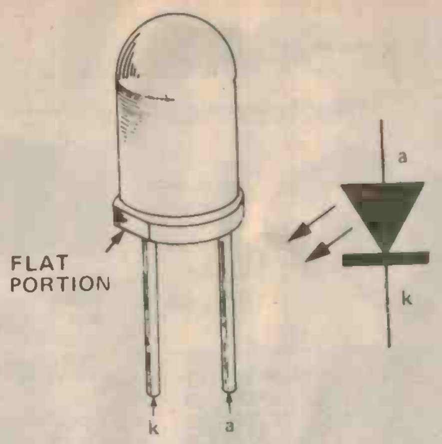


Fig.6. Identifing LED connections has caused many a paralysed moment of doubt — look for the flat bit, if there's one present then your problems are over.

Note: Only the essential basic components are listed here. For various additional suggested experiments, additional resistors and capacitors will be needed; these values will be critical.

SEMICONDUCTORS
1 x SN7414N
1 x SN7400N
2 x SN7476N
1 x SN7494N
1 x SN7490N
1 x SN7447N
1 x 747 Display

OTHER COMPONENTS
1 x 0.1uF
1 x 1.0uF
1 x 10uF
1 x 100uF
1 x 680uF
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All the above 10V working, or more.
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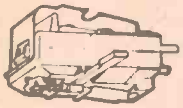

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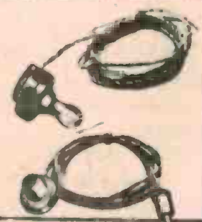

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1, 2, 2.5, 3 amp **26c ea.**

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.2 mm² (6 x 0.2 mm) Perfect to have on hand around the workshop. Comes in red, Black, Green, Yellow, Blue, Orange, Grey, White

$1. per 15 metres

Variable Capacitor

C1604 140F

Suitable for VHF, and communications quip. Low tolerance.

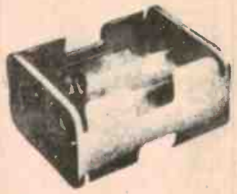
$1.95 ea.

Dwell Meter Kitset **$6.60**

Complete kit less meter and case. Save on service costs and keep your car in good tune. Set ignition points accurately with this easy-to-assemble kit. Meter required is 1mA Kit featured in EA July '77.

We regret that all these offers must end 30th April 1978.

Battery Holders



BH6

Penlight 6 cell can be soldered in or use the clips on top.

Only 45c ea.

BH11

Penlight 3 cell for 4.5V or join two up for 9V

35c ea.

BH9 935 6 cell. Ideal for heavier applications where there is room.

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MES Lampholder

LH3

Suits our 6, 12, 24V lilliput lamps.

10c ea.

WOW!

We've had some microphone specials in the past but this one beats all. Suits most cassette recorders. Complete with plugs and stand.

Tape Recorder Microphone CDM1631

Only $2.15

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Model CA2/RT for VHF operation **$6.25**

TECHNICAL DATA:

CA2/RT

Constructed in non-ferrous materials for lasting beauty. All metals chrome plated. Spare parts including replacement cables readily available.

Frequency range approx. 80 mHz-180 mHz

V.S.W.R. — 80 mHz 1.1:1

175 mHz, less than 1.1:1

Spare lamps 6.5V 3 amp. Tubular MES.

PL23 **32c**

Slider Knob

We might as well give these away at this price.

K25 **20c ea.**

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Order value	Charge
$5 — $9.99	Nil
$10 — $24.99	$0.50
$25 — $49.99	$1.50
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Clips

CL7 Red and Black.

9c ea.

CL10 Good old everyday crocodile clip.

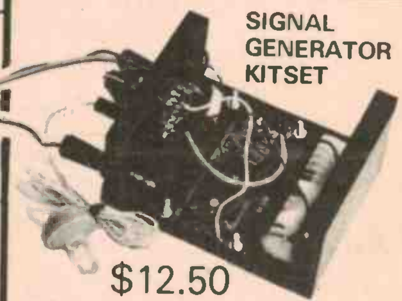
9c ea.

CL11 Fahnstock Clip. Ideal to patch up circuits.

10c ea.

CL12 Robust plastic-covered. Red and Black.

40c ea.



SIGNAL GENERATOR KITSET

$12.50

Inject audio signals into circuits for fault finding. Also trace audio signals. The perfect kitset for the beginner. Kit comes complete except for 2 penlight cells. Comprehensive building instructions are supplied.

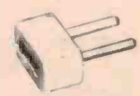
Plugs and Sockets

Polarised plug and socket.

P2 **7c ea.** S2 Wafer **9c ea.**

Suitable power supplies, etc. 4 and 5 pin.

P4 or 5 **8c ea.** S4 or 5 **9c ea.**



P12 2 pin plug

S12 Ideal combination.. 2 pin p. & s.

12c ea.

d.i.n.

3 pin d.i.n. plugs and metal chassis sockets.

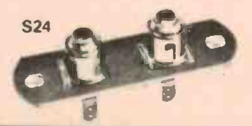
P14 30c ea.

S14 30c ea.

PHONO PLUGS

P22 Metal phono plug. Matches socket below.

Only 6c ea.



S24

Twin Socket

45c

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All only 35c ea.

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LOOK ONLY 65c ea

Dual without switch

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100K Lin
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100K Log
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500K Log

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25K Lin Single
100K Lin Single
250K Lin Single
500K Lin Single
10K Log Single
25K Log Single
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ONLY 50c ea.

Preset Pots PT8A

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9, 7.5, 6-0-6, 7.5, 9V.

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Transformer prices will have to rise soon so be in now.

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28 Pin IC sockets
Top quality blue 28 pin sockets

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80c ea.

SW2 2 pole 2 pos.
SW4 2 pole 4 pos.
SW6 3 pole 4 pos.
SW7 4 pole 3 pos.

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DPDT, anodized lever.

Only 40c ea.

SW20 SPST ROCK

SW22 SPST ROCK

SW23 DP DT ROCK

All 40c ea.

SW24 SPST Toggle 50c ea.

SW26 SPDT 60c ea.

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65c ea.

ON/OFF ROTARY

240V 4 amp

78c ea.

Push OFF!

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Rotary key witch. Suitable low voltage.

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3.5 mm Box Socket. S60B 14c ea.

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Co-ax. Plugs

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Nowhere do you buy these at this price.

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Plastic covered

C6 Plug and socket

35c ea.

Semiconductors

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AC188 .01	.58	IN4005	.10
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BB105	.45	IS44	.07
BC178B	.14	OA91	.08
BC179B	.34	SN7403N	.30
BC183LB	.25	SN7495AN	.70
BC184B	.14	SN7496N	$1.30
BC184C	.14	SN74107N	.50
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BFR80	.30	TIS58	.50
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IN4001	.10	TP4007AN	.38
IN4002	.10	TP4028AN	$1.48

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Noting down music by computer

Literal transcription by a computer of a performance in standard musical notation. By P.Mars, Robert Gordon's Institute of Technology, Aberdeen.

REPRODUCING A MUSICAL SCORE automatically is not a new idea. The first version of an automated piano, in the form of a pianista, was introduced more than a hundred years ago. Later developments include the well-known pianola and the piano camera. Our own research stemmed from an interest in modern jazz piano.

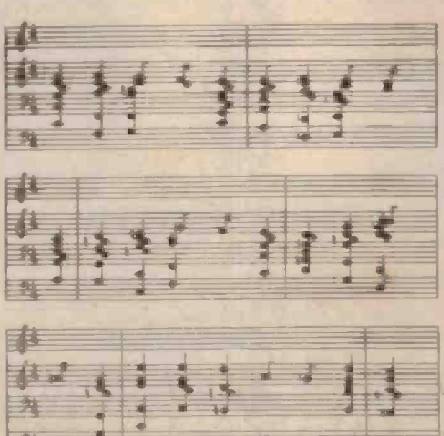
There is a tremendous scarcity of original, accurate transcriptions of such music. Many jazz pianists have had no classical training in music, and even those who have cannot spare the time for the tedious work of transcribing. But the keyboards of the piano and organ are ideally suited to the computer. It is a reasonably simple matter to arrange that every time a note is struck it is recorded, and to monitor accurately the times when they are struck. All the information can be recorded in the binary form of 1 and 0, that is, the language of the digital computer. Information can be monitored during a performance by using an automatic transcription unit and storing it in digital form on a cassette recorder. It can then be processed by computer to produce a transcript, in musical notation, of the original keyboard performance.

The transcription unit samples the entire keyboard at a rate of, for example, 20 times/second throughout the performance and the information on pitch and timing of notes, after some manipulation, is recorded. No audio frequency needs to be recorded; all that is wanted is digital information, so it does not matter if the piano is out of tune or even if a dummy keyboard is used.

It is quite simple to connect the automatic transcription unit and cassette recorder to any keyboard device, but although direct electrical connections can be made to electronic organs and pianos, optical transducers are needed to convert the key movements of ordinary pianos.

During a performance any notes struck by mistake are, of course, transcribed, for the print-out is not governed by any law of musical tonality. Difficulty might arise in drawing the lines between the bars of the music because the musician seldom sticks exactly to a strict enough tempo to follow a particular crotchets/minute count, so the bar lines may be incorrectly placed. However, if the performer does stay within the constraint and tolerance of a specific count, the computer can draw bar lines quite simply. Unfortunately, for some practical applications such as transcribing avant garde jazz, timing within a piece modulates and may have random variations.

A further disadvantage of the system is that it offers little or no discrimination between which hand plays which note or set of notes. All note tails are drawn upwards and no distinction is made between lower and upper hand in the print-out. For similar reasons, no rests are drawn; it is impossible, for a particular piece, to ascertain individual voicings. Rests must be added by the composer after the automatic transcription has been made. No expression marks are incorporated automatically, either, because modelling musical expression mathematically poses an unsolved problem; all expression marks must be added later by the composer. The system allows a key to be specified but many compositions involve changes in key and it is not practical to account for them 'on-line', during performance. This information must be added later, 'off-line'.



Transcription of Chopin's 'Prelude in C minor', opus 28, No. 20.

In spite of these limitations, the machine gives a completely literal transcription in terms of note pitch and time, making the system attractive as a potential labour-saving device for musicians.

We intend to add to the system in the near future, to permit the original transcription to be edited with the aid of a conventional visual display unit. The composer will be able to insert expression marks, rests and so on automatically.

Fast

Recent work in conjunction with the well-known jazz pianist Oscar Peterson has shown that the transcription system can cope with the fastest of jazz improvisations. It is a relatively simple matter to play back original transcriptions under remote computer control, and thereby provide an audio check on their validity. It is also possible to include semi-automatic composition. For example, given a standard popular tune, the computer can be organised to play the standard left-hand chord sequence and generate jazz improvisation, superimposed on the original chord sequences. For any chord, notes that obey the standard harmonic laws can be randomly selected for improvisation. Every improvisation so produced is original and the composer can simply select the most attractive; the automatic transcription system then produces a conventional music-notation output.

Although the system was originally developed to solve problems associated with jazz piano, it can obviously be applied to all forms of keyboard music.

Self-resonance in capacitors

Roger Harrison has been plotting again — this time it's self-resonant frequency versus lead length of ceramic capacitors!

THE LEADS AND CONSTRUCTION of all capacitors form an inductance which is effectively in series with the capacitance of the component. The combined effect forms a series resonant tuned circuit, the frequency of which (the self-resonant frequency) is mainly dependant on the length of the connecting leads, the construction of the capacitor and the way it is mounted.

The impedance of an ideal capacitor decreases with increasing frequency. But in a real capacitor the series inductance of the leads and construction causes the impedance of the capacitor to increase above the self-resonant frequency. Within a range of 0.7 to 1.4 times this frequency the impedance will be equal to, or better than, the reactance of the pure capacitance.

One can make use of this characteristic in bypass applications by using a capacitor of appropriate value and lead length so that its series resonant frequency is at, or close to, the frequency in use. Series resonant bypasses do a better job.

Alternatively, when selecting a bypass capacitor, always ensure that, for the value chosen, its series resonant frequency is above the highest frequency likely to be encountered in the circuit. This ensures that the impedance is always low over the frequency range of interest.

There are other ways in which the series resonance of a capacitor can be utilized. A pi-network, as is frequently used in the output stages of transmitters, is shown in Fig. 1. The output capacitor, C2, will have a value that depends on the frequency and the input/output impedances. The leads of this capacitor can be cut to length before installation so that the series resonant frequency of the capacitor falls on the second harmonic transmitter frequency. Thus it acts as a trap of very low impedance at this frequency.

If the second and third harmonics are to be suppressed, two capacitors may be connected in parallel (their added values to equal the value of C2), and resonated at the frequencies of the two harmonics. Other frequencies (such as spurious mixing products) may be suppressed in the same fashion provided each frequency is sufficiently separated.

In interstage coupling applications, the coupling capacitor may be resonated to the frequency used. Mounting a bypass capacitor flat against a groundplane (i.e. metal chassis or printed circuit board ground plane) increases its series resonant frequency by about 5%-10%. Adding 2 mm or 3 mm wide copper strips along the length of the wire leads of a capacitor can increase its series resonant frequency by 30%-40%.

The series resonant frequency of a capacitor may be measured by soldering

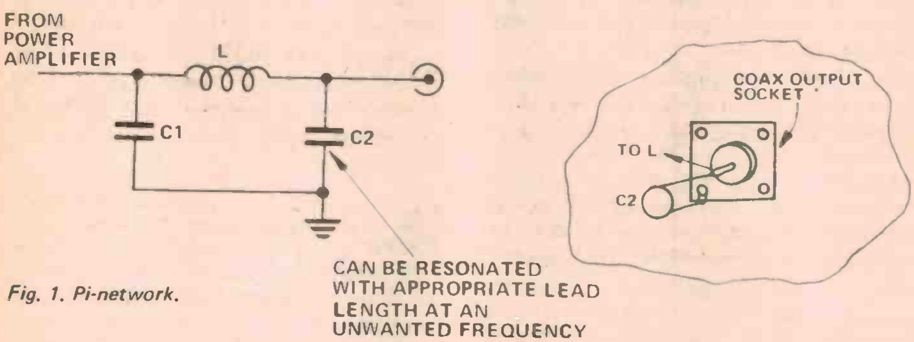


Fig. 1. Pi-network.

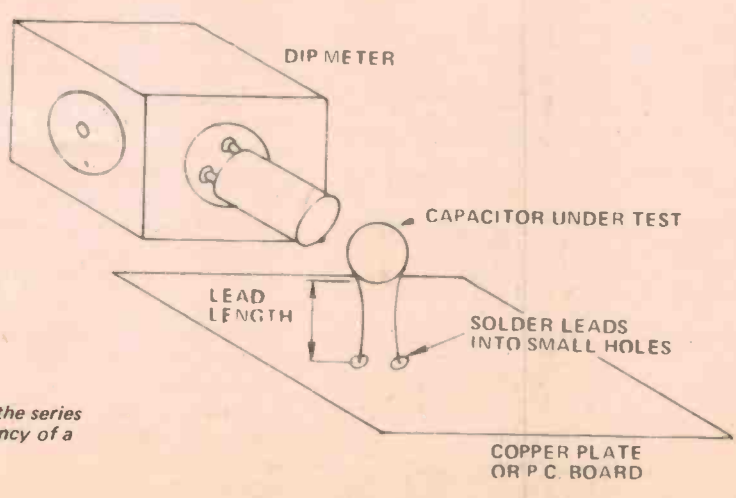


Fig. 2. Finding the series resonant frequency of a capacitor.

TABLE 1. SERIES RESONANT FREQUENCIES OF VARIOUS CAPACITOR STYLES

Value	Style & Size	Lead Lengths & Resonant Frequencies 25 mm	20 mm	12 mm	5 mm	1 mm	Bandwidth
100pF	Hi-K disc ceramic, 5mm dia	80 MHz	–	135 MHz	165 MHz	200 MHz	Broad
100pF	NPO disc ceramic, 20 mm dia	75 MHz	–	105 MHz	130 MHz	–	Narrow
100pF	NPO tubular ceramic, 20 x 3 mm	69 MHz	–	99 MHz	122 MHz	–	Narrow
100pF	Stacked mica	60 MHz	–	95 MHz	120 MHz	–	Narrow
470pF	Lo K disc ceramic, 5 mm dia.	–	–	65 MHz	80 MHz	140 MHz	Narrow
470pF	Hi-K disc ceramic, 7 mm dia.	40 MHz	–	60 MHz	–	–	Broad
680pF	Hi-K disc ceramic, 5 mm dia.	–	40 MHz	53 MHz	74 MHz	92 MHz	Narrow
1000pF	Hi-K disc ceramic, 5 mm dia.	34 MHz	37 MHz	45 MHz	58 MHz	84 MHz	Narrow
1000pF	Hi-K disc ceramic, 20 mm dia.	25 MHz	–	35 MHz	46 MHz	–	Sharp
1000pF	Plastic Film 'Greencap'	28 MHz	31 MHz	39 MHz	50 MHz	65 MHz	Sharp to Broad
4.7nF	Hi-K disc ceramic, 7 mm dia.	–	–	18 MHz	22 MHz	–	Broad
4.7nF	Hi-K disc ceramic, 'Red cap', 5 mm	18 MHz	21 MHz	25 MHz	33 MHz	–	Sharp to Broad
4.7nF	Plastic Film 'Greencap'	13 MHz	15 MHz	18 MHz	26 MHz	–	Sharp
.01μF	Hi-K tubular ceramic, 10 x 3 mm	8 MHz	–	11 MHz	14 MHz	–	Broad
.01μF	Hi-K disc ceramic, 10 mm dia.	–	–	13 MHz	15 MHz	–	Broad
.01μF	Hi-K disc ceramic 'Redcap', 5 mm	10.3 MHz	11.7 MHz	16 MHz	21 MHz	34 MHz	Sharp to Broad
.01μF	Plastic Film 'Greencap'	9.3 MHz	10.8 MHz	13.5 MHz	18 MHz	22 MHz	Sharp to Broad
1000pF	Resin-sealed Button Mica, 10 mm dia.	–	–	–	500 MHz	–	Broad
1000pF	Gold-sealed Button Mica, 10 mm dia.	–	–	–	800 MHz	–	Broad
1000pF	Solder-in Ceramic Feedthrough	–	–	–	400 MHz	–	Broad
1000pF	Screw-mount ceramic Feedthrough	–	–	–	250 MHz	–	Broad
.082μF	Resin-sealed Button Mica, 10 mm	–	–	–	100 MHz	–	Narrow

the leads to a relatively large copper plate or piece of p.c. board, as shown in Fig.2, and finding the resonance with a grid-dip meter (gate-dip meter, or base-dip meter for modern instruments).

Table 1 lists the series resonant frequencies of a variety of values, styles and sizes of capacitors. The lead lengths noted are the lengths of each lead (refer Fig.2), the disc ceramic is obviously a good choice for bypass applications into the middle VHF region. For applications to 60 MHz or so the common, plastic film 'greencap' is quite good along with various styles of ceramic capacitors. For stringent applications in the VHF-UHF region or for effective bypassing over wide bandwidths, the button mica capacitor or ceramic feedthroughs are necessary. Button ceramics exhibit similar characteristics. Note the high self-resonant frequency of the 0.082μF button mica.

The self-resonant frequency of disc ceramics is dependent largely on its diameter and lead length. The graph in Fig. 3 illustrates this for a variety of disc ceramics and a stacked mica capacitor for comparison.

Fig. 3. Self-resonant frequency versus lead length for various diameter ceramic disc capacitors (after J. Bork, 'A note on the self-resonance of ceramic capacitors,' proc. I.R.E. (Aust) May 1957).

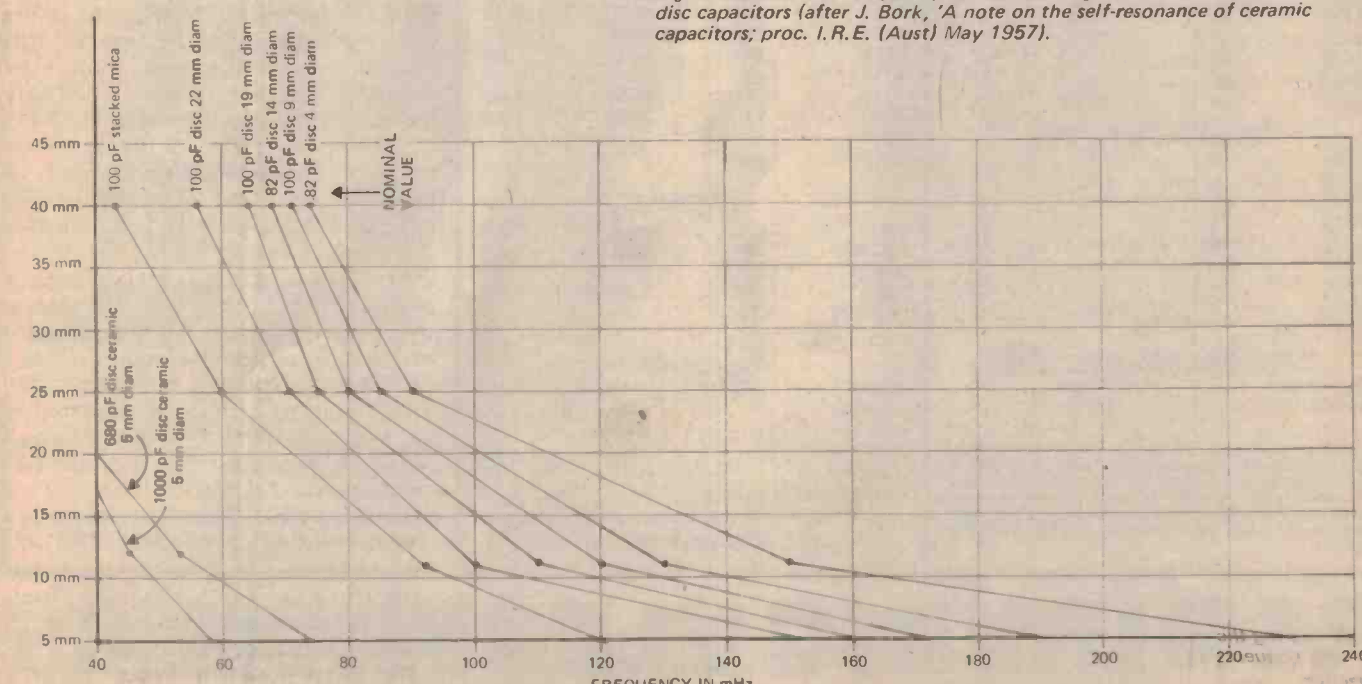


FIG 3

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7407	.77	7444	1.75
7408	.28	7445	1.39
7409	.28	7447	1.15
7410	.25	7451	.25
7411	.31	7454	.25
7412	.25	7470	.59
7413	.47	7474	.55
7414	.86	7475	.66
7416	.78	7491	1.01
7417	.78	7492	.61
7420	.25	7493	.61
7421	.25	74107	.50
7423	.44	74121	.51
7425	.44	74123	1.25
7426	.38	74141	1.14
7427	.44	74175	1.60
7430	.25	74367	1.25

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7806	6v	1A.	1.30
7808	8v	1A.	1.30
7812	12v	1A.	1.30
7815	15v	1A.	1.30
7818	18v	1A.	1.30
7824	24v	1A.	1.30
7912	-12v	1A.	2.00
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U2013 SPDT (Centre off)	1.00
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U2023 DPDT (Centre off)	1.20

CMOS

4001	.25	4021	1.40
4002	.25	4023	.25
4006	1.40	4024	.86
4007	.25	4027	.83
4008	1.32	4028	1.25
4011	.25	4040	1.30
4012	.25	4049	.60
4013	.55	4066	.85
4014	1.40	4069	.30
4015	1.20	4510	1.46
4016	.55	4511	1.46
4017	1.40		
4018	1.40		

LINEARS

uA311	.80	uA339	.85
uA3401	.85	uA555	.45
uA556	1.10	uA741	.35
9368	1.75	LM380	1.25
RL4136	3.60		

DIODES

OA91	.15	OA95	.16
1N4002	1A	200V	.07
1N4004	1A	400V	.08
1N5625	5A	400V	.45
1N 4148			.05
30 AMP 400V Bridge			4.75

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BC108	.18	PN3566	.20
BC109	.18	PN3568	.20
BC547	.20	MJ2955	1.60
BC548	.20	2N3055	.85
BC549	.20	FT3055	.80
BD139	.60	TIP31B	.75
BD140	.60	TIP32B	.75
BF180	.60		

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FND 357	.375"	c.c.	1.30
FND 500	.5"	c.c.	1.40
RED LED			.22
GREEN LED			.35
YELLOW LED			.40

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4.7uF	25V	PCB	.07
10uF	25V	PCB	.08
10uF	50V	PCB	.09
22uF	16V	PCB	.07
22uF	35V	PCB	.09
33uF	16V	PCB	.08
33uF	50V	PCB	.10
47uF	16V	PCB	.09
47uF	35V	PCB	.11
100uF	10V	PCB	.10
100uF	16V	PCB	.11
220uF	25V	PCB	.14
470uF	16V	PCB	.16
1000uF	25V	PCB	.36
2500uF	50V	Axial	1.85

TANTALUMS

1uF 35V	.18	2.2uF 35V	.20
4.7uF25V	.22	10uF 16V	.20
15uF 16V	.27	22uF 16V	.30

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Lab-quality instrument offers superb performance and features at low cost.

OF THE VARIOUS QUANTITIES encountered in electronics (such as charge, voltage, current, frequency), perhaps the easiest to measure accurately is frequency. Various types of frequency-measuring equipment exist, ranging up from the simple absorption wavemeter (every ham should have one) to sophisticated multi-counter instruments which use microprocessors to calculate the measured frequency.

The earliest really accurate instruments were of the heterodyne type (such as the BC221), in which finely calibrated oscillator was tuned to zero-beat with the incoming signal. Many of these devices are still in use. In the late fifties and early sixties came the first 'digital' counters appeared, based on Dekatron tubes, which are cunning decade counter and display valves.

Integrated circuits and LED have now made possible compact, portable counters that can be held in the palm of the hand, and these can easily be built by the hobbyist. What we haven't seen however, is a design for use at UHF, where CB and mobile radio, are appearing, or which offered versatile measurement of time or period.

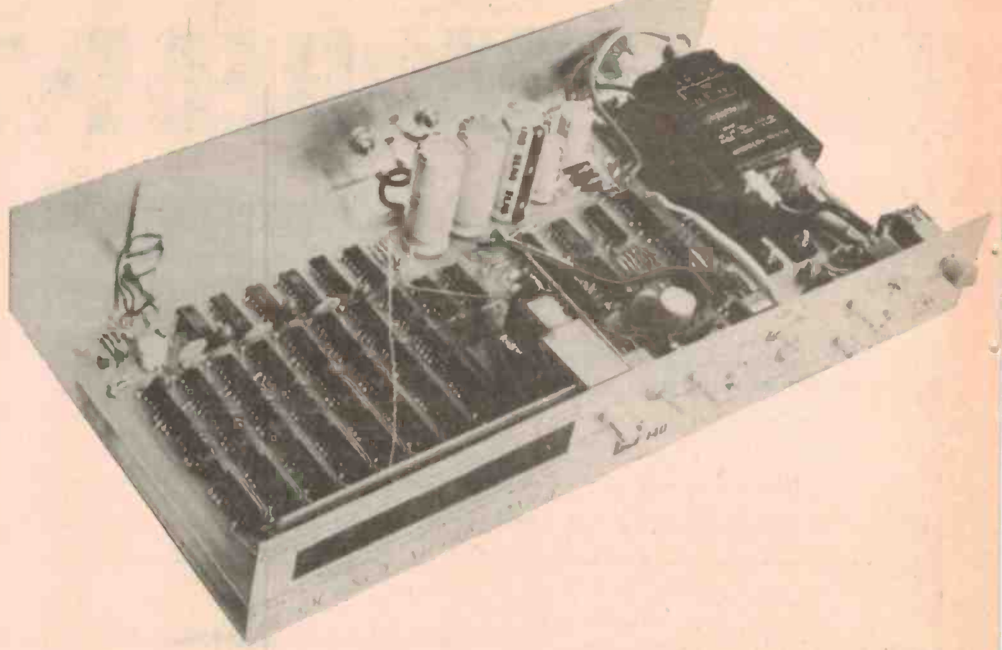
With these thoughts in mind, we set out to do a design study, and came up with a lab-quality instrument which should be very reasonably priced. The design is based mainly on TTL with some CMOS and ECL. We rejected LSI MOS and CMOS devices for various reasons. Although this increases board size and power consumption, the gain in simplicity of layout and trouble-shooting, as well as leading zero suppression, is well worth-while.

SPECIFICATIONS ETI – 140

Modes of operation	Frequency, period and time
Range	
Frequency	10 Hz – 50 MHz
High frequency	50 MHz – 1 GHz *
Period	0.1 µs – 10 sec.
Time	1 µs – 100 sec.
Resolution	
Frequency	1 Hz
High frequency	10 Hz
Period	0.1 µs
Time	1 µs
Display	8 digit LED, leading edge blanking
Sensitivity	
Normal input	20 mV
High frequency input	20 mV
Time inputs	0 V to +3 V level shift
Input impedance	
Normal input	1 Meg // 15 pF
High frequency input	≈ 75 ohms
Time input	> 10 k
Maximum input voltages	
Normal input	70 V ac, ∓ 100 V dc
High frequency input	200 mV ac, ∓ 50 V dc
Timing inputs	∓100 V dc
Crystal frequency	
nominal	4000 kHz
actual	3999.995 kHz
Stability and accuracy	
Frequency	Depends on crystal used and initial adjustment. Oven used keeps temperature within 2° C.
Period and time	approx −0.000125%

* The upper limit of the prescaler has not been checked due to the lack of a signal source but both the preamplifier (OM335) and the divider ICs are specified up to 1 GHz.

Project 140



Design Feature

When considering this instrument initially we looked at ways to reduce both cost and component count of the unit. Our initial design of the counter section used TTL for the first two stages and CMOS for the rest. It then called for four 8 bit shift registers to take the information from the counters, latch it, and provide the multiplexing for the display. Multiplexing reduces the power consumption of the displays for the same light output and the total network would have saved 10-11 packages. However the PCB layout beat us unless a plated through board is used which would have cancelled any cost saving. The increased difficulty of fault-finding, even with fewer components, also weighed against this approach.

The counter in the LSD position has to operate at over 50 MHz. The only way to obtain this performance was to make our own divide by 10 using 74S74 dual D type flip flops as the 74LS90 is only specified to 32 MHz (although one sample we had worked at 60 MHz) and the 74S90 is no faster.

The network of 74S74's should give 60-70 MHz minimum clock rate.

Preamplifiers which can work from almost dc to 50 + MHz involving a Schmitt trigger always prove troublesome and this one was no exception. We originally dc coupled it throughout using matched FETs and a differential pair to give the correct level for the 9585 IC. This proved to have too much gain to be stable and the design shown here was the final result. Originally we used three diodes to limit the output voltage to +2v in the ECL-TTL translator but replacing it with a resistor-diode not only made it cheaper but increased the frequency response by 50% and improved stability.

Operation

The frequency and period modes are commonly known and do not require much explanation. The only extra control provided over the normal sensitivity control, is the dc shift. When measuring the frequency or period of a pulse waveform where the pulse is narrow in relation to the repetation rate, triggering problems can arise. This is due to noise pulses being counted as the average voltage is almost zero. However by using the dc shift the signal can be lifted above (or below) zero and the problem eliminated. For maximum sensitivity on normal ac signals the dc shift must be adjusted back to zero.

With the time mode intervals from 1 μs to 100 sec can be measured using pulses or level changes, into the respective sockets. A voltage change from 0V to 3V (or +3V to 0V) is all that is necessary although up to ∓ 100V can be used. For accurate timing the pulse should have a rise time of less than 1 μs. For measuring single pulses, both inputs can be paralleled and starting and finishing on opposite edges. If it is a repetitive pulse chain the unit will time the first pulse after the release of the reset button.

Calibration and Testing

To calibrate the unit a known frequency is needed so that CVI can be adjusted to give the correct reading. Alternatively a radio receiver can be used tuned to the PMG 12 MHz time transmission, VNG, and the 4 MHz crystal beat against it (take a wire from pin 11 of IC30, wrap it around the radio aerial and adjust for zero beat. This sets the crystal to exactly 4 MHz. However this is not the exact frequency needed (life wasn't meant...). Now feed the 4 MHz into the input and record the result. It should be about 3,999,995 Hz which is about 0.000125% low. Now measure the frequency of another crystal (*or extremely stable*) oscillator, record the reading and then adjust CVI to give a reading 0.000125% higher (or whatever error your unit requires). As this low reading is due to the time required for the strobe-reset pulses it is independent of the crystal frequency and adjusting CVI will not affect the reading when the counter is used to measure its own internal frequency.

Adjustment of the crystal trimmer should not be done until it is warm (allow 10 minutes) and the oven should be fixed into the chassis to prevent movement of the leads which can affect the frequency slightly. If CVI does not have enough range the parallel capacitor should be varied.

The period mode should be checked for operation. With the time mode the display can be reset by the push button and timing can be started by shorting out the start socket and stopped with the stop socket. Starting and stopping can also be performed by switching the polarity switches from negative to positive edge triggering. It should not be possible to restart the counter before the display has been reset.

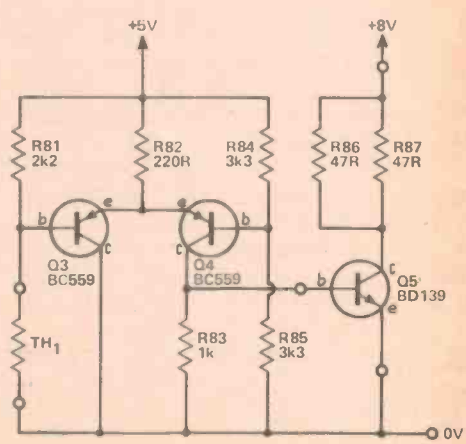
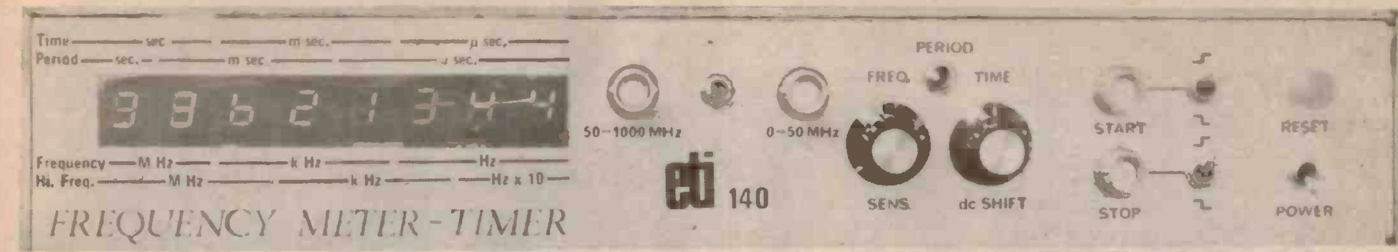


Fig. 1. The circuit diagram of the oven circuit



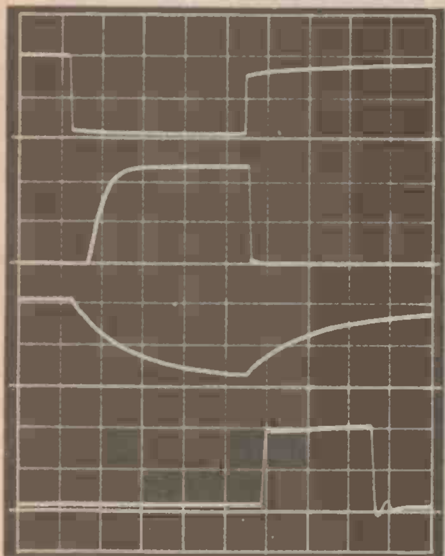


Fig. 2. Waveform diagrams showing the relationships of the strobe-reset pulses. They are, from the top down:
The output of IC37/1, pin 13
The 'strobe' pulse, i.e. the collector of Q2
The input to IC37/2, pin 10
The reset pulse on pin 5 of IC37/2
The vertical scale is 2 V/division while the horizontal is 200 ns /division. It can be seen that between the strobe pulse and the reset pulse there is a delay of about 50 ns.

The following pins are not shown on the circuit diagrams but are connected as shown below. Pins in the third * column are used as interconnections or are unused inputs terminated to some output.

	To +5V	To 0V	*
IC1	4,10,14	7	
IC2	4,10,14	7	
IC3	5	4,6,7,10	13
IC4	5	4,6,7,10	13
IC5	5	4,6,7,10	13
IC6	5	4,6,7,10	13
IC7	5	4,6,7,10	13
IC8	5	4,6,7,10	13
IC9	5	4,6,7,10	13
IC10	5	12	
IC11	5	12	
IC12	5	12	
IC13	5	12	
IC14	5	12	
IC15	5	12	
IC16	5	12	
IC17	5	12	
IC18	3,5,16	8	
IC19	3,16	8	
IC20	3,16	8	
IC21	3,16	8	
IC21	3,16	8	
IC22	3,16	8	
IC23	3,16	8	
IC24	3,16	8	
IC25	3,16	5,8	
IC26	14	7	8,9
IC27	5	2,3,6,7,10	
IC28	14	7	
IC29	14	7	
IC30	14	7	
IC31	2,4,6,7,10	11	
IC32	16	1,7,8,9,15	
IC33	16	1,8,9	1,2,3
IC34	14	7	
IC35	16	1,7,8,9	
IC36	14	7	
IC37	2,3,11,16	8	
IC38	14	7	1,2,5,6
IC39	14	7	
IC40	5,14	6,7,8	
IC41	14	7	
IC42		2,3,5,6	

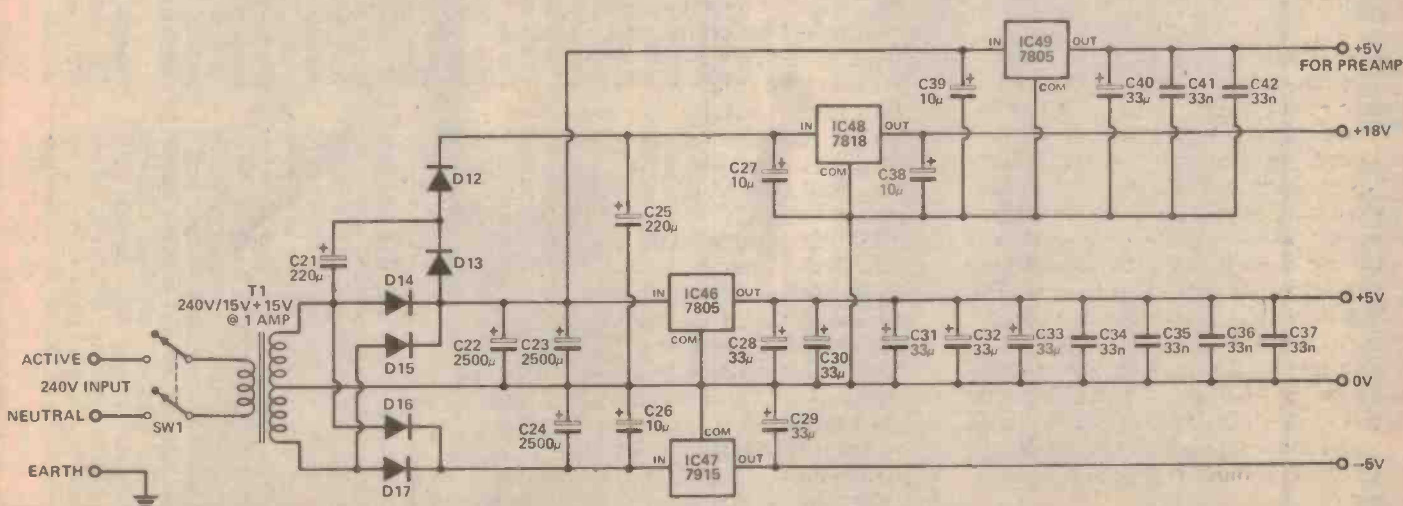


Fig. 3. The circuit diagram of the power supply

1 GHz FREQUENCY METER – TIMER

HOW IT WORKS – ETI 140

The circuit is complex but can be sparated into sections to make the explanation clearer:

A. Input preamplifier.
B. Prescaler.
C. Counter section.
D. Time base.
E. Frequency-period control logic.
F. Time measurement control logic.
G. Power supply.

Preamp
Transistors Q6, Q7 and Q8 form the high to low impedance unity gain buffer required to allow the one megohm input impedance. Diodes D5 and D6 prevent excessive input voltages damaging the unit.

Amplification is provided by IC42 which is an ECL triple differential line amplifier. Each stage has a gain of about seven giving a total voltage gain in IC42/1 and IC42/2 of around 50. The inputs of IC42/1 are biased to the internal reference voltage (pin 11) by R91 and R92 with the input signal being ac coupled via C10,11. The voltage on pin 16 can be dc shifted to allow better triggering on pulse type inputs.

The third section of IC42 is used as a Schmitt trigger to ensure that the output is square and jitter free. As the outputs of ECL move only from about +3.3 V to +4 V (on a +5V supply), a translater is needed to drive the TTL logic which follows.

Transistors Q10 and Q12 are both constant current sources with Q12 providing about 18 mA (0.6 V across 33 ohms). As the base of Q10 can be either of two levels (3.3 V or 4 V) it supplies either 33 mA (1.1 V across 33 ohms) or 9 mA (0.3 V across 33 ohms). As the two current sources are in series the differential current must go somewhere if they are to remain constant current supplies! With 33 mA from Q10, the difference (15 mA) flows through R103 and D9 to give about +2 V on the output. When the current drops to 9 mA the clamp diodes in the 74S10 which follows the preamp clip the voltage at about -0.7 V. If these limits were not used the two inputs Q9 and Q13 are used to disable one of the inputs. With both transistors off the prescaler output is disabled (it needs a pulldown resistor), leaving the normal input active. If the transistors are on the prescaler is operational but the dc shift on pin 16 of IC42 forces the output (pin 7) high, effectively disabling the input.

Counter Section
The counter section consists of eight decade counters, latches, decoders and the LED displays. Due to the symmetry of the network the centre four stages aren't shown on the circuit diagram.

Seven of the counter stages are the familiar 7490/7475/7447 combination (except that they are the LS versions) but the decade counter of the LSD (least significant digit), which has to work at over 50 MHz is made out of four D type flip-flops using a NOR gate to get the divide by ten function. Both the D type flip-flops and the NOR gate have to be 'S' series TTL to give 50 MHz + operation (our prototype went over 100 MHz!).

All the counters can be reset by a '1' on the reset line and counting is advanced on the positive transition of the count input. With the latches, if the strobe line is high ('1'), whatever data is presented to it by the counter will be transferred to the decoders. When the strobe line goes to a '0' the data present at that time will be stored and displayed with the information from the counters no longer affecting the display.

Due to the interconnection between the decoder IC's the leading zeros will be blanked, leaving only the right hand digit on with no input signal. To reduce the load on the 5V regulator the displays are supplied from the unregulated supply.

Timebase
The timebase is a 4 MHz crystal with IC30/1 and IC31/2 providing the necessary amplifier to make an oscillator. The frequency is adjustable by CV1. For critical applications an oven can be used, stop dividing (this is used in the time mode). This 1 MHz output is then divided to 10 kHz by IC32 (dual decade counter) and then to 100 Hz or 62.5 Hz by IC33. This IC is a dual divide by 16 counter with the AND gate IC34/1 resetting the first half (IC33/1) upon reaching decimal 10 and IC34/2 and IC34/3 resetting the second half to zero at ten if the control input to pin 13 of IC34 is high. If it is low the reset pulse is disabled and the counter will divide by its normal 16. This change in division ratio is necessary as the prescaler divides by 16 and not 10. A final division by 100 is done by IC37 to give the final timebase periods of 1 s and 1.6 s.

Frequency-Period control logic.
In the frequency mode the output of the preamp is coupled to the count input of the display section via IC28/1 and IC28/3. These need to be 74S10 (not LS) to handle the frequencies involved. The 1 sec (or 1.6 sec) time base is coupled to the monostable IC37/1 via IC36/1 and IC36/3 and is therefore triggered every one second generating a pulse 800ns wide. This is used for the strobe pulse (open and close the latches every one second). This output also disables counting during this period to eliminate any error due to the latch closing while a pulse is still rippling through the decade counters.

The output of this mono has to be buffered by Q2 as the input of the latches is equal to 32 LS TTL loads (about 15mA). This transistor causes a propagation delay of 100 ns on the leading edge and 50 ns on the trailing edge. After a delay at about 80 ns (which is to compensate for the 50 ns propagation delay of Q2) the second monostable IC37/2 is triggered giving a 250 ns wide pulse. This is the reset pulse. The process of frequency measurement is therefore to reset the counters, clock the counters at the input frequency, after 1 sec open and close the latches which displays the number reached by the counters, then immediately reset the counters and start the process all over again.

In the period mode the 1 MHz output totally wrong result. Because of this we use the RS slip flop IC38 which is set by the strobe pulse, stopping any further pulses, and reset by the 'C' output of IC35/2. This IC (IC35/2) is reset by the strobe pulse and the 'C' output does not occur for 400 ms giving a maximum reading rate of 2.5 per second. The reset pulse is not involved in this process and occurs every 10 clock pulses of the input.

Time Measurement
Separate inputs are used for time measurement with both start and stop inputs available. These inputs are buffered by IC39 with both true and complementary outputs available.

Timing is done by coupling the 1MHz output to the count input (via IC28/2, IC28/3 as per period mode), holding the latches open so the counter information is always displayed and controlling the divide by 4 (IC31) to stop and start the counting.

This control is performed by the D type flip flops IC40/1 and IC40/2, after being gated by IC41/3 and IC41/4. If the Q output of IC40/1 is a '1' and the $\overline{Q}$ output of IC40/2 is a '1', IC31 will be enabled. When the reset button is pressed IC40/1 is set to a '0' on Q, and IC40/2 to a '1' on $\overline{Q}$, disabling IC31. This also puts a high on the 'A' input of the reset monostable IC37/2. When the button is released this causes a reset pulse to occur resetting the counters (and display) to zero.

The D input of IC40/1 is normally connected to a '1' and this is clocked into the Q output on the positive transition of the input to pin 3. When this occurs counting will start. This also puts a '1' on the D input of IC40/2 and if a positive transition occurs on pin 11 (clock) the Q will go to a '1' and the Q to '0', which will stop the counting. Triggering the stop input before the start will have no effect as the D input is a '0' and once toggled no further action will occur until reset by the pushbutton. Either positive or negative edge triggering can be selected allowing the width of a pulse to be measured by feeding it to both inputs and selecting the transistors would saturate, reducing the response to a few MHz.

Prescaler

For frequencies above 50 MHz, a prescaler is used with an amplifier IC43 providing about 26 dB gain to frequencies up to about 1 GHz and IC44 and IC45 each dividing the signal by four to give a total division by 16. To compensate for this odd division the timebase is changed from 1 sec to 1.6 sec when the prescaler is used.

As these dividers are ECL (what else at 1GHz!) a similar translater is used (Q11). To prevent interference between and this is controlled by Q3 and Q4. These transistors compare the voltages on their bases and control the drive to Q3, which, along with R86 and R87, is mounted on the crystal body to act as a heater. Also on the crystal body is the thermistor TH1 which provides the necessary feedback to Q3 to stabilize the temperature at about 70°C. The crystal is mounted in a polystyrene box to provide the thermal insulation required.

The output of the oscillator is buffered by IC30/3 before being divided by four by the JK flip flop IC31. If the JK inputs of IC31/1 are taken low the flip flop will from IC31 is gated into the count input via IC28/2 and IC28/3. The output of the preamp, after being divided by ten in IC27 then controls the strobe-reset monostables via IC36/2 and IC36/3. The result is that we count the number of one μs pulses in the time taken for 10 cycles of the input frequency. This gives the period of one cycle to 0.1 μs accuracy. Problems with flickering occur when updating a display more often than about 1/5 sec, especially 7 segment displays, as the eye cannot follow the change. This can be shown that if the display is alternating between 100 and 99 the result could appear as 188 which is a appropriate edge.

Power Supply

Four voltages are required for the unit: +5 volt for most of the logic, +8 volts unregulated for the displays (to save power disapation in the 5 volt regulator) +18 volts for the prescaler and -5 volt for the preamplifier. A separate +5 volt regulator is used for the preamplifier and prescaler to prevent any feed back via transients in the 0V line.

The regulators are standard 3 terminal regulators with the ∓8 volt supply simply fullwave rectified. The +26V for the 18V regulator is voltage tripled.

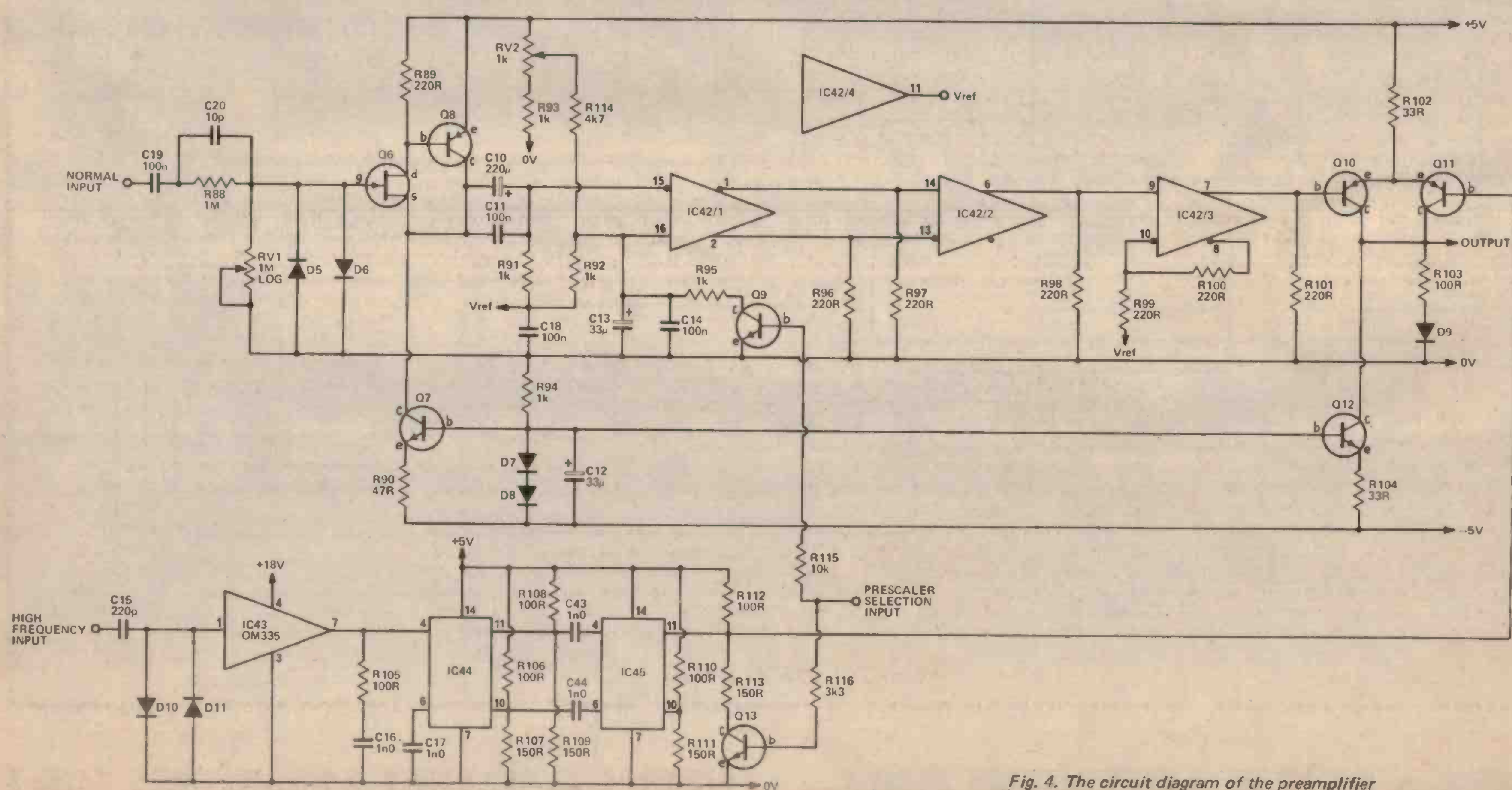


Fig. 4. The circuit diagram of the preamplifier

1 GHz FREQUENCY METER – TIMER

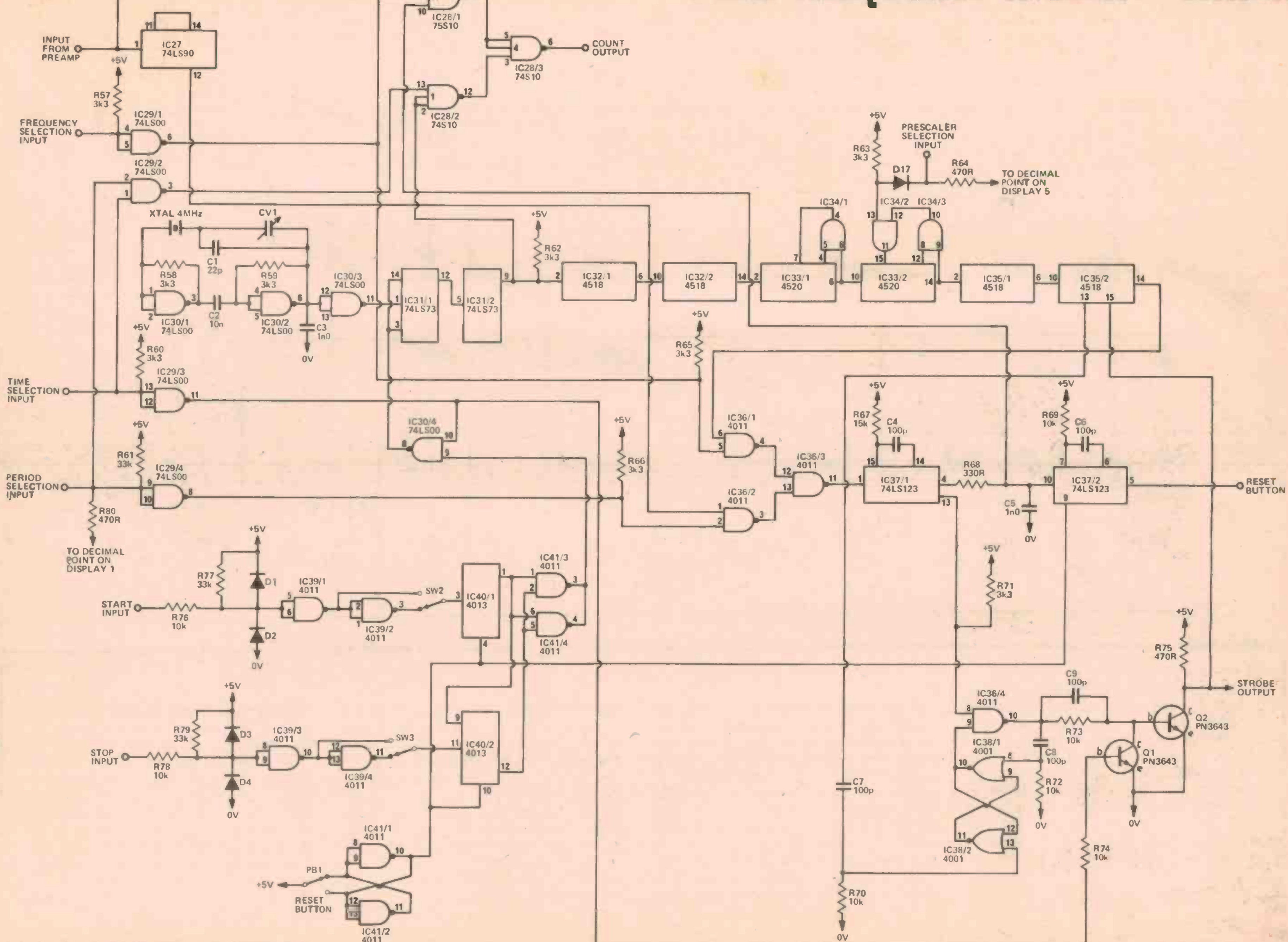


Fig. 5. The circuit diagram of the control logic

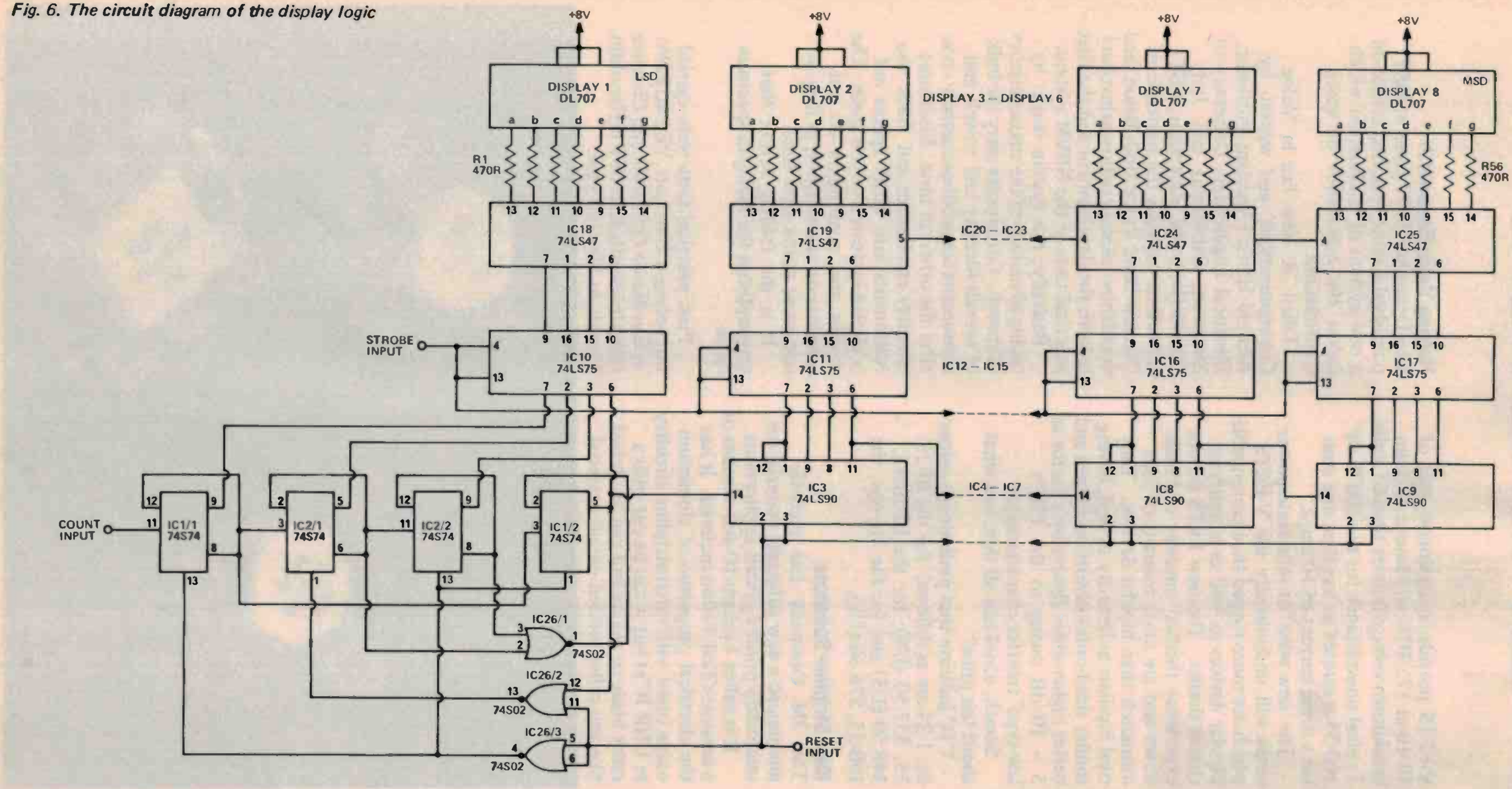


Fig. 6. The circuit diagram of the display logic

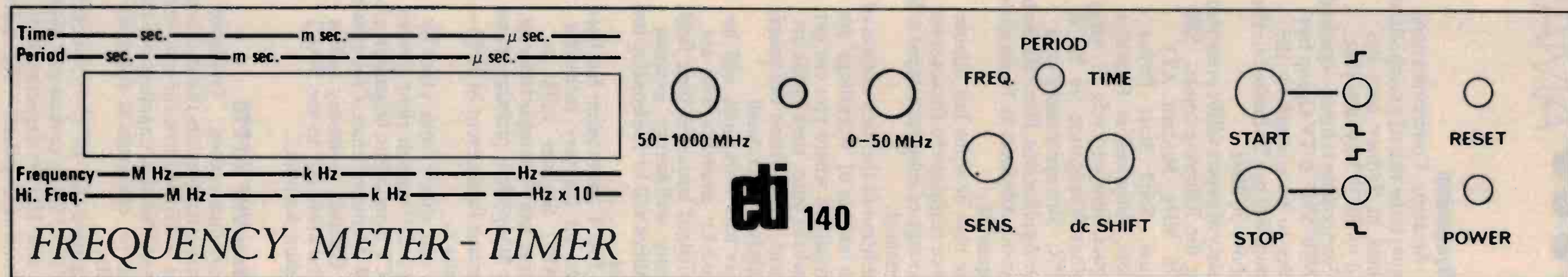


Fig. 7. The front panel artwork. Full size 320mm x 55mm

FACT Symposium

Future Amateur Communications Techniques is the title of a symposium to be held in Sydney over the weekend of 20-21 May, this year.

The Symposium is being organised by the NSW VHF & TV Group but the topics to be covered by the symposium will not be limited to the world above 50 MHz.

A variety of papers will be presented covering the following topics: SSB on 1296 MHz, Modern ATV techniques, Solid State Power Amplifiers, Advances in Repeater Techniques, Sunspot Cycle 21, using Anomolous Propagation for HF & VHF DX, Microprocessors and Amateur Applications, Phase III Oscar and Beyond, Advances in Transceiver Techniques etc.

There may be some last minute changes or additions to these topics but the range of subjects covered will be maintained.

In addition to the presentation of papers a number of 'workshops' are being organised where you can get your eyeballs onto 'state of the art' equipment and question the people who built it in close detail.

Papers and workshops will be presented by amateurs who are acknowledged leaders in their field and many well-known amateur personalities will be confronting the audience.

The FACT Symposium has been modelled on the very successful FAMPARC Seminar held in Melbourne late November last year.

This Symposium promises to be *the* Amateur Radio event of 1978 -- don't miss it.

You can ensure your place by sending a $10 deposit right now to the FACT Symposium Organiser, c/o WIA, 14 Atchison Street, Crows Nest 2065. Cheques or money orders should be made out to the 'FACT Symposium Account'.

High Power VHF V-FETS

The communications Transistor Corporation has recently released a range of three V-FET devices for solid state VHF power amplifier applications characterised for operation at either 80 or 175 MHz.

Designated the BF25-35, BF50-35 and BF100-35, the devices can deliver 25, 50 and 100 W respectively of continuous-wave power. The three V-FETS provide a maximum gain of 10 dB at 175 MHz and source to drain breakdown voltage is more than 65 volts. Typical on-resistance for the 100 W BF 100-35 is quoted as less than one ohm for a drain current of 10 amps.

The 'new wave' of solid state power amps will undoubtedly use V-FETS which are more rugged than comparable bipolar devices as well as simplifying circuit design. The new FETS do not experience thermal runaway or breakdown and are more tolerant of load mismatch than bipolar devices. They rival bipolars in linearity as well, having similar third-order distortion figures and better higher-order figures by a factor of 5 -- 10 dB owing to the FET's law-type' transfer characteristics.

Smack, drool and all that, but what about the price?

CTC indicate that preliminary prices fc: 1-24 are as follows: for the BF25-35, $37.50 (US); for the BF50-35, $48.50 (US) and for the big one, the 100-35, $76.50 (US).

New Stripline Substrate

The 3M Company has recently announced a new substrate material for microstrip printed circuit applications.

It is called Epsilam-10 and consists of a ceramic-filled Teflon material. It has the electrical properties of aluminium oxide (used with microstripline circuitry in UHR IC's) but it can be cut with a razor blade or shears and can be etched like any other printed circuit material.

Halving Voice Bandwidth

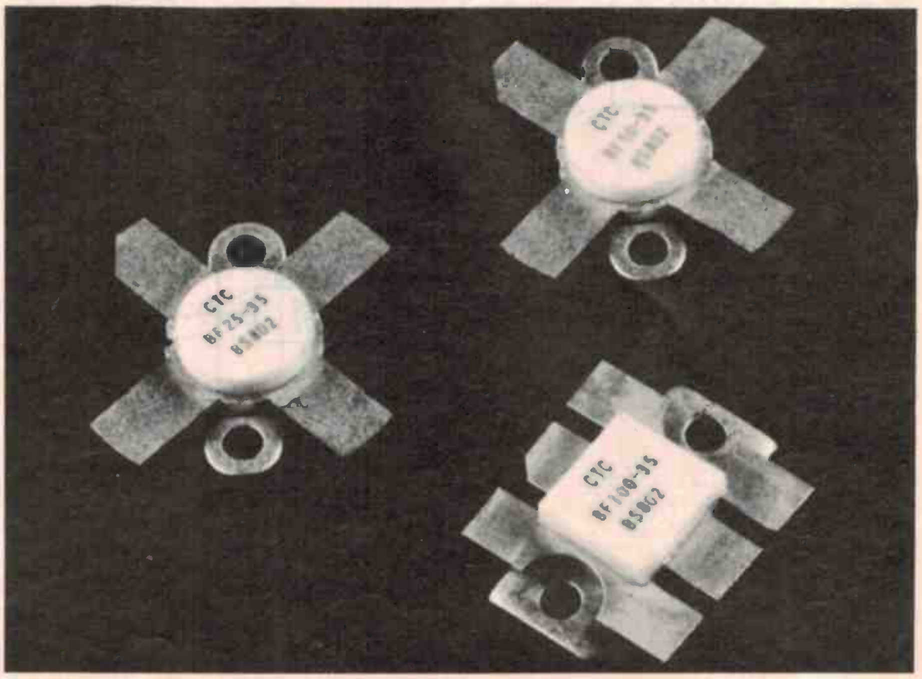
The December 1977 issue of QST published a rather exciting article on a new system of modulation which *halves the bandwidth* of voice transmissions.

Titled 'A New Era in Voice Communications' and written by Richard Harris (Assistant Professor, Electrical Engineering, University of Stockton, California) and Judy Gorski (Editorial Supervisor, QST), the article explains the principle of 'Narrow Band Voice Modulation' and details how amateur radio was involved in both the development and the first practical tests of the NBVM system.

Basically, the system works by taking advantage of the characteristics of speech. Consonants carry the bulk of speech identity and vowels and consonants are produced serially - one after the other, in time. Electronic circuitry emphasizes and 'folds' the consonants into blank spaces not occupied by vowels as you speak. The vowels and consonants do not interfere on transmission as they do not occur at the same time.

It is the folding action that accomplishes the saving in spectrum space.

First practical tests were carried out between Tom Lott, VE2AGF/W6 in San Mateo California and Clarence (Smithy)Smith, KH6BFF in Honolulu, Hawaii, in May last year.



SWL COMMUNICATIONS

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

Holland
Radio Nederland's schedule, effective until May, shows the following broadcasts aired at convenient times for reception in Australia: 0730-0820 GMT on 9770 kHz, 0730-0920 GMT on 9715 kHz, both these programmes beamed via the Bonaire relay station. 2030-2120 GMT 21640 and 17810 kHz (via Bonaire), 15220 kHz (via Lopik), and on 11730 and 11740 kHz (via the Madagascar relay station).

Florida transmissions of WYFR.
The religious broadcaster, Your Family Radio (WYFR), has provided details of transmissions via their new transmitters at Okeechobee in Florida. The station advises that reception reports of these Florida programmes are needed, and will be verified by a distinctive QSL card from the one issued for reports of their older transmitter site at Scituate in Massachusetts. Florida broadcasts in English until the end of April will be: On 17865 kHz: 1605-1700 GMT, 1800-2100 GMT. On 17845 kHz: 1700-1900 GMT, and on Sundays only 1230-1551 GMT. On 15440 kHz: 1700-1900 GMT. On 11815 kHz: 2100-2300 GMT.

Swaziland.
Trans World Radio at Manzini advises of its current broadcasts on the 16 metre band. These services may be heard until the end of April on the following schedule: On 17775 kHz: 1445-1500 in Lingala, 1500-1545 in French, 1915-1930 Lingala, and 1930-2015 in French. All programmes may be heard daily. Trans World Radio Manzini has plans to build two new 100 kilowatt transmitters to expand its coverage area to include South Asia and North and West Africa. At present, programming is beamed primarily for reception in Southern Africa.

African signals.
The Voice of Kenya has recently put a new transmitter into operation. The Swahili language service is now carried on 4933 kHz, and offers good reception in Australia from fade-in at about 1500 GMT, through until sign off at 2013 GMT. Swahili news was carried at 2000 GMT.

Voice of Zimbabwe.
This programme, broadcast via the facilities of Radio Mozambique at Maputo, is currently audible in Australia on 4855 kHz at 1800 GMT. An English station identification for Radio Mozambique is given at sign on, followed by the Voice of Zimbabwe programme in English. The Portuguese language programming of Radio Mozambique continues at 1816 GMT with musical selections.

More DX notes on page 101 . . .

The Australian Radio DX Club is a non-profit body, with headquarters in Melbourne. For further information on shortwave radio, and on the activities of the ARDXC, please write to the General Secretary, ARDXC, P.O. Box 67, Highett, 3190, Victoria, enclosing a 20c stamp.

TRANS WORLD RADIO

P. O. BOX CC, AGANA, GUAM 96910

YOUR STATION FOR INSPIRATION

KTWR

"For God so loved the world, that he gave his only begotten Son, that whosoever believeth in him should not perish, but have everlasting life."
John 3:16 (Kings James Version of the Bible)

KITS FOR ETI PROJECTS

We get many enquiries from readers wanting to know where they can get kits for the projects we publish. The list below indicates the suppliers we know about and the kits they do.

Any companies who want to be included in this list should phone LES BELL on 33-4282.

Key to companies:

- **A** Applied Technology Pty. Ltd. 109 - 111 Hunter St, Hornsby. 2077. NSW.
- **C** Amateur Communications Advancements, PO Box 57, Rozelle, NSW.
- **D** Dick Smith Pty. Ltd. of Crows Nest, NSW. (see Ads. for address).
- **E** E.D. & E. Sales, Victoria.
- **J** Jaycar Pty. Ltd. 405 Sussex St., Sydney 2000.
- **L** Delsound Pty. 1 Wickham Terrace. Queensland.
- **M** Mode Electronics. PO Box 365, Mascot 2020.
- **N** Nebula Electronics Pty. Ltd. 15 — 19 Boundary St., Rushcutters Bay 2011. NSW.
- **O** Appollo Video Games of Hornsby, NSW.
- **P** Pre-Pac Electronics. 718 Parramatta Rd., Croydon NSW 2132.
- **S** BKX Electronics Supply Service.179 Victoria St., Kings Cross. NSW 2011.
- **T** Townsville Electronics Centre. 281E Charters Towers Rd, Rising Sun Arcade, Hermit Park. 4812

PROJECT ELECTRONICS

ETI 041	Continuity Tester	DS
ETI 043	Heads or Tails	DATS
ETI 044	Two-Tone Doorbell	DATS
ETI 045	500 Second Timer	DS
ETI 047	Morse Practice Set	DS
ETI 048	Buzz Board	DS
ETI 061	Simple Amplifier	DATS
ETI 062	Simple Amplifier Tuner	DS
ETI 063	Electronic Bongo's	DS
ETI 064	Intercom	ATS
ETI 065	Electronic Siren	DS
ETI 066	Temperature Alarm	ADTS
ETI 067	Singing Moisture Meter	DS
ETI 068	Led Dice	ADS
ETI 072	2-Octave Organ	DS

TEST EQUIPMENT

ETI 101	Logic Power Supply	E
ETI 102	Audio Signal Generator	E,DS
ETI 103	Logic Probe	E
ETI 107	Widerange Voltmeter	E
ETI 108	Decade Resistance Box	ES
ETI 109	Digital Frequency Meter	E
ETI 111	IC Power Supply	ES
ETI 112	Audio Attenuator	ES
ETI 113	7-Input Thermocouple Meter	P,E
ETI 116	Impedance Meter	ES
ETI 117	Digital Voltmeter	E,AS
ETI 118	Simple Frequency Counter	E,AS
ETI 119	5V Switching Regulator supply	ETS
ETI 120	Logic Probe	L,ES
ETI 121	Logic Pulser	L,ES
ETI 122	Logic Tester	ES
ETI 123	CMOS Tester	ES
ETI 124	Tone Burst Generator	ES
ETI 128	Audio Millivoltmeter	L,ES
ETI 129	RF Signal Generator	L,ES
ETI 131	General Purpose power supply	E,N
ETI 132	Power Supply	NS

SIMPLE PROJECTS

ETI 206	Metronome	ET
ETI 218	Monophonic Organ	ET
ETI 219	Siren	ET
ETI 220	Siren	ET
ETI 222	Transistor Tester	ETS
ETI 232	Courtesy Light Extender	E
ETI 234	Simple Intercom	ET
ETI 236	Code Practice Oscillator	E
ETI 239	Breakdown Beacon	E

MOTORISTS' PROJECTS

ETI 301	Vari-Wiper	ET
ETI 302	Tacho Dwell	ET
ETI 303	Brake-light Warning	E
ETI 309	Battery Charger	P,E
ETI 312	CDI Electronic Ignition	P,ET
ETI 313	Car Alarm	E,DT

AUDIO PROJECTS

ETI 401	Audio Mixer FET Four Input	E
ETI 403	Guitar Sound Unit	E
ETI 406	One Transistor Receiver	ET
ETI 407	Bass A.p	E
ETI 408	Spring Reverb. Unit	E
ETI 410	Super Stereo	E
ETI 413	100 Watt Guitar Amp	P,L,E,J,DT
ETI 413	x 200 Watt Bridge Amp	SE
ETI 414	Master Mixer	E,J
ETI 414	Stage Mixer	E
ETI 416	25 Watt Amplifier	E
ETI 417	Amp Overload Indicator	E
ETI 419	Guitar Amp Pre-Amp	P.E.DT
ETI 420	Four-channel Amplifier	L,E
ETI 420E	SQ Decoder	E
ETI 422	International Stereo Amp	S L,E,D
ETI 422B	Booster Amp	E
ETI 422	50 Watt Power Module	E
ETI 423	Add-on Decoder Amp	E
ETI 424	Spring Reverberation Unit	S L,E
ETI 425	Integrated Audio System	E
ETI 426	Rumble Filter	E
ETI 427	Graphic Equaliser	S L,E,J
ETI 430	Microphone Line Amp	E
ETI 433	Active Crossover	E,J
ETI 435	Crossover Amp	E,J
ETI 438	Audio Level Meter	L,ES
ETI 440	Simple 25 Watt Amp	L,E
ETI 441	Audio Noise Generator	L,ES
ETI 443	Compressor-Expander	E,J
ETI 444	Five Watt Stereo	ES
ETI 445	Preamp	J,E,D
ETI 446	Audio Limiter	J,E
ETI 447	Phaser	E,J
ETI 449	Balanced Mic Preamp	J
ETI 480	50 W. 100 W Power Amp	A
ETI 480P	Power Supply	DAT
ETI 482A	Preamp Module	A
ETI 482B	Tone Controller	A
ETI 485	Graphic Equalizer	JS
ETI 480	50W, 100W Power Amp	A,D,B

MISCELLANEOUS

ETI 502	Emergency Flasher	E
ETI 503	Burglar Alarm	ET
ETI 505	Strobe	L,E,D
ETI 506	Infra-Red Alarm	E
ETI 509	50-Day Timer	E
ETI 512	Photographic Timer	E
ETI 513	Tape Slide/Synchroniser	E
ETI 514	Flash Unit — Sound Operated	E
ETI 515	Flash Unit — Light operated	E
ETI 518	Light Beam Alarm	ET
ETI 525	Drill Speed Controller	E
ETI 526	Printimer	E
ETI 527	Touch Control Light Dimmer	E
ETI 528	Home Burglar Alarm	P,ET
ETI 529	Electronic Poker Machine	E
ETI 533	Digital Display	L,E,AS
ETI 534	Calculator Stopwatch	A,D
ETI 539	Touch Switch	E
ETI 540	Universal Timer	ES
ETI 541	Train Controller	ET
ETI 543	Double Dice	A
ETI 544	Heartrate Monitor	A
ETI 528	Home Burglar Alarm	MS
ETI 583	Gas Alarm	M

ELECTRONIC MUSIC

ETI 601 4600	Synthesiser	J
3600	Synthesiser	J
ETI 602	Mini Organ	E,A,D

COMPUTER PROJECTS

ETI 630	Hex Display	A
ETI 631	VDU Keyboard Encoder	A
ETI 632	VDU 1 k x 8 Memory Card	A
ETI 633	VDU Sync Generator	A

RADIO PROJECTS

ETI 701	TV Masthead Amplifier	E,D
ETI 702	Radar Intruder Alarm	D
ETI 703	Antenna Matching Unit	E
ETI 704	Crosshatch/Dot Generator	L,A,D,ES
ETI 706	Marker Generator	ES
ETI 707	Modern Solid State Converters	C,E
ETI 708	Active Antenna	E
ETI 710	2 metre Booster	C,E
ETI 711B	Single Relay Remote Control	A
ETI 711C	Double Relay Remote Control	A
ETI 711R	Receiver	A
ETI 711AR	Remote Control Transmitter	A
ETI 711DR	Remote Control Decoder	A
ETI 740	FM Tuner	A
ETI 780	Novice Transmitter	E

ELECTRONIC GAMES

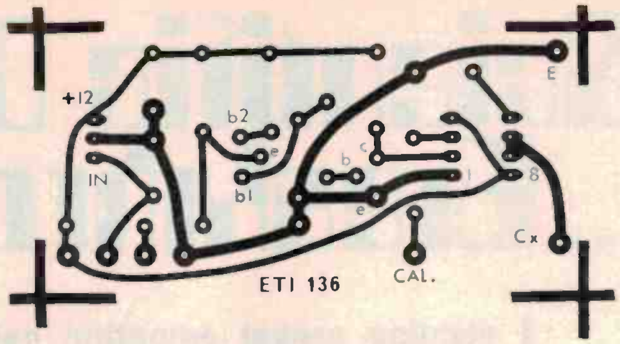
ETI 804	Selecta-Game	O,A,DS

Making negatives

This method can be used to copy ETI artwork from October 1977 on only. The film used is Scotchal 8007 which is UV sensitive and can be used under normal subdued light.

Cut a piece of film a little larger than the pc board and expose it to UV light through the page of the magazine. The non emulsion side should be in contact with the page. This surface can be detected by picking it up by one corner and it will curl towards this surface. Exposures of about 20 minutes are normally necessary.

The film can now be developed by placing it emulsion side up on a table, pouring some Scotchal 8500 developer on the surface and rubbing it with a clean tissue.



predictions

AMATEUR & SWL COMMUNICATIONS

Ionospheric Predictions for the month of April

THESE PREDICTION GRAPHS have been prepared courtesy of Amateur Communications Advancements from predictions supplied by the Ionospheric Prediction Service Division of the Department of Science.

The graphs indicate the maximum usable frequency (MUF) on HF circuits between various centres in Australia and selected points overseas.

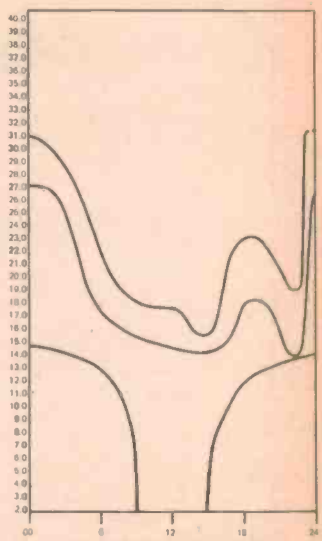
For less than 50% of the days of the month the highest frequencies propagated will be at least as high as the uppermost curve. Between 50% and 90% of the days of the month the MUF will be at least as high as the curve beneath the upper curve. The absorption limiting frequency (ALF), which affects the lowest frequencies that will be propagated, is indicated by the lower curves on the graphs.

Time is given in Universal Coordinated Time (UTC) along the horizontal axis.

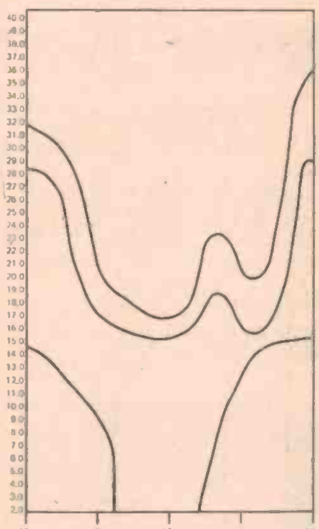
Frequency is given in 1 MHz increments up the side of the graphs from 2 MHz to 40 MHz.

Where the MUF exceeds the upper limit of the graph, six metre propagation is indicated, so VHF enthusiasts take note.

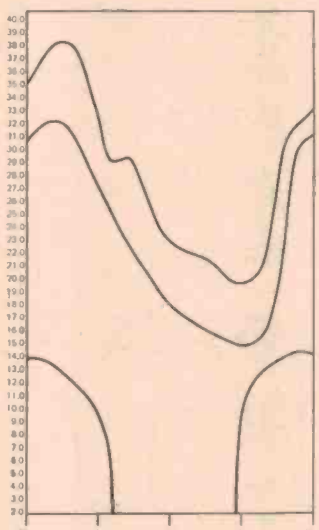
Note that areas adjacent to the points given for each prediction chart will experience similar propagation. For example, Canberra and SW NSW amateurs and SWLs may use the Sydney-Tokyo chart as a guide to working surrounding Asian areas such as Korea, Hong Kong and the nearby island chains. The Sydney-Ft. Collins chart may be used to indicate propagation to central and south USA.



PERTH-FT COLLINS
LENGTH 16257 KMS

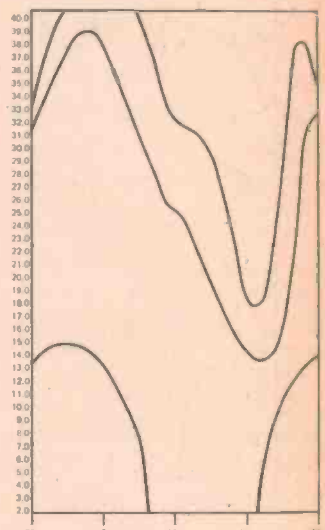


MELB-FT COLLINS
LENGTH 14143 KMS

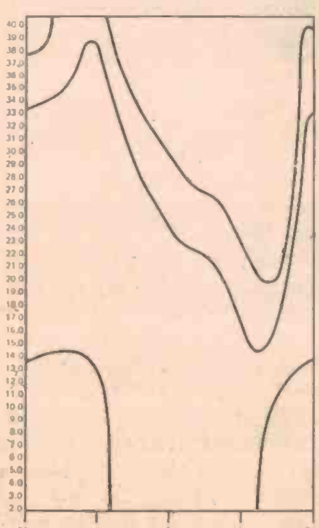


SYDNEY-HONOLULU
LENGTH 8203 KMS

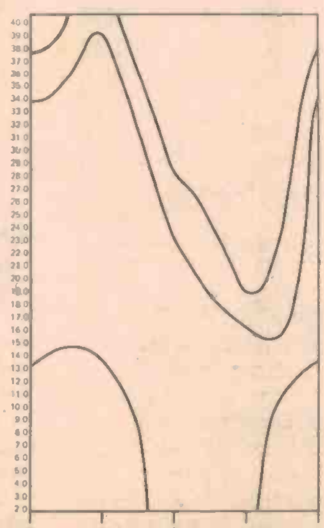
MELB'NE-HONOLULU
LENGTH 8879 KMS



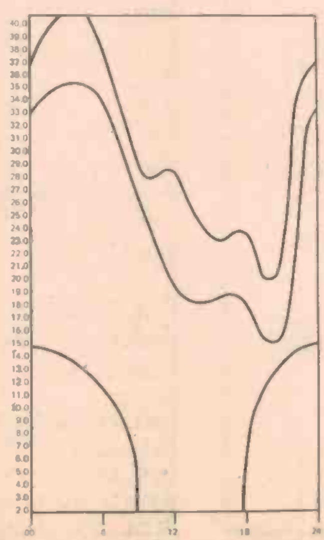
BRISBANE-TOKYO
LENGTH 7156 KMS



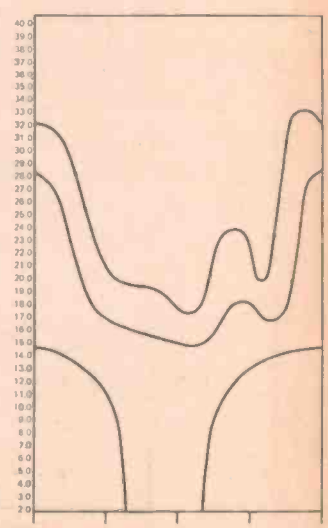
SYDNEY-TOKYO
LENGTH 7822 KMS



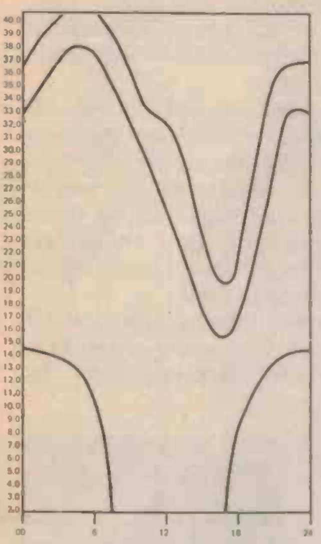
ADELAIDE-TOKYO
LENGTH 7853 KMS



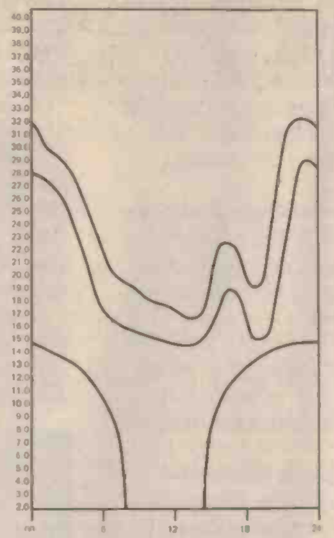
ADEL-HONOLULU
LENGTH 9206 KMS



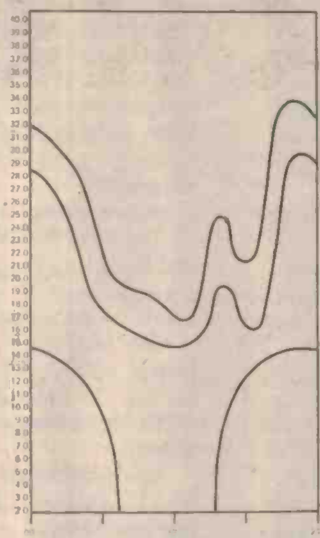
ADEL-FT COLLINS
LENGTH 14502 KMS



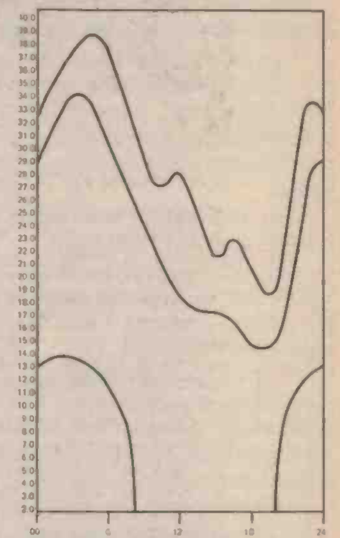
BRIS-HONOLULU
LENGTH 7610 KMS



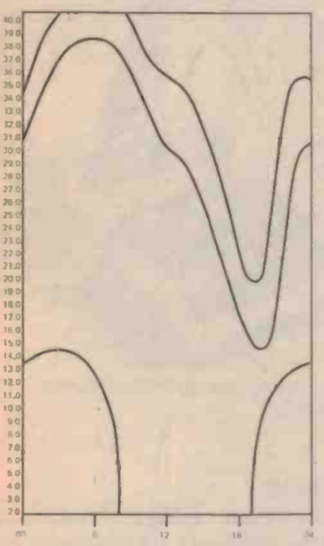
BRIS-FT COLLINS
LENGTH 12902 KMS



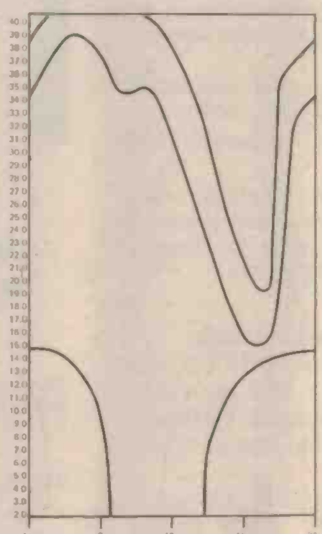
SYDNEY-FT COLLINS
LENGTH 13434 KMS



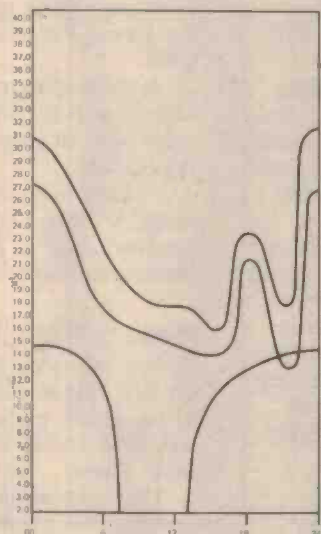
MELBOURNE-TOKYO
LENGTH 8190 KMS



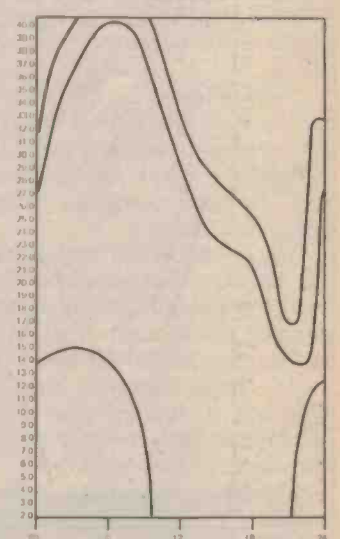
TOWNSVILLE-TOKYO
LENGTH 6144 KMS



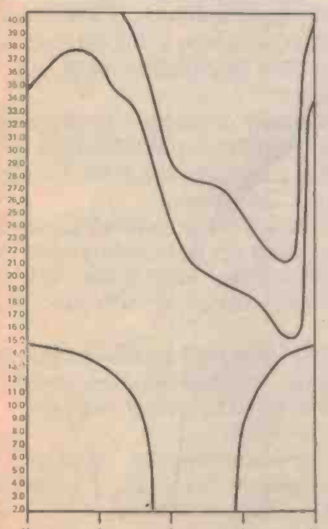
T'VILLE-HONOLULU
LENGTH 7558 KMS



TOWNS-FT COLLINS
LENGTH 12873 KMS



PERTH-TOKYO
LENGTH 7922 KMS



PERTH-HONOLULU
LENGTH 10967 KMS

SWL COMMUNICATIONS

DX news from Sri Lanka.

"Radio Monitors International" is a 15 minute DX programme broadcast each Sunday in the Overseas Service of the Sri Lanka Broadcasting Corporation. The programme consists of three segments: a station profile, a report on a technical topic, and DX Digest in which listeners reports are acknowledged. Radio Monitors International is prepared in India by the host, Adrian Peterson, and reception reports will be welcomed at the programme address, Box 15, Poona, India. All correct reports are acknowledged by a fully detailed verification card. Times to hear the programme are: 1100 GMT on 17850 kHz, 15120 kHz and 11835 kHz. 1900 GMT on 17850, 15115, 11870, 9720 and 7190 kHz. 0315 GMT on 15425 and 9720 kHz.

Norway broadcasts.

Radio Norway's schedule current until May shows the following transmissions at convenient times for listeners here in Australia 0700-0830 GMT to Australia and New Zealand on 11850 kHz, and to the Far East on 11895 and 15135 kHz. 1900-2030 GMT to the Pacific on 9610 kHz. 0500-0630 GMT to the Pacific on 9645 kHz. All Radio Norway's programmes are in the Norwegian language, except for the last half-hour of the Sunday broadcast, when an English language segment is aired.

CB NEWS

Kemtronics rigs and accessories

Lawrence and Hansen, claimed to be Australia's biggest electronic. electrical and instrument retailers/wholesalers, have introduced a range of CB rigs and accessories under their Kemtronic brand name.

The transceiver line begins with the CB500 economy AM rig.

This little 18 channel rig has the minimum of controls plus an S/RF meter and features a mic which plugs into the front panel.

Top of the Kemtronics line is the SSB1000, an 18 channel SSB/AM rig with an RF gain control, ANL and NB circuitry, and a large S/RF meter. The mic also plugs into the front panel.

The accessory line includes a range of three SWR/Field-strength meters.

The smallest (model 30-100) is a simple hand-held meter that measures only SWR and field strength on any frequency between 1.5 MHz and 150 MHz.

Next in line is the 30-102 model, a fairly conventional SWR meter that can also be used to measure power and field strength over the same frequency range.

It features a large meter with an easily read scale.

Top of the Kemtronics meter line is the 30-103 which measures SWR, power and field strength and also includes an antenna tuning unit. The 30-103 is obviously intended for base station use.

Two microphones, a noise-reducing type and a unidirectional type, are included in the accessory range along with an extension speaker.

The Kemtronics basic 18ch AM rig, the CB500 (top) and combination SWR/FS/ power meter and antenna tuner, model 30-103 (bottom).

An interesting item in the Kemtronic accessory range is a mobile noise suppressor kit, model 36-106 which includes power lead filters for the transceiver, ignition coil points, suppressor capacitor, generator/alternator suppressor etc.

The range of Kemtronic's antennas includes the usual centre-loaded magnet base, magnet base rubber duck and bottom-loaded trunk lip mount antennas.

Also included are two helical whips.

The model 33-103 is 1.3 metres long and has a slug tuning adjustment on the tip – no more chopping bits off – oops, too far – catastrophes!

The model 33-114 is a 1.5 metre helical with a short adjustable whip-section on the top for adjusting the SWR. No cutting problems with this one either.

Also worth mention is the model 33-112 antenna. This is a fibreglass, top-loaded whip – the type claimed to give the best performance of all loaded mobile whips.

It has a short adjustable whip on top for tuning the antenna to the lowest SWR.

A range of antenna mounting accessories is also available along with coax cables and an anti-theft transceiver locking bracket.

Further enquiries, brochures etc available from Lawrence and Hanson's head office at 142 Dorcas St, South Melbourne, 3205 (697-1599).

Philips UHF CB release in March

Philips will release their UHF CB, the FM320, late in March. It is expected to be on sale early April in Victoria and NSW and later that month in the other states.

The long awaited UHF FM rig features 40 channels, digital LED readout, automatic channel stepping and small size. It will come with a six month warranty and is expected to retail at around $330.

Hy-gain Bankrupt

We learned shortly before going to press that Hy-Gain in the United States have filed for bankruptcy.

Despite obtaining extended finance late last year following a disastrous $(US)24 million loss over the 1976-77 financial year, Hy-Gain have been unable to make headway with their CB product lines.

Hy-Gain Supported E.F. Johnson's bid to have the U.S. International Trade Commission put import restrictions on Japanese manufactured CB transceivers they claimed were severely affecting market prices in America.

Hy-Gain were represented in Australia by O.B.C. International Marketing P/L who were placed in the hands of a receiver late last year. O.B.C. were a division of the Luxor corporation. Executives from O.B.C. have declined to comment.

It has been reported that the collapse of Hy-Gain in the U.S. and their agent here will affect the supply of spare parts for Hy-Gain equipment. However, this is only likely to be significant in the long term. Apparently there are sufficient stocks to supply needs for the immediate to medium-term future.

Amtronics International have taken over the Hy-Gain agency from O.B.C. International Marketing here in Australia.

The latest preamp base mic from Turner – the Expander.

The Expander

The 'Expander 500' is Turner's newest pre-amplified base station microphone. It features separate volume and tone controls, built-in meter for reading both audio input and bettery condition and includes a six-wire cable making the Expander 500 compatible with all transceivers.

Compression circuitry compensates for varying mouth-to-mike distance and speech characteristics and reduces over-modulation distortion.

The sliding volume control adjusts the audio input for full modulation. The tone slider control adjusts the bass-treble balance for maximum speech clarity.

A push-to-test button shows battery condition on the dual-function meter.

The microphone head tilts for operator comfort.

For further enquiries, contact Communications Power Inc., on (02) 357-2022 or (02) 36-3703.

SEMCON MICROCOMPUTERS PTY. LTD.

ATTENTION MOTOROLA D2 OWNERS!

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Australian Designed and Built

- Fast Access 350 ns Chips (2102LF)
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- Write Protect
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- 298 Assembled with Parity
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Eight for $59.00

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THIS MONTHS SPECIALS

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2708 $18.50 — 2102 LFPC $1.90

1 Amp Positive Regulators T0220 $1.20

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74LS02 .33	74LS40 .37	74LS138 1.20
74L0S4 .34	74LS42 1.30	74LS160 1.20
74L0S05 .37	74LS47 1.30	74LS161 1.20
74LS08 .33	74LS74 0.55	74LS174 1.00
74LS09 .33	74LS75 0.70	74LS175 1.00
74LS10 .33	74LS85 1.58	74LS190 1.20
74LS11 .33	74LS86 0.60	74LS191 1.20
74LS13 .80	74LS90 1.20	74LS192 1.20
74LS14 1.40	74LS91 1.20	74LS193 1.20
74LS20 .33	74LS92 1.20	74LS367 .80
74LS30 .33	74LS93 1.20	

I.C. SOCKETS — LOW PROFILE

SOLDER		DIL — TIN		WIRE WRAP GOLD	
8	.25	22	.35	24	1.40
14	.35	24	.45	14	.70
16	.28	28	.50	16	.70
18	.35	40	.90		

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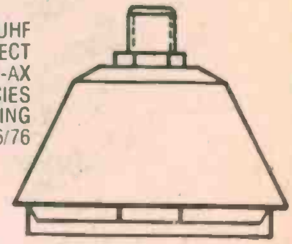
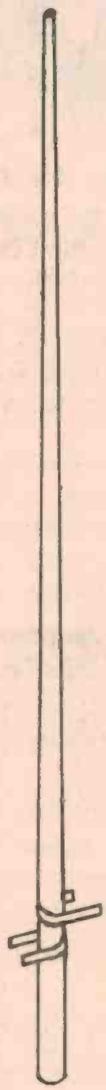
FOR CITIZENS BAND RADIO

DESIGNED AND MANUFACTURED IN AUSTRALIA

SCALAR'S UHF
MOBILE MOUNT FOR CORRECT
TERMINATION OF CO-AX
AT UHF FREQUENCIES
PAT. PENDING
No. 20506/76



MODEL OB



CB420
HIGH PERFORMANCE DUAL BAND
476 AND 27 MHz
MOBILE CO-LINEAR WHIP
GAIN AT 476 MHz 4.5 dB
OVERALL HEIGHT 42"

CB410
HIGH PERFORMANCE
4.5 dB GAIN MOBILE
WHIP. REQUIRES NO
TUNING. OVERALL
HEIGHT 21"

CB420

CB470 GDB GAIN CO-LINEAR
BASE ANTENNA. ENCLOSED IN
FIBREGLASS RADOME. LENGTH, 8ft.

A WIDE RANGE OF SCALAR UHF/CB AND 27 MHz CB ANTENNAS (FROM 30" to 108" LONG) AND ACCESSORIES ARE AVAILABLE FROM LEADING RETAILERS AND DISTRIBUTORS THROUGHOUT AUSTRALIA.

TRADE ENQUIRIES WELCOME.

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TELEPHONE 7259677.
CABLES WELKIN TELEX AA34341

NSW: 20 THE STRAND, PENSHURST 2222. TEL: 570-1392
QLD: 969 ANN ST, FORTITUDE VALLUE, QLD 4006
TEL: 52-2594. TELEX AA43007

Buying components can be great fun, especially when you only want 16 IC's from one manufacturer and 10 from another and a few 10W resistors and a couple of connectors and Purchasing is too busy to write out 6 fiddly little orders and then the relay supplier reckons you're joking when you say you need one in a hurry and he only takes orders in hundreds and then while you're wondering how the hell you're going to get the circuit together, you're thumbing through Electronics Today and you see this advert for a crowd that can supply all the parts and aren't put off by the quantities — large or small — and are small enough to care and they've even given you their telex number and they might just be the people to call and . . . . phew !

CLIP THIS OUT YOU NEVER KNOW WHEN YOU'LL BE NEEDING US !!

CAPACITORS, SEMICONDUCTORS — *Fairchild, ITT, National (NS), NEC, Motorola Signetics, Texas.* RELAYS — CONNECTORS — *Acme/Kings,* HEATSINKS — *Delco,* RESISTORS — *Soanar. Ferguson . . .*

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ED/ET1

STRIKE GOLD

SOVEREIGN CITY ELECTRONICS
Ballarat

PHILIPS — LOCMOS

HEF 4000	.30	HEF 4021	1.28	HEF 4050	.50	HEF 4082	.32
HEF 4001	.30	HEF 4022	1.22	HEF 4051	1.24	HEF 4085	.94
HEF 4002	.30	HEF 4023	.30	HEF 4052	1.24	HEF 4086	.94
HEF 4006	1.28	HEF 4024	.99	HEF 4053	1.24	HEF 4093	.96
HEF 4007UB	.30	HEF 4025	.30	HEF 4066	.80	HEF 4510	1.34
HEF 4008	1.24	HEF 4027	.57	HEF 4068	.33	HEF 4511	1.76
HEF 4011	.30	HEF 4028	.99	HEF 4069UB	.35	HEF 4512	1.86
HEF 4012	.30	HEF 4029	1.50	HEF 4070	.32	HEF 4516	1.76
HEF 4013	.50	HEF 4030	.52	HEF 4071	.30	HEF 4518	1.56
HEF 4014	1.28	HEF 4035	1.28	HEF 4072	.32	HEF 4519	.74
HEF 4015	1.24	HEF 4040	1.37	HEF 4073	.32	HEF 4520	1.41
HEF 4016	.52	HEF 4041	.99	HEF 4075	.32	HEF 4528	1.02
HEF 4017	1.24	HEF 4042	1.96	HEF 4076	1.86	HEF 4531	2.74
HEF 4018	1.28	HEF 4043	1.24	HEF 4077	.39	HEF 4539	1.12
HEF 4019	.73	HEF 4044	1.24	HEF 4078	.32	HEF 4555	1.02
HEF 4020	1.41	HEF 4046AE	2.92	HEF 4081	.30	HEF 4556	1.02

GENERAL ELECTRIC

SCR's		TRIACS & DIACS		UJT's & PUT's	
C 103B .8A 200V	1.14	SC1410 10A 400V	1.95	2N2646	1.24
C 10601 4A 400V	1.19	SC1510 15A 400V	1.37	2N2160	3.65
C 1220 8A 400V	2.11	ST2	.33	013T1 (2N6028)	1.88
C 122E 8A 500V	2.54	ST4	.60	013T2 (2N6027)	1.18

signetics TTL LOW SCHOTTKY

74LS00	.36	74LS30	.36	74LS74	.49	74LS93	1.23
74LS02	.36	74LS42	1.42	74LS78	.47	74LS95A	1.70
74LS04	.38	74LS51	.36	74LS85	1.99	74LS164	1.76
74LS10	.36	74LS55	.36	74LS86	.56	74LS196	1.70
74LS20	.36	74LS73	.47	74LS90	1.73	74LS367	1.19

signetics LINEAR

UA 741	.56
LM 301	.56
LM 308	1.43
LM 381	3.04
LM 382	2.69

TIMERS

NE 555	.64
NE 556	1.43

REGULATORS

LM 309K	2.56
LM 340T(V)	2.10
LM 723	.65
UA 78CU(V)	2.10

Transistors

AC127	65c
AC128	65c
AC187	65c
AC188	65c
BD137	60c
BD138	60c
BD139	65c
BD140	65c
BC547	22c
BC548	22c
BC549	22c
BC557	22c
BC558	22c
BC559	22c
2N3638	18c
2N4258	18c
MJE3055	80c

Polyester Film 100V Caps

capacity uf	1 ea	10 ea
.001 - .01	8c	6c
.012 - .033	10c	7c
.039 - .056	12c	9c
.068 - .18	14c	10c
.22 - .33	18c	15c
.39 - .56	22c	18c
.68 - .82	28c	24c

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1mfd	42c	3.3mfd	1.10
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2.2mfd	75c	6.8mfd	2.10

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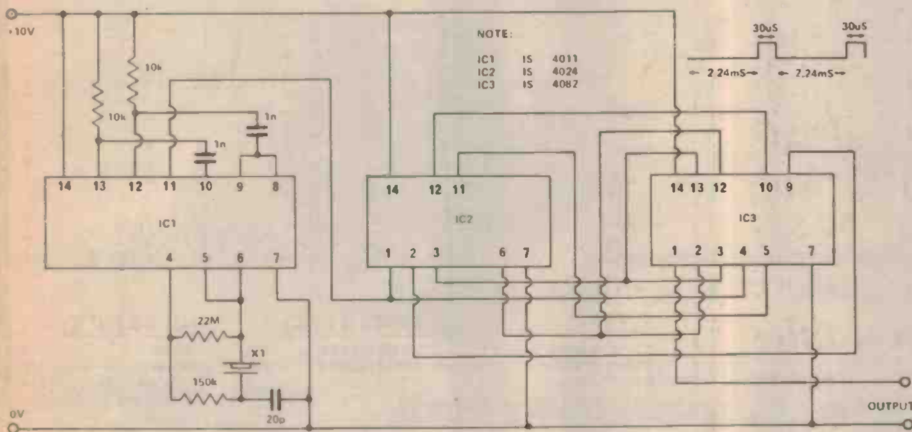
Ideas for experimenters

These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.
Electronics Today is always seeking material for these pages. All published material is paid for — generally at a rate of $5 to $7 per item.



A perfect . . . .

As any orchestral player knows, a source of 440 Hz, perfect or standard A is essential if he is to be in tune. On many occasions a piano will not be available — hence this circuit.

In the following a standard crystal at 32.768 kHz is used to stabilise an oscillator. This frequency is then divided by 149 and doubled to give 439.8 Hz, an error of only 0.05%!!!

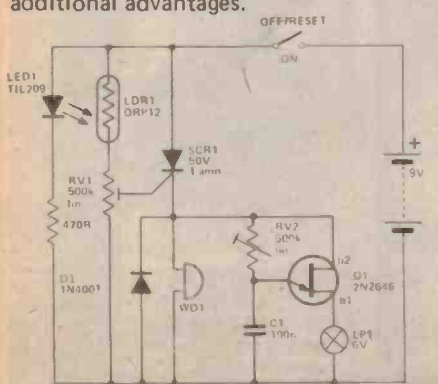
To enable a division of 149 to be obtained, a dual AND gate is used. The first gate detects the 149th pulse, and the second resets the binary counter on the 150th pulse.

The resulting 30us pulse may be fed to a suitable amplifier.

Bite Detector

Since there are many fishermen in the country, there must be many, who like myself, try to combine their hobby with electronics.

This circuit is for a simple bit detector, and construction of such a unit represents a considerable saving over the buying of a commercial instrument, while at the same time offering many additional advantages.



In operation, a piece of silver foil is folded over the line, and placed between the LED and the LDR. When a fish pulls on the line, the foil will jump up, and light will shine on the LDR, causing the resistance to go low, firing the SCR. Even if the foil drops again, due to its latching action, the SCR will remain on. WD1 will now emit a loud note, and the unijunction transistor, Q1, acts as a relaxation oscillator making LP1 flash (the rate of flashing being dependant on the setting of RV2). SW1 is the on/off reset switch.

The setting of RV1 will depend on the amount of light reaching the LDR under quiescent conditions. The circuit is, if anything, too sensitive and in strong winds or heavy currents, additional weighting of the line may be necessary, in this case lead foil should be used.

WD1 and LP1 may be taken from the unit via an extension lead, and kept by the anglers tent or sleeping bag. The

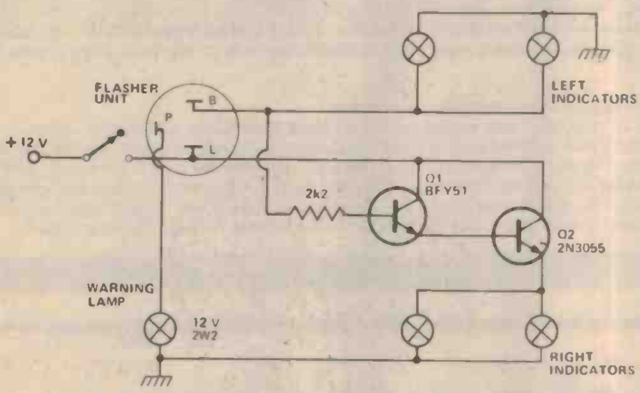
Continued on page 109 . . .

. . . from page 107

unit may be built onto a rod rest and should be fully waterproofed.

The device has other applications; it may be used as a burglar alarm with a "trip wire" type detector, or perhaps even as a device to tell you when the cat has come in!

WD1 should be the type of device that draws a continuous current once energised.



Hazard Warning Flasher

Hazard warning lights can be a life-saver in motor vehicles. But the high cost of commercial units prevents some people from fitting them. The circuit I have devised is both simple and inexpensive to install.

A flasher unit is used to operate the left hand indicators. At each flash a current of 5mA is supplied to the base of Q1, switching it on. The emitter now goes high switching on Q2 which connects the right hand indicators. If more lamps are to be lit (i.e. when a trailer is being towed) a more powerful flasher unit is required. As Q2 carries the full current of the right hand indicators (3.5A to 5.25A) it must be mounted on a suitably large heatsink. This can be achieved by fitting the circuit in an aluminium case 4" x 3" x 1¼" and mounting Q2 directly using a mica shim and rubber bushes to isolate it from earth. The flasher unit should be mounted on the outside of the case for ease of replacement.

The circuit shown is for negative earth, but is easily adapted for positive earth vehicles.

NPN-PNP Indicator

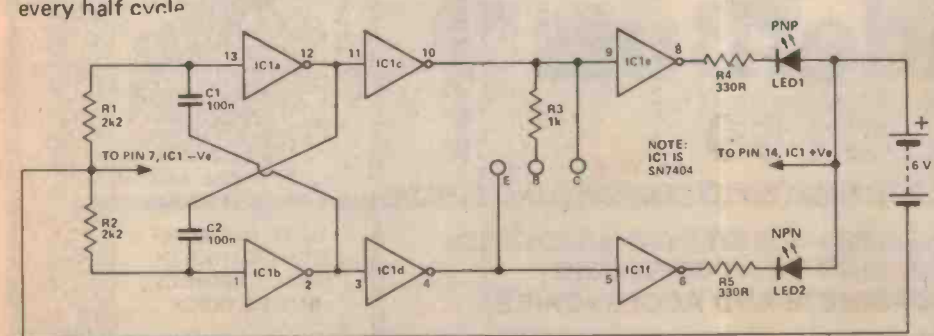
The first 2 inverters IC1a and IC1b form a multivibrator running at approximately 2 kHz. The next two inverters buffer the multivibrator outputs, which then go to the collector and emitter of the transistor under test.

The signal applied to the base of the transistor is always in phase with the collector so the transistor, whether PNP of NPN, will always be turned fully on every half cycle.

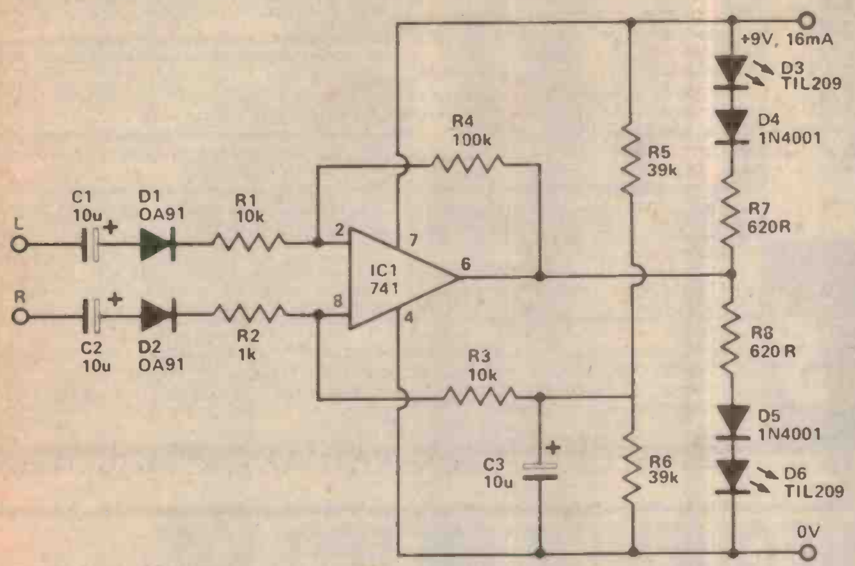
When a NPN transistor is being tested the collector will always be near OV and when a PNP transistor is being tested the emitter will always be near OV.

The last two inverters detect which terminal is held at OV and drive the appropriate LED via the current limiting resistors R4 and R5.

The six inverters needed are all contained in a single IC package – the SN7404.



Ideas for experimenters



Stereo Balance Meter

One of the more irritating aspects of owning a stereo system is the need to keep both channels in balance. What often sounds right when adjusting the controls turns out wrong when resuming one's normal listening position.

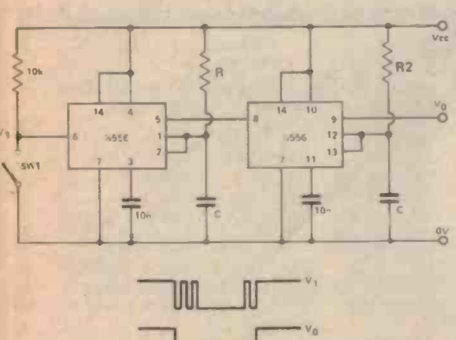
This circuit offers a solution to this problem provided that one's equipment is fitted with a stereo/mono mode switch.

IC1, a 741 op amp, is used as a differential amplifier. L and R signals are taken from across the speaker terminals. D1 and D2 rectify these and the resulting dc voltages are applied to the inputs of the IC.

The output voltage from the IC1 is applied to the LED's D3 and D6 via the current limiting resistors R7 and R8, and the diodes D4 and D5.

These latter components allow the LED's to extinguish at extremes of the IC's voltage swings.

To use the indicator, switch the amplifier into the mono mode and adjust the balance control until both LED's are equally illuminated. The amplifier can now be switched back into stereo mode and will be found to be in perfect balance.



Contact Debounce

The circuit described below can be used to provide contact debounce, or can be used as a dual retriggerable monostable.

With SW1 in the off position, pin 5 is low, and holds pin 9 high — the same as the input. When the switch closes, pin 6 goes low causing the monostable to start timing. Pin 5 goes high allowing pin 9 to go low. As the monostable is retriggerable, any contact bounce only extends the timing period.

When the timing period is complete, pin 5 remains high, due to pin 6 being held low by the switch. Releasing the switch allows pin 5 to go low which triggers the second monostable. Pin 9 now goes high and remains high after the timing period as pin 8 is being held low. Any bounces during this period merely retriggers the first monostable. For this reason, to ensure correct operation, the period of the second monostable must be twice that of the first.

The period of the bounce suppression is the timing period of the first monostable, and is given by:

$$T \text{ (seconds)} = 0.693 \times R \times C.$$

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.015 — 8c	.15 — 14c		
.018 — 8c	.18 — 14c		
022 — 8c	.22 — 16c		
.027 — 8c	.27 — 16c		
.033 — 8c	.33 — 18c		
.039 — 9c	.39 — 19c		
.047 — 9c	.47 — 22c		
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100 uF	10c($6)	12c($7)	14c($11)
220 uF	12c($8)	16c($10)	35c($17)
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ZENER DIODES: 15c each 400mW 5% E24 values 3V to 33V

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4A	30V C106V1	—	40
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10A 400V SC146D	—	$1.50
25A 400V SC260D	—	$2.50
DIAC S12	—	35
Chart to identify leads Plus trigger info.		15

DIODES:

1N4001	—	7c(1A 50V)
1N4002	—	8c(1A 100V)
1N4004	—	9c(1A 400V)
1N4007	—	12c(1A 1000V)
1N4148	—	6c $4.50/100 $38/1000

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Postage N.S.W. $2. Interstate $4. Registration $2, "Comet" — Sydney $2 insured. 'T.N.T.' Air-road courier, insured $6 anywhere in Australia.
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Please Note: The prices shown in December ETI were a misprint.

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242	300MA	150MA	198	0-12V at 150 MA x 2	2.50
111	0.5	0.25	283	0-12V at 0.25A x 2	3.25
213	1.0	0.5	425	0-12V at 0.5A x 2	4.00
71	2	1	793	0-12V at 1A x 2	6.00
18	4	2	1020	0-12V at 2A x 2	7.50
70	6	3	1538	0-12V at 3A x 2	9.50
108	8	4	2268	0-12V at 4A x 2	12.50
116	12	6	2722	0-12V at 6A x 2	14.00
115	20	10	5300	0-12V at 10A x 2	20.75

15/30 Volt Range: Primary 220-240 volts: Secondary Windings 0-12-15v at 5 amps, 0-5-9-15v at 5 amps. Voltages obtainable: 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30, or 12-0-12 or 15-0-15.

Ref. No.	Amps 15v	30v	Wt. gms.	Secondary Taps	$
51	10	5	3120	0-12-15, 0-5-9-15	15.00

30 Volt Range: Primaries 220-240 volts
Voltages obtainable 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30, or 12-0-12 or 15-0-15.

Ref.	Amps	Wt.Gms.	Secondary Taps	$
112	0.5	623	0-12-15-20-24-30	5.00
79	1	737	0-12-15-20-24-30	6.25
3	2	1361	0-12-15-20-24-30	8.50
21	4	2600	0-12-15-20-24-30	10.50
89	10	5670	0-12-15-20-24-30	21.75

50 Volt Range: Primaries 220-240 volts
Voltage obtainable: 6, 7, 8, 10, 14, 15, 17, 19, 21, 25, 31, 33, 40, 50, or 25-0-25

Ref.	Amps	Wt.	Secondary Taps	$
102	0.5	737	0-19-25-33-40-50 V	7.00
103	1	1304	0-19-25-33-40-50 V	8.00
104	2	2495	0-19-25-33-40-50 V	10.50
105	3	3176	0-19-25-33-40-50 V	12.50
106	4	4100	0-19-25-33-40-50 V	15.00
107	6	5444	0-19-25-33-40-50 V	22.00

60 Volt Range: Primaries 220-240 volts
Voltages obtainable: 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 or 24-0-24 or 30-0-30.

Ref.	Amps	Wt.	Secondary Taps	$
124	0.5	737	0-24-30-40-48-60 V	6.50
126	1	1361	0-24-30-40-48-60 V	8.00
127	2	2495	0-24-30-40-48-60 V	10.50
125	3	4083	0-24-30-40-48-60 V	15.50
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207	500, 500	566	0-8-9, 0-8-9	5.25
205	500, 600	1077	0-15-20, 0-15-20	6.00
214	300, 300	623	0-20, 0-20	4.00
221	700 (DC)	737	20-12-0012-20	6.50
206	1A 1A	1304	0-15-27, 0-15-27	9.00
203	500, 500	822	0-15-27, 0-15-27	8.50
204	1A 1A	1417	0-15-27, 0-15-27	12.00

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7403	.14	7460	.20	74158	1.39
7404	.16	7464	.35	74160	1.23
7405	.19	7465	.35	74161	.95
7406	.29	7470	.38	74162	1.39
7407	.28	7472	.35	74163	.95
7408	.22	7473	.35	74164	.95
7409	.17	7474	.31	74165	.95
7410	.16	7475	.49	74166	1.19
7411	.25	7476	.34	74170	1.90
7413	.43	7483	.68	74173	1.49
7414	.65	7485	.88	74174	1.19
7415	.25	7486	.38	74175	.95
7416	.35	7489	2.25	74176	.84
7417	.35	7490	.43	74177	.84
7420	.16	7491	.75	74180	.95
7423	.37	7492	.48	74181	2.30
7425	.35	7493	.48	74182	.85
7426	.22	7494	.75	74185	2.20
7427	.35	7495	.75	74190	1.25
7430	.20	7496	.75	74191	1.15
7432	.23	74100	1.15	74192	.89
7437	.25	74107	.37	74193	.85
7438	.25	74121	.37	74194	1.15
7439	.50	74122	.38	74195	.74
7440	.15	74123	.45	74196	.98
7441	.85	74125	.54	74197	.95
7442	.59	74126	.58	74198	1.69
7443	.65	74132	.75	74199	1.69
7444	.73	74141	.85	745200	3.95
7445	.65	74145	.90	74279	.79
7446	.81	74150	.98		
7447	.59	74151	.68		
7448	.79	74153	.60		
7450	.17	74154	1.20		

LOW POWER SCHOTTKY

74LS00	.36	74LS32	.38	74LS95	2.09
74LS02	.36	74LS40	.45	74LS107	.59
74LS04	.36	74LS42	1.40	74LS164	2.20
74LS08	.38	74LS74	.59	74LS193	2.20
74LS10	.36	74LS90	1.30	74LS197	2.20
74LS20	.36	74LS93	1.30		

LOW POWER

74L00	.29	74L51	.29	74L90	1.40
74L02	.29	74L55	.29	74L91	1.20
74L03	.23	74L71	.29	74L93	1.50
74L04	.29	74L72	.45	74L95	1.50
74L06	.29	74L73	.56	74L98	2.25
74L10	.29	74L74	.56	74L164	2.25
74L20	.29	74L78	.75	74L165	2.30
74L30	.29	74L85	1.09		
74L42	1.39	74L86	.65		

HIGH SPEED

74H00	.25	74H22	.25	74H61	.25
74H01	.25	74H30	.25	74H62	.25
74H04	.25	74H40	.25	74H74	.39
74H08	.25	74H50	.25	74H101	.58
74H10	.25	74H52	.25	74H102	.58
74H11	.25	74H53	.25	74H103	.60
74H20	.25	74H55	.25	74H106	.72
74H21	.25	74H60	.25	74H108	.72

CMOS

4000A	.26	4018A	1.39	4066A	.89
4001A	.25	4020A	1.72	4068A	.44
4002A	.25	4021A	1.18	4069A	.44
4006A	1.35	4022A	.94	4071A	.26
4007A	.26	4023A	.25	4072A	.35
4008A	1.52	4024A	.89	4073A	.39
4009A	.57	4025A	.25	4075A	.39
4010A	.54	4027A	.59	4078A	.39
4011A	.29	4028A	.98	4082A	.35
4012A	.25	4030A	.44	4518A	1.56
4013A	.45	4035A	1.27	4528A	1.56
4014A	1.27	4040A	1.19	4585A	2.10
4015A	1.27	4042A	1.47		
4016A	.48	4049A	.59		
4017A	1.01	4050A	.59		
74C00	.19	74C74	1.04	74C162	2.49
74C02	.26	74C76	1.34	74C163	2.66
74C04	.44	74C107	1.13	74C164	2.66
74C08	.68	74C151	2.62	74C173	2.22
74C10	.35	74C154	3.15	74C195	2.26
74C20	.35	74C157	1.76	80C95	1.15
74C42	1.61	74C160	2.48	80C97	.96
74C73	1.04	74C161	2.49		

CERAMIC DISC CAPACITORS

1pf 50V	56pf 50V	270pf 50V	.01uf 1000V
5pf 50V	68pf 50V	390pf 50V	022uf 50V
7pf 50V	82pf 50V	470pf 50V	030uf 50V
10pf 50V	100pf 50V	600pf 50V	050uf 50V
22pf 50V	120pf 50V	820pf 50V	1uf 50
27pf 50V	150pf 50V	001uf 50V	
33pf 50V	180pf 50V	0047uf 50V	
47pf 50V	220pf 50V	01uf 50V	

	(each)	(Minimum 10 per value)
0-100	$.10 ea	$.05 ea
100-		$.04 ea

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7416	$ .19
7430	.16
7432	.19
7437	.19
7438	.19
7440	.13
7445	.49
7495	.55
74123	.25
74141	.59
75LS60	.99

LINEAR SPECIALS

LM300 TO-5	$ .49
LM302 TO-5	.39
LM307 mDIP	.19
LM308 TO-5	.59
LM311 TO-5	.49
LM311 mDIP	.49
340T-5V	.79
340T-6V	.79
340T-15V	.79
LM380-8 mDIP	.69
LM565 DIP	.89
LM723 DIP	.39
LM739 DIP	.79

5738 CALC. CHIP 5 FUNCT WITH MEMORY $2.95

MARK I CLOCK KIT
6 DIGIT CLOCK KIT WITH ONE PC BOARD. ACCOMMODATES MM5314 CLOCK CHIP AND 6 FND359 DISPLAYS. CONTAINS ALL COMPONENTS, 3 SWITCHES AND ASSEMBLY INSTRUCTIONS. HAS TERMINALS FOR ADDITIONAL REMOTE DISPLAY. **$10.95**

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2510	$1.75
2511	1.95
2518	2.50
2522	1.95
2532	2.29
5016	.89

CERAMIC DISC CAPACITOR PACKAGE

10 EA. OF FOLLOWING VALUES — 50 VOLT

1pf	33pf	82pf	220pf	820pf	.022uf
5pf	47pf	100pf	270pf	.001uf	.030uf
10pf	56pf	150pf	470pf	.0047uf	.050uf
22pf	68pf	180pf	600pf	.01uf	.1uf

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2708 FULL SPEED EROM **$10.95**

5314 6 DIGIT CLOCK CHIP **$2.95**

1702A **$3.95**

74S200 256 BIT RAM TRI-STATE **$3.25**

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LD110, LD111 3½ DIGIT A/D CONVERTER SET **$24.75**

2513 CHARACTER GEN 64 x 8 x 5 ASCII **$6.95**

82S23 256 BIT PROM **$2.95**

Clock Kit

MM5314 with 6 NS71 .27" displays 2 P.C. boards — Display board may be remote. Internal or wall transformer can be used. 50-60 Hz, 12-24 hour. Includes all necessary transistors, resistors, capacitors, diodes, 3 switches and complete assembly instructions.

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CALCULATOR CHIPS

CT5002	12 digit, 4 function fixed decimal battery operation — 40 pin	1.95
CT5005	12 digit, 4 function plus memory, fixed decimal — 20 pin	2.49
MM5725	8 digit, 4 function, floating decimal 18 pin	1.98
MM5736	6 digit, 4 function, 9V battery operation — 18 pin	2.95
MM5738	8 digit, 5 function plus memory and constant floating decimal, 9V battery operation — 24 pin	3.95
MM5739	9 digit, 4 function, 9V battery operation — 22 pin	3.95

OPTO ISOLATORS

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MCT2	Opto isolator transistor	1.09

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LONG LIFE — HIGH RELIABILITY
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NO MOVING CONTACTS
NO ARCING — NO RF NOISE
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78 dB min AT 1 FT. — 450 Hz

				EA
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16 pin	.22	40 pin	.69
18 pin	.29		

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Voltage controlled oscillator — sine, square, triangular output. **$3.95**

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4½ DIGIT DVM LOGIC **$ 4.95**

SIGNAL DIODES — 400 MW
20/$1.00

CALCULATOR DISPLAY
9 MAN 3 M ON PC BOARD

$ .75 ea.

Jumbo LED'S
green - yellow amber - clear 16¢ ea.

ZENER DIODE — 400MW
3.6V 5.1V 6.8V 15V
4.7V 5.5V 10V **$ .15 EA.**
8/$1.00 ANY MIX

RESISTOR PACKAGE

CARBON FILM ± 5% ¼ or ½W
15 EA. OF THE FOLLOWING VALUES
100, 220, 470, 1K, 1.5K, 3.3K, 4.7K, 6.8K, 10K, 33K, 100K, 1M

180 RESISTORS **$5.45**

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DL702	RED CC .30" LHD	.99
DL707	RED CA .30" RHD	.99
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LITRONICX 1802 MEMORY

CALC. KIT ONLY **$7.95**
ADAPTER 60Hz **$3.95**

RESISTOR PACKAGE

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USAGE EVALUATED ASSORTMENT
455 RESISTORS, 44 VALUES
$12.95

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20 KEYS
2 SLIDE SW
3" x 3½

$ .99

ELECTRONIC DOOR CHIME KIT

WITH TI TMS 1000 MICROPROCESSOR CHIP PROGRAMMED TO PLAY 24 DIFFERENT TUNES

$39.50 SHIPPING $1.00

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ME4 Infrared Clear	.17" dig.	$.29
MV10B Clear TO-18	.17" dig	.25
MV50 Clear - axial	.09" dig.	.12
NSL100 Red - point	.19" dig	.12
RL209 Red diff.	.12" dig	.12
RLT-T1-03 White diff. no flange	.124" dig.	.15
RLC200 Red diff Current reg	.19" dig.	.25
RL4403 Red diff.	.19" dia	.15
Jumbo Green, yellow amber or clear - diff.	.19" dia.	.18

LINEAR CIRCUITS

LM300H	.71	LM372N	2.93	LM733H	79
LM301CN	28	LM376CN	59	LM739N	99
LM302H	65	LM380N	1.29	LM741CN(8)	32
LM304H	80	LM380-8CN	95	LM741CN(14)	32
LM307CN	28	LM381N	1.75	LM741CH	35
LM307H	30	LM382N	1.75	LM747H	79
LM308H	89	LM385K	45	LM747N	71
LM309H	1.05	NE531V	2.90	LM748CN	35
LM309K	99	NE540L	2.90	LM1310N	2.80
LM310CN	1.07	NE548A	1.00	LM1414N	1.59
LM311CN	89	NE550A	75	LM1458CN	1.29
LM317H	89	LM555CN	39	LM1458CN	59
LM319N	89	NE556A	85	LM1496N	89
LM319N	1.13	LM560N	2.95	LM1800N	2.48
LM320K		LM561N	2.95	ULN2208	69
5, 5.2, 12, 15	1.29	LM565N	1.19	ULN2209	89
LM320T		LM565H	1.39	CA3046	1.19
5, 12, 15	1.19	LM566N	1.39	CA3081	1.49
LM322N	1.59	LM566CN	1.19	LM3900N	49
LM324N		LM567CN	1.29	LM7524	79
ILM2902N	1.52	LM567H	1.49	LM7525	79
LM339N	1.58	LM703H	59	80388	4.59
LM340K		LM703CN	39	75451CN	35
5, 6, 8, 12		LM709N	25	75452CN	35
15, 18, 24	1.29	LM709H	20	75453CN	35
LM340T		LM710N	59	75454CN	35
5, 6, 8, 12		LM711N	39	75491N	71
15, 18, 24		LM723H	55	75492N	65
(78 — Equiv.)	1.19	LM723N	52		
XR320	1.15	XR2567	1.99	XR4212	1.75
XR2206	2.95	XR4136	1.75	XR4739	1.15
XR2207	2.95	XR4202	1.75		

TANTALUM CAPACITORS

Solid dipped ±20%

.1 mfd	35V	$ .25	10 mfd	16V	$ .40
.33 mfd	35V	.25	10 mfd	25V	.45
1 mfd	35V	.25	15 mfd	10V	.40
2.2 mfd	20V	.25	15 mfd	20V	.45
2.2 mfd	35V	.30	22 mfd	16V	.45
3.3 mfd	35V	.30	33 mfd	10V	.40
4.7 mfd	16V	.30	47 mfd	6V	.40
6.8 mfd	6V	.30	56 mfd	6V	.45
6.8 mfd	50V	.40	150 mfd	15V	1.50

MM5369 Divider mDIP	2.49
Crystal 3.58 MHZ color TV	1.75
Crystal 2.010 MHZ	1.95

CARBON FILM RESISTORS 5%

¼W — ALL STANDARD VALUES FROM .56 OHMS TO 5.6M OHMS
½W — ALL STANDARD VALUES FROM 1 OHM TO 15M OHMS

QTY	PRICE (each)	PRICE (Minimum 10 per value)
0-10	$.10 ea	
10-100	$.10 ea	$.05 ea
100-1000		$.04 ea

METAL FILM RESISTORS 1%

STANDARD DECADE VALUES FROM 10.5 OHM TO 464K OHM

	EACH	MINIMUM 10 PER VALUE	MINIMUM 100 PER VALUE
0 - 10	$.20		
10 - 100		.20	$.15
100 -		.10	$.04

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Accommodates 5 16 pin IC's with additional interconnection holes. 1/16" phenolic with silver plated copper circuits. 2 5/16" x 6 9/16" **$1.80 ea.**

UNIVERSAL BREADBOARD
Silver plated copper circuit board 4-1/16" x 5-1/16". 2 rows of 27 holes for DIP IC's, space for transistors, resistors & capacitors. Versatile and simple for bread boarding IC circuitry. **$1.50 ea.**

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A MODERN MAGAZINES PUBLICATION

Managing Director: Arnold Quick
Secretary: Charles O'Leary
Publisher: Collyn Rivers

PRODUCTION

Art Director: Jim Hattersley
Assembly: Eric Osojnik
Production Manager: Roy Leaght
Subscriptions & Circulation: John Oxenford
Project Design: Nebula Electronics
Acoustical Consultants: Louis A Challis & Assoc.

ADVERTISING

Sydney: Bob Taylor (Manager), Geoff Petschler (NSW Manager), 15 Boundary St, Rushcutters Bay 2011. Tel: 33-4282.
Melbourne: Tom Bray (Manager), Poppe Davis, Suite 24, 553 St. Kilda Rd, Melbourne. Tel: 51-9836.
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Adelaide: Ad Media Group of SA, 37 Fullarton Rd, Kent Town 5067. Tel: 42-4858.
Perth: Aubrey Barker, 38 Mounts Bay Rd, Perth. Tel: 322-3184.
Hobart: H.W. Lincolne Advance Publicity, 281 Elizabeth St, North Hobart, 7000.
Tokyo: Genzo Uchida, Bancho Media Service, 15 Sanyeicho, Shintuku-Ku, Tokyo 160.
London: Electronics Today International, 25-27 Oxford St, London, W1R 2NT. Tel: 01 434-1781/2.

Electronics Today International is published by Modern Magazines (Holdings) Ltd, 15 Boundary St., Rushcutters Bay NSW 2011. It is printed (in 1978) by Wilke & Co., Browns Rd, Clayton, Victoria and distributed by Australian Consolidated Press.

Advertisers: Index:

The competition don't like the sound of this at all.

For quite some time, other manufacturers have been trying to produce tape with the qualities of the Maxell UD-XL. At the same time, Maxell have been quietly perfecting an even better series.

The UD-XL I and UD-XL II tapes are designed to attain maximum performance at the ferric and chrome position on your tape deck. Whichever tape position you choose, Maxell can give you a better performance.

UD-XL I TAPE, FOR FERRIC (norm.) POSITION (120us)

UD-XL I offers an excellent sensitivity of 1 dB higher than even UD-XL. MOL performance is also 1 dB higher over the entire audio frequency spectrum. The result is a new standard in ferric tape, with wider dynamic range and less distortion than ever before.

How does the UD-XL I compare then, with ordinary low-noise tapes?

Sensitivity is higher by 2.5 dB, and MOL performance by as much as 6 dB.

Yet, for all this UD-XL I requires no special bias or equalization. Simply set your tape selector as you normally would at the ferric position – but there the comparison ends.

UD-XL II TAPE, FOR THE CHROME POSITION (70us)

UD-XL II tape is such a dramatic improvement on most other tape that can be used in this position, that comparison is really unfair.

For example, if you're familiar with conventional chromium-dioxide tape, you'll know of the associated problems of head wear, poor output uniformity and relatively high price – plus low maximum output level and rather high distortion.

UD-XL II tape offers you excellent MOL, sensitivity, and an output improvement of more than 2 dB over the entire frequency range.

Maxell's unique 'Epitaxial' process gives you absolute sensitivity and stability, and no drop-out problems. What's more, the shells are moulded in diamond cut dies, and made to tolerances 5 times greater than the Philips standard. And, like all Maxell tapes, UD-XL II has the unique 5-second cleaning leader.

In short, if you're recording in the chrome position, you can now achieve all the advantages – with none of the drawbacks.

A prospect we think you'll find very exciting – even if the competition don't.

maxell®
simply excellent

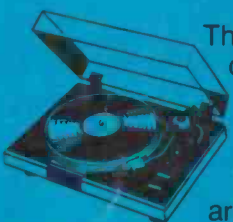
For details on all Maxell Recording Tape write to Maxell Advisory Service, P.O. Box 49, Kensington, N.S.W. 2033

WT3/79

What's the real advantage of owning matching stereo components?

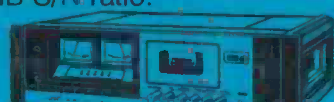
Matched stereo components are not simply components that are designed to look alike. Instead they are matched to deliver the right kind of balanced performance that will bring out their very best musicality under all conditions of use. The real advantage of owning matched stereo components is the way they work together in the areas of critical performance, such as input/output power levels, distortion and signal to noise ratio. The way they deliver what we at JVC like to call The Musical Truth.

The Musical Truth is something special in sound. It's an indication that your records sound as good in your listening room as they did when they were cut in the studio, or your tapes just as good as the original sound or music you recorded. Only superior components . . . matched to handle the fine nuances of music can create pure Hi-Fi entertainment for your enjoyment. That's why if you're serious about music, you'll want matched components . . . just like these JVC units we've pictured here.



The JL-A40 direct-drive turntable is a beauty in its own way, what with automatic operation for arm cut/shut-off, a beautifully realistic price, low 0.03% wow/flutter & high 70 dB S/N ratio.

The KD-S200 II stereo cassette tape deck matches the best-selling JVC knobless receiver line. You can stack it with the receiver, co-ordinate the design of your system, operate everything from the front. It features a wide 30-16,000Hz (chrome, typical) frequency response and a high 56 dB S/N ratio.



The JR-S300 II FM/AM stereo receiver gives you dependable power output (50W RMS per channel, THD 0.1%), advanced tuner circuitry (usable sensitivity 10.8dBf) and the unique JVC five tone-zone S.E.A. Graphic Equalizer.

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Balanced performance!

For pure Hi Fi entertainment!

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WT78/1