ELECTRONICS Australia

HiFi, Radio & Computers

OCTOBER 1979

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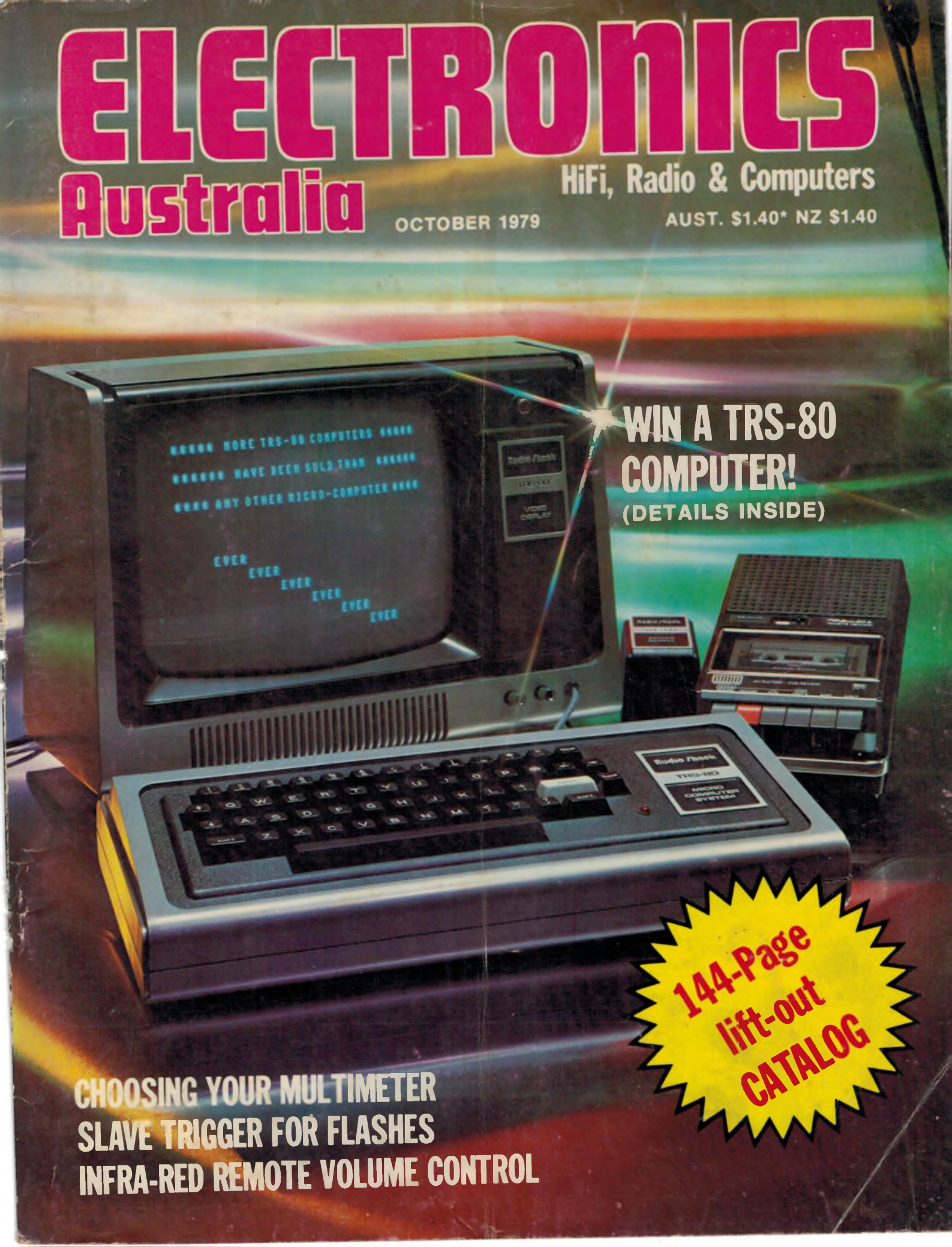


WIN A TRS-80 COMPUTER!

(DETAILS INSIDE)

144-Page lift-out CATALOG

CHOOSING YOUR MULTIMETER

SLAVE TRIGGER FOR FLASHES

INFRA-RED REMOTE VOLUME CONTROL

ULTIMATE.

Philips High Fidelity Laboratories.

In any range of equipment there is a leader. One which sets the standard by which the others are measured.

With Philips Hi-Fi Stereo, the Hi-Fi Laboratories range stands at the very top.

These state-of-the-art Hi-Fi components, which were developed in America, offer precision craftsmanship, technical perfection and outstanding performance.

High-Fidelity Pre-Amplifier

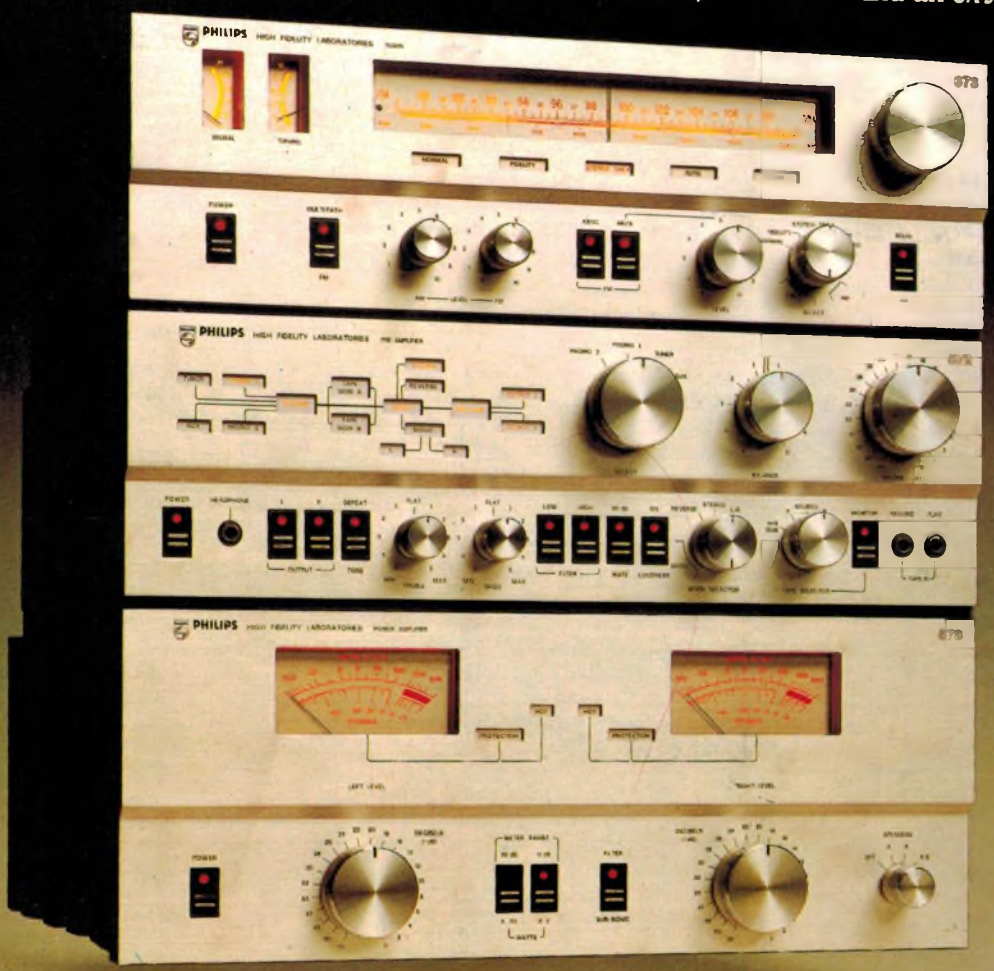
The AH 572 High-Fidelity Stereo Pre-Amplifier is an ultra-low distortion (0.008%) two-channel unit featuring high-accuracy step detent controls, illuminated function readouts and touch switches with LED indicators for smooth, silent, sophisticated programming. It also includes adjustable phono input levels and a tape selector that provides five separate tape modes.

High-Fidelity Stereo AM/FM Tuner

The AH 673 High-Fidelity Stereo AM/FM Tuner incorporates touch switches with LED indicators and illuminated function readouts. Other features include ASNC (Automatic Stereo Noise Cancelling). Separate level controls for AM and FM. An FM interstation disturbance mute. And an exclusive AM centre-tuned meter for wide-band full fidelity AM reproduction.

High-Fidelity Stereo Power Amplifier

The 210 watts RMS per channel high-performance AH 578 High-Fidelity Stereo Power Amplifier completes the Philips Hi-Fi Laboratories range. It comprises high-accuracy step detent controls, touch switches with LED indicators and illuminated power meters and protection indicators. Also incorporated in the AH 578 are a sub-sonic filter, thermal and overload protection, and provision for connecting two pairs of loudspeaker systems.



Philips Hi-Fi Laboratories Range. A step closer to sound perfection.

PHILIPS

We want you to have the best PHILIPS

ELECTRONICS Australia

Volume 41 No. 7 October, 1979

Australia's largest selling electronics magazine

Developed in our laboratory, this infra-red remote control lets you adjust the volume of your hifi system from the comfort of your armchair. Find out how to build it on page 38.

Our latest slave flash trigger is based on a low-cost silicon solar cell and is specially designed to eliminate false triggering. The details are on page 50.

On the cover

Tandy's TRS-80 is probably the world's largest selling home computer. You could win a 4K/Level 1 machine just like the one pictured by entering the Tandy Electronics Grand Software Contest. Turn to page 65 for the details.

FEATURES

HIFI TOPICS AND REVIEWS

PROJECTS AND CIRCUITS

SPECIALLY FOR THE NEWCOMER

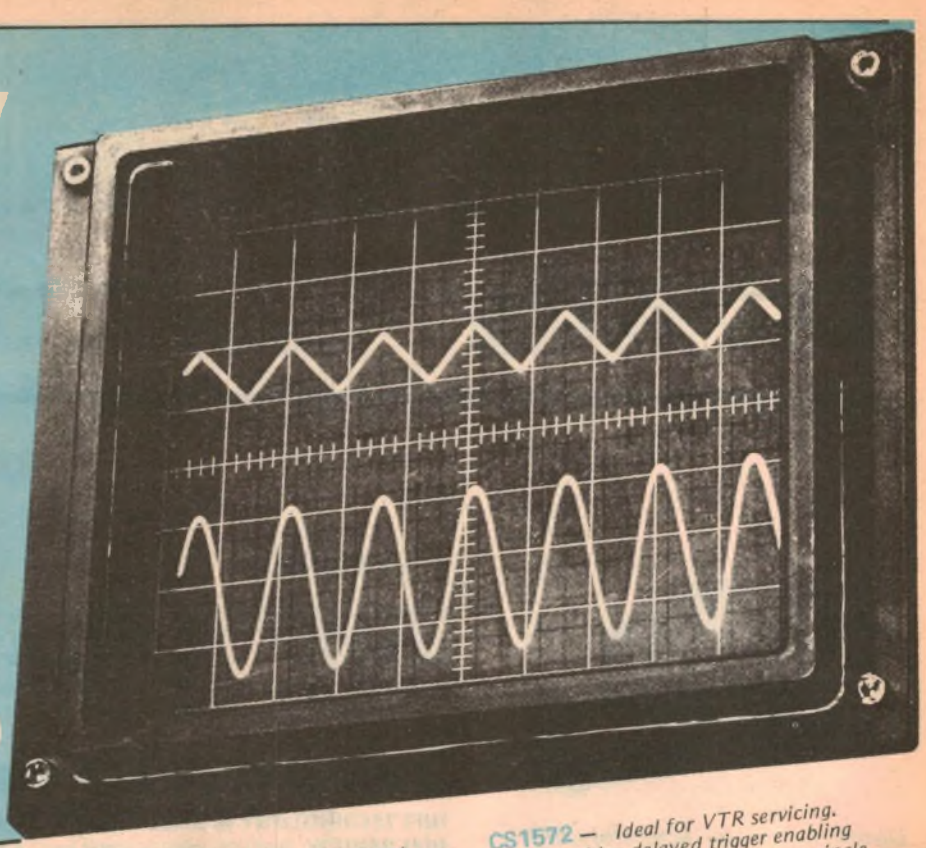
MICROCOMPUTERS

AMATEUR RADIO, DX

COLUMNS

DEPARTMENTS

A NEW TRIO from TRIO



CS1352 — *Ideal for field use. Completely portable, AC, DC and battery operation. Dual trace 75mm display. DC–15MHz bandwidth and 2mV/div sensitivity plus triggered sweep. Features auto free-run for convenient voltage measurements and wide bandwidth for Lissajous phase measurements.*

CS1577 — *A laboratory instrument with widest 30MHz bandwidth. Dual trace with a sensitivity of 2mV/div — ideal for low level signals. Max. sweep time is 0.1uS/div for measurement of fast rise time pulses. Auto-level (FIX) eliminates time consuming sync adjustments, plus auto free-run.*

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PLUS AN UPDATE FOR THE POPULAR CS1560A

CS1560A MK II — *has improved IC circuitry and a new CRT with electronic trace rotation and provision for a camera. Still provides 10mV/div sensitivity with 15MHz band width and sweep times to 0.5uS/div. Auto free-run for making voltage measurements and wide bandwidth for accurate Lissajous phase measurements. The most popular scope for TV, lab, educational and general use.*

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PM102

Editorial Viewpoint

Putting things in perspective

It isn't very often, but from time to time we get letters from irate readers who have struck trouble with one of our project designs, as the result of an error or oversight in our published material. I imagine other technical magazines get the same sort of letters. The writers usually take us to task for not checking our articles thoroughly enough, not anticipating all of the potential problems, not publishing notes and corrections speedily enough, or presumably "not caring".

It is understandable that readers react in this way; no one likes to encounter problems in building a project, and it is particularly irritating if those problems seem to be due to someone else's lack of care. But I'd like to set the record straight with a few words of explanation.

First of all, we certainly do care. In fact, we go to considerable lengths in an effort to ensure that our published information is as correct, as accurate and as complete as possible.

Among our staff, accuracy and attention to detail are given major importance. Every article and item that is prepared for the magazine is checked in detail by at least one person other than the writer — often more. This includes not only text but also circuits, diagrams, PCB patterns, parts lists and specifications. In each case the checking techniques we use have been refined over the years to make them as effective as possible.

But the fact is that despite all of this checking and cross checking, errors still creep through. We are only human, and at times we work under considerable pressure in order to get your magazine out on time each month.

I can assure you that we aren't proud of those "Notes and Errata" that appear with irritating frequency. We regard them as failures, and we do our best to keep them as few as possible. But we all have to realise that perfection is a goal which can never be achieved in the real world. All we can do is keep on trying.

You can help us, particularly when it comes to publishing notes and corrections as soon as possible. When you find an error, please let US know as soon as you can. Don't just curse us for our failings and forget the matter, or complain to the person behind the counter at your local supplier.

To paraphrase Socrates, the reader who tells us when we are wrong does a great honour to both ourselves and our other readers.

— Jamieson Rowe

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News Highlights

Electric cars: the Americans are getting serious!

This sleek new, subcompact electric car has just been unveiled in the United States by the Department of Energy (DOE). Called "Electric Test Vehicle-One" (ETV-1), it was developed as one of DOE's electric vehicle activities, and offers impressive performance, driveability, comfort and styling.

ETV-1 was designed and built for DOE by the General Electric Research and Development Centre and Chrysler Corporation. GE developed the electrical drive system and associated electronic controls, while Chrysler Corporation was responsible for styling, body design and fabrication, suspension, brakes and vehicle testing.

The new GE/Chrysler electric car incorporates the latest technological advancements. Features include:

- computerised electronic controls with pushbutton operation;
- low-cost, high-current power transistor modules to control motor speed;
- a regenerative braking system that recovers some of the energy normally lost in braking to recharge the propulsion batteries;
- an on-board battery charger that can recharge the batteries in 10 hours;
- an aerodynamic body design to reduce drag;
- extensive use of lightweight materials to reduce overall weight; and
- independent front and rear suspension.

Key chassis features of ETV-1 include a separately excited DC motor which drives the front wheels, and 18 high-energy lead-acid batteries located down the centre of the vehicle. In operation, the car is quiet and vibration free. A microprocessor controls propulsion commands, "fuel" gauge computation, dashboard displays and battery recharging.

Performance of the sporty two-door hatchback is impressive. Computer performance projections indicate a 160km driving range at speeds up to 75km/hr. This range is about 50% better than earlier electric vehicles, and is about three times the average distance driven daily by motorists in America.

Other performance figures include a cruising speed of around 90km/hr, a passing speed of 100km/hr, and the ability to accelerate from 0 to 50km/hr in 9 seconds.

The car was designed to meet all applicable federal motor vehicle safety standards. A successful test

(Continued on P5)

TI has talking language translator

A talking language translator, utilising speech synthesis and offering solid-state electronic modules for English, French, German and Spanish, was introduced by Texas Instruments at the Summer Consumer Electronics Show in Chicago. It will be available in Australia before Christmas.

Designed for world travellers as an aid in communicating in a foreign country and for language students in learning to pronounce a foreign language, the hand-held device is programmed with a vocabulary of words and phrases selected for every day use. It can be used as a basic vocabulary for learning a language.

The Language Translator has the ability to form thousands of spoken phrases by linking together its spoken vocabulary words.

Each module will contain about 1000 words of which half will be spoken and displayed while half will be displayed only.

Internally, the technology of the machine is much like that employed in TI's Speak & Spell, a spelling learning aid for children introduced last year. Components include a speech synthesizer chip, a controller and four ROMs.

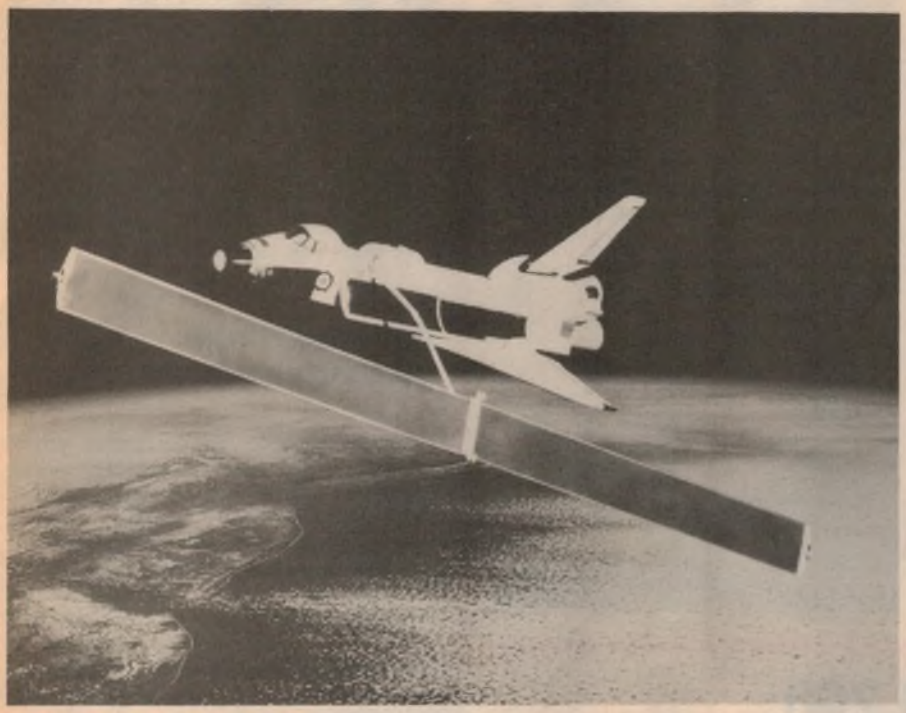
The voice sounds used for different languages were carefully selected to provide the best, most generally accepted accents. Spanish, for example, offers the Spanish of the Americas and of Mexico, since a majority of Spanish-speaking people reside in these areas. The French is Parisian.

Solar panel for space shuttle

A giant panel of solar cells almost as long as a city block could give NASA's space shuttle orbiter enough additional electric power to triple its stay-time in space. The system, proposed by McDonnel Douglas Corporation, is known as "PEP" — power extension package.

The shuttle orbiter is equipped with three fuel cells consuming an on-board supply of hydrogen and oxygen to provide electricity for the vehicle itself and for all payload requirements. Fuel consumption will restrict space shuttle flights to six days in orbit unless a supplementary energy source is provided.

The PEP system would deploy a wing-like panel of photo-voltaic cells 76.6 metres long and 4 metres wide, from the orbiter's open cargo bay, to convert solar energy to electricity. By reducing the drain on the fuel cells, it could extend orbiter missions to 20 days for low-inclination orbits. For special sun-synchronous missions, stay time could be as much as 48 days, or the system could help meet the needs of experiments with exceptionally high power demands for short periods.



National Semiconductor sues Zilog

According to a recent report in the British magazine "New Scientist", two of the US's big semiconductor manufacturers are locked in a law suit over trade secrets. National Semiconductor is suing Zilog for $US5 million in damages, claiming that Zilog unfairly obtained details of National's plans to produce a new microprocessor.

At the centre of the dispute are six former National employees who recently moved to Zilog. National says the six took with them confidential documents including the specifications of its advanced 16-bit microprocessor. Zilog agrees that the employees had taken some papers from National, but denies that the documents relate to plans about new products.

At last report, National Semiconductor had won the first round of the battle, having been granted a temporary injunction to prevent Zilog from using any of the alleged trade secrets.

Hoot Mon . . . silicon bagpipes!

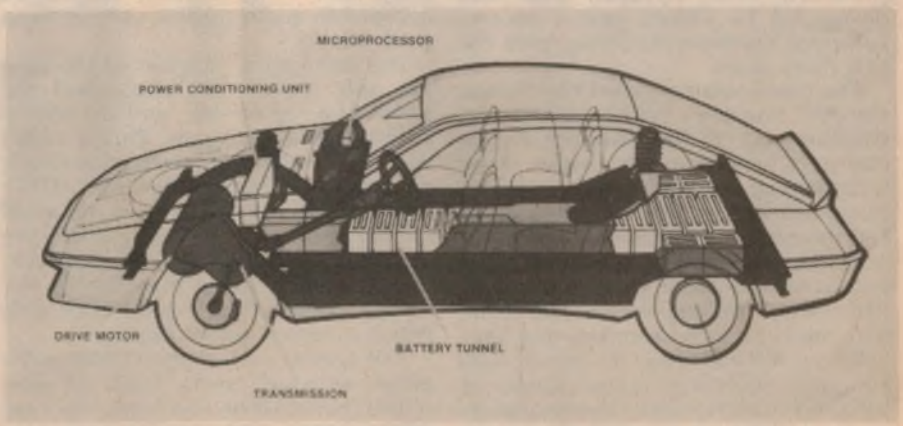
This item appeared in a recent issue of the Sydney Morning Herald: "Glasgow, Tuesday. — Electronic bagpipes have arrived. The instrument employs the latest space-age silicon chip technology and, according to its inventor, Mr George Smith, produces the same sound as traditional bagpipes but without the bag and the blowing. It costs $A195 compared with $1480 for the bag models. — AAP-AP."

Electric car . . . continued from page 4

demonstrated that occupants would be protected from battery or structural intrusions, acid leakage, and battery/cabling shorts during a 50km/hr crash into a concrete barrier. This test also showed that the car's structure abosrbs enough crash energy to allow occupant survival.

DOE emphasises that ETV-1 is a test car and is not commercially available to the public. However, in order to ensure that it represented a practical car, the vehicle was designed so that it could be mass produced for about $US6400 (1979 dollars) by 1985.

The cost of running the car over its 10 year life cycle, including electricity for recharging, is estimated to be less than 12 cents per kilometre. This is comparable to existing internal combustion engine cars.



Front-wheel drive and microprocessor control are features of the new GE/Chrysler electric car. Vehicle is powered by 18 lead-acid batteries.

NEWS HIGHLIGHTS

What's new in calculators?

World's thinnest calculator

Electronic calculators are getting thinner and thinner. The latest from Sharp, the EL8152, is just 1.6mm deep (less than the thickness of a 20 cent piece) and is billed as the slimmest calculator in the world!

The EL8152 has no raised keys. Instead, it incorporates Sharp's sensor touch panel that "pings" to confirm each entry, though silent operation is also possible (of course). Other features include an 8-digit liquid crystal display, a non-volatile memory, a per cent key, and an automatic power-off to help save power.

An indicator also shows the condition of the two silver oxide batteries used to power the calculator. The

unit is available in Australia through various retail outlets at a recommended retail price of $49.95.

Credit card-sized from National Semiconductor

Called the NS199, this new credit card-sized calculator from National Semiconductor comes in a brushed metal case only 4mm thick and measures just 90 x 50mm. Main features include a liquid crystal display with error indication, four memory functions, a per cent key, and automatic power shut-off. The unit comes complete with a vinyl case.

Philips unveils V2000 VCR

Philips has finally disclosed details of its long-awaited V2000 video cassette recording system. The V2000 is designed to stem the flood of Japanese video products into Europe, and was developed by Philips and a second European company, Grundig, over the past three years.

The new cassette, called the "video compact cassette" (VCC), is a logical development of the standard Philips compact cassette for audio tape recorders. It resembles the rival VHS cassette (made by JVC) in size, shape and its use of 1.25cm wide tape, but is not compatible with the VHS recording system (or any other video format, for that matter). Playing time is said to be four hours in each direction, and later V2000 machines may be fitted with automatic reverse — in the manner of some up-market audio-cassette players — to provide up to eight hours uninterrupted playing time from a single cassette.

An important feature of the V2000 is that it employs a tape speed of 2.5cm per second. This is faster than in the VHS and Beta systems made by JVC and Sony, and makes it easier to provide acceptable audio quality, even in two-track stereo.

The video track "stripes" on the tape are only 22um wide, about half the width of a human hair, and are laid by helically rotating heads. Philips copes with this narrow width with what is called "dynamic track following" (DTF). The rotating video heads are mounted on tiny piezo-electric crystals which are fed, during recording and playback, with a control signal that distorts the crystal to deflect the head back into line if it moves out of alignment.

This system enables the V2000 to dispense with the extra track of sync pulses that must be laid along the tape edge in other video systems, and leaves room for relatively wide stereo sound tracks and an additional "cue" track.

New technique for joining optical fibres

Philips Research Laboratories in Eindhoven have reported progress in joining optical fibres together. The new Philips technique fuses the ends of the fibres and works in a way described as "rather like soldering wires together".

Basic components of the technique are a V-groove and fibre handling system, an electric arc discharge arrangement to provide the heat, and a halogen lamp projection system that throws a 60 times magnification of the fibre ends onto a screen in two mutually perpendicular views. After lining up the fibre ends on the screen, the operator applies an initial arc to burn off any plastic coating on the fibre. A second application produces the join, the heating time being chosen for the particular fibre.

The machine, still experimental, makes joints in which the optical loss can be kept below an average of 0.06dB and does not exceed 0.15dB.

Research into computer abuse

Many examples of computer crime have occured overseas in recent years, some of them quite spectacular. However, there are no real statistics relating to the Australian situation and this led to the formation, in August 1978, of the Computer Abuse Research Bureau (CARB) at the Caulfield Institute of Technology in Victoria.

CARB describes itself as "a non-profit organisation aimed at profiling and preventing computer abuse".

In an attempt to secure figures on local computer crime, CARB is currently conducting national surveys of Australian and New Zealand computer users. The survey involves some 5000 questionnaires and is aimed at finding out what can be done to improve computer security, and to assess the effectiveness of various security controls.

According to CARB, computer crime in Australia generally goes unreported, most firms preferring to "fire" rather than prosecute. CARB says that, by guaranteeing anonymity, it hopes firms will voluntarily reveal the "misdemeanors" of past employees so that the true facts regarding computer abuse in Australia and New Zealand may be revealed.

Returns from the survey will be entered onto a data base similar to that used by the Stanford Research Institute in California. The results will be made available to industry towards the end of 1979.

NEWS HIGHLIGHTS

Business Briefs:

Vicom International Pty Ltd has received approval to run a VHF/UHF colour television translator and an FM transmitter at the coming EEEMC Exhibition to be held at the Sydney Showgrounds from October 16-19.

The translator will be a Hirschmann 10W unit. Hirschmann is an Austrian based company specialising in VHF/VHF and VHF/UHF television translators from 1 Watt to 2kW. The FM transmitter will be run on equipment supplied by CCA Corporation of USA and will operate on 88.90MHz.

Philips has won major contracts for the supply of printed circuit boards for use in the instrument panels of cars manufactured by General Motors-Holden and Ford Australia. The instrument panels are manufactured by VDO Ltd, a Melbourne-based car part manufacturer, and will be used in the Holden Commodore and Ford XD Falcon.

The printed circuit boards will be manufactured by Philips at Hendon, South Australia. Until now, the printed boards used by GMH have been designed and manufactured in Germany.

National Semiconductor Corporation is embarking on a five year multi-million dollar plan to expand its semiconductor manufacturing facility in Greenock, Scotland. The five year project is aimed at providing National Semiconductor with a broad semiconductor components and systems technology capability in Europe.

Dr Robert Heikes, Vice President, Europe and Latin America, said, the expansion will make the Greenock wafer processing facility one of the largest and most modern semiconductor manufacturing plants in Europe.

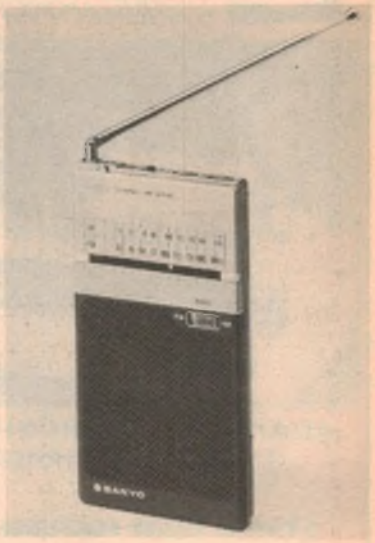
Philips-TMC has been awarded a large contract for a new series of small intersection traffic controllers by the NSW Department of Main Roads. The contract is for development of the VC-6 controller, leading to the supply of 125 units.

The VC-6 traffic controller contains a microcomputer to co-ordinate traffic flow as demands change. The unit is pedestal mounted, requires less footpath space than base-mounted units, and is said to be ideal for the control of inner city intersections.

The complete number of contract units will be delivered to the DMR by the end of 1979.

Soanar Electronics Pty Ltd has recently been appointed Australian distributor for the Semiconductor Group of Motorola Incorporated. Soanar says that a comprehensive range of Motorola transistors and ICs will be stocked at its branches throughout Australia. For technical information on the complete range of Motorola products, contact Soanar Electronics Pty Ltd, 30-32 Lexton Rd, Box Hill, Victoria 3128.

Slim AM/FM radio from Sanyo



Part of Sanyo's "slim and trim" range, this new AM/FM pocket radio is just 12.5mm deep and features an LED tuning indicator on the slider of its tuning dial. Other features of the new radio, known as the RP6700, include a height of 137mm, a width of 72mm, and 190mW of audio output power. Three type AAA batteries power the receiver, which is supplied complete with earphone jack and carrying case.

Recommended retail price is $93. Enquiries to Sanyo Australia Pty Ltd, 14 Mars Rd, Lane Cove 2066.

High density optical disc

Hitachi Ltd has developed a large-capacity optical disc memory for document storage.

The new memory can record over 10,000 sheets (A4 size) of documented information on a 30cm disc, and has a recording density 10 times that of magnetic recording. Hitachi hopes to offer the new product as soon as possible, and says that the price will be comparatively low.

The new system uses a laser to digitally record information on the disc. During the recording process, the laser beam melts the disc material to make a series of holes about 1um in diameter. Amorphous selenium material which melts below 400°C is used as the disc recording material. This material is coated on an acryl substrate, and two such sheets are combined to form the disc.

For playback, the intensity of the laser beam is reduced to 1/10 its previous value and focussed onto the holes on the disc surface. Information is then read by detecting the reflected beam.

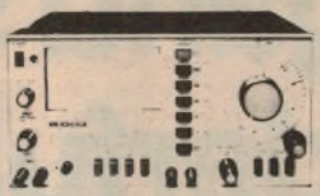
LEADER TEST INSTRUMENTS

LBO 508A OSCILLOSCOPE

Bandwidth DC-20 MHz. Sensitivity 10mV/cm. 130mm highly C.R.T.

$899

LDM 170 DISTORTION METER



20Hz-20kHz 0.3% F.S. Measures distortion, signal-to-noise ratio, signal levels.

$490

LAC 895 ANTENNA TUNER

Built-in SWR and in-line Watt meter. 5 bands from 3.5 to 28 MHz. 500W pep transmitter input.

$182

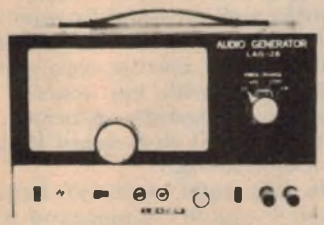
LBO 510A OSCILLOSCOPE

20 mV/4MHz. FET'S input

BUDGET PRICED

$399

LSG 16 RF SIGNAL GENERATOR



100KHz-100MHz Solidstate RF signal generator. Suited for aligning the IF circuits in AM, FM and TV sets.

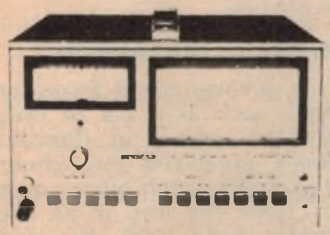
$119

LAG 26 AF SIGNAL GENERATOR

20Hz-200kHz Stable generator for all types of audio circuit.

$166

LFM 39A WOW AND FLUTTER METER



For accurate and easy determination of the wow and flutter characteristics of tape recorders to JIS, CCIR and DIN standards.

$699

LMV 181A AC MILLIVOLT METER

AC Voltages from 100yV up to 300V. 5Hz-1MHz.

$189

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New frontiers in magnetics . . .

Wiegand's wonderful wires

An unusual new magnetic switching effect makes possible the generation of large voltage pulses without power input. Called the Wiegand effect, it's already finding application in security card systems, industrial equipment, and automobile ignition systems.

by GERALD M. WALKER

It's a long way from the drab, concrete-floored lab where I first met John Wiegand to the carefully tailored research facilities of Echlin Manufacturing Co in Branford, Connecticut. But Wiegand's jump from obscure tinkerer to electronic-systems designer is less remarkable than the magnetic jump that he was the first to discover and name.

It's rare that anyone has an effect in physics named after him. Rarer still does the discoverer of the physical effect get to oversee its practical applications. But Wiegand, an unlikely blend of professional musician and electronics technician, has done both — without any formal training as a physicist.

The effect that Weigand discovered involves the way magnetic fields in a suitably prepared wire can be made to reverse themselves suddenly. This phenomenon can be used to generate sharp, uniform electrical pulses with far simpler equipment than techniques now available. That's important because the pulse is the key to many electronic process. So the Wiegand effect is already finding practical applications in automobiles, security systems, and industrial equipment. And new applications are continually being discovered.

John R. Wiegand inspects a batch of specially treated wires that possess the unique magnetic properly he discovered. When moved past a magnet, the wire cores shift polarities rapidly, generating strong electrical pulses of several volts.

"When anyone asks about my engineering department, I tell him that everybody's engineering department is mine," Wiegand says gleefully. "The licensees are prompting ideas for application."

The Wiegand effect hasn't always been so well accepted by engineers.

"Nobody believes it's possible to generate large, narrow, consistent electrical pulses with this system," Mort Velinsky, Wiegand's associate, complained when I first visited Wiegand's lab four years ago.

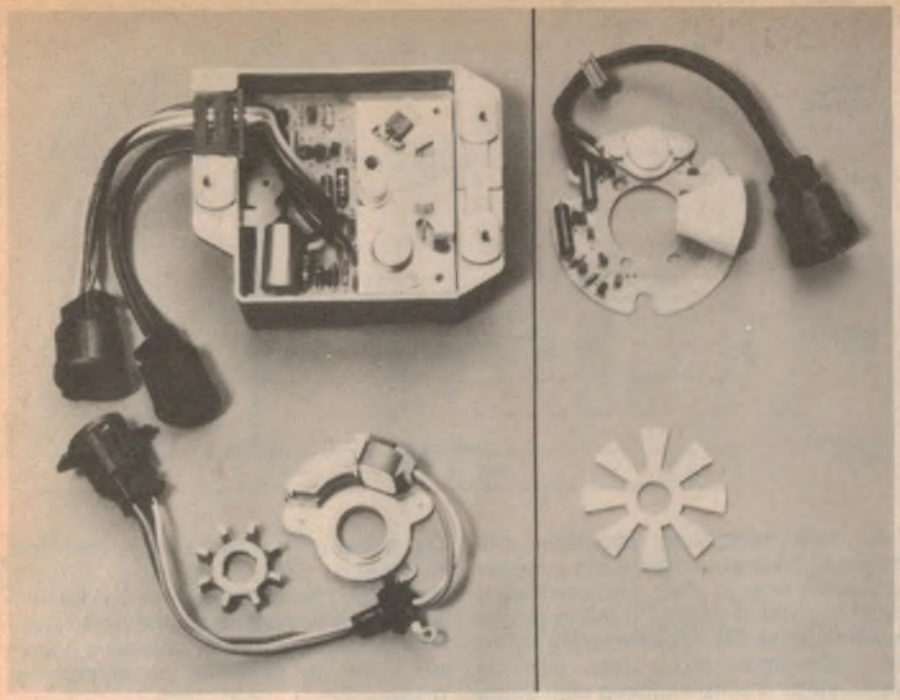
He was right. I didn't believe it, either. I couldn't understand how he could produce such pulses using only a short length of wire, two small permanent magnets, and a pickup coil. So Wiegand sat me down for a lesson in basic physics.

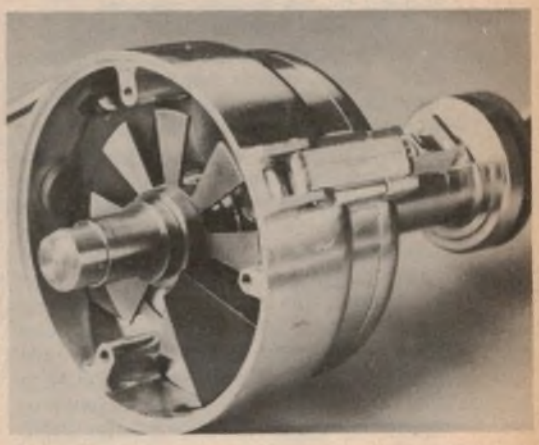
A matter of magnetism

In an unmagnetized ferromagnetic material, such as a bar of iron, the magnetized regions or domains are randomly organized throughout the iron, cancelling each other's magnetic effect. Place the iron in an external magnetic field and the domains gradually shift polarities to line up with the applied field. If the iron stays in the field long enough, it becomes magnetically saturated — all its domains are neatly lined up in the direction of the field.

But if the magnetic field is applied gradually, and is slowly built up to full strength, the material does not become magnetized smoothly. Instead of continuously lining up with the field, the domains snap into alignment at different times as various magnetic field values are reached. This sudden snapping action is the well-known Barkhausen jump. These tiny magnetic jumps can be detected by a

Electronic ignition for cars





Wiegand-triggered auto distributor (middle and far right) is far less complex than the conventional variable reluctor pick-up and associated electronics (left). The Wiegand wire and pick-up coil are in the bottom half of the slotted wedge-shaped container, along with a small permanent magnet. The top half holds a more powerful magnet placed in opposing polarity. The pin-wheel-shape vane rotates in the slot between the magnets and the wire. At the air gap between the blades, the upper magnet asserts its force, causing the wire core to flip polarity and generate a pulse in the pick-up coil. This pulse subsequently controls a power transistor which switches the ignition coil.

coil wrapped around the iron. The signals picked up by the coil can be amplified and played back through a loudspeaker where they make distinctive clicking sounds.

Wiegand, listening to the clicks with his trained musician's ear, had an idea. Maybe he could tame and "program" the Barkhausen jumps in ferromagnetic wire. If he could get the magnetic domains in a wire to jump in response to varying field strengths induced by a magnetic recording head, he'd have invented a new type of wire recorder. But as Wiegand worked on this challenge, he noticed that the Barkhausen jumps produced more than just clicks.

A powerful twist

"I was hearing explosions from my wire," he told me. "The jumps were so high, I was getting a measurable voltage. At first it was only millivolts, but it was apparent that higher jumps would then produce higher voltage."

So Wiegand began searching for a way to program the jumps to produce that higher voltage. After years of painstaking trials of both methods and materials, he developed his patented process of twisting the wire many times under tension, then heat-tempering it.

"Actually, what I've done is control Barkhausen jumps by work-hardening vicalloy (vanadium cobalt alloy) wire," Wiegand explained to me. "If Barkhausen had access to the cobalt alloy we produce today, he would have been able to control the wire," he added modestly.

What Wiegand produced with all his twisting and tempering was a magnetically unstable, ferromagnetic wire with a permanent deformation that winds like a helix around its circumference. This configuration forces the domains in the Wiegand wire to bide their time when exposed to an increasing magnetic field — until a certain threshold is reached. Then the domains abruptly make one large *Wiegand* leap, switching polarity together.

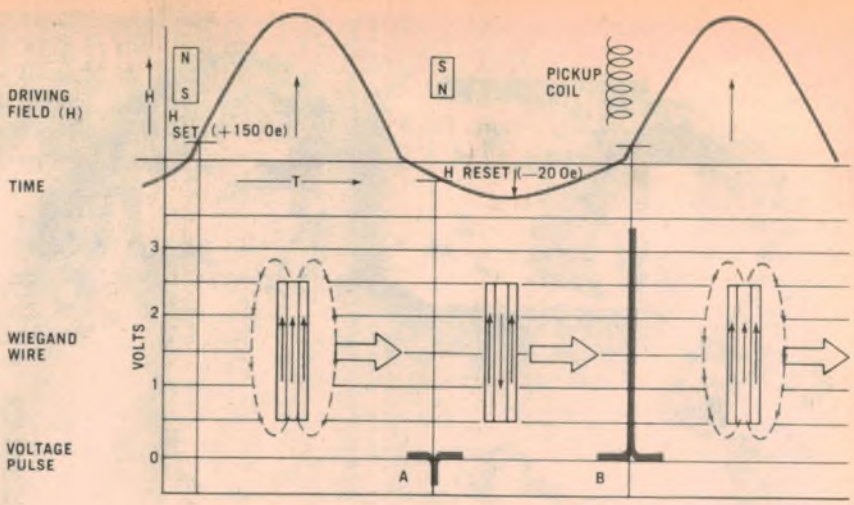
The effect of this magnetic leap is enhanced by the wire's twisted-in tension, which makes it bistable: the inner core is magnetically softer than the wire's outer shell. The core flips polarity at much lower field strengths than the shell. This puts the wire in a state of magnetic tension, which is relieved by a large Wiegand jump (see diagram). This magnetic leap produces nearly ideal

Comparison of pulse generators used in electronic ignition

	Signal-noise ratio	Rate sensitivity	Temperature range (°F)	Gap sensitivity	Electrical input	Pulse amplitude
WIEGAND EFFECT	Very good	Not rate sensitive	-95 to +500 (approx)	Minimal	None	Volts
VARIABLE RELUCTANCE	Fair	Poor	-95 to +500 (approx)	Critical	Not required	Millivolts to volts
HALL EFFECT	Poor	Good	-40 to +275	Moderate	Required	Millivolts
LED	Poor	Not rate sensitive	-40 to +275	Minimal	Required	Millivolts

Wiegand wire generates regular electrical pulses as it travels through two fields applied by small permanent magnets. First a "set" field of about 12 x 10^3A/m, polarized in one direction, fully magnetizes or saturates the wire; all of its randomly oriented magnetic domains become aligned with the field. The wire then moves into the weaker, oppositely polarized "reset" field applied by the smaller magnet.

This less-powerful field (about 4 x 10^3A/m) doesn't affect the wire's hard outer shell, which needs a coercive force stronger than the original set field to switch polarity. But the weak field does force the wire's magnetically softer core to reverse polarity. Because the wire has been specially twisted and tempered, the core flips suddenly, reversing polarity abruptly when the field reaches a certain critical threshold. This flip produces a small negative pulse (A). But when the wire passes out of the reset field, the core flips once more, reswitching polarity to line up with the more-powerful magnetic field on the wire's outer shell.



In this switching process, the magnetic system moves from a higher to a lower energy state, and releases a large amount of energy in the form of a positive pulse (B). These sharply defined, high-amplitude pulses can be detected by a simple pickup coil. Since the pulse is generated only when the magnetic field reaches a certain threshold, the field can also be applied at any rate without changing pulse size. And no external power source is needed either to generate or detect the pulse.

pulses that can be detected by a pickup coil wrapped around the wire.

The perfect pulse

A variety of pulse generators are now in use (see table for a few examples), but most have some drawbacks. The ideal pulse generator would produce large, sharply defined pulses of about the same amplitude, no matter at what rate of speed they were produced. These pulses would have a high signal-to-noise ratio and they'd be immune to electrical interference from nearby circuits. With pulses like these, it would be easier to design electronic control circuits. The usual pulse-shaping networks and noise-suppressing electronics would not be needed.

The magnetic property that Wiegand identified and controlled makes possible a pulse generator with these capabilities.

The new discovery has elegantly simple applications. On my first visit Wiegand showed me a short three-cm length of wire about 0.25mm in diameter. "If I wrap this with 1000 turns of number 38 copper wire, I have a Wiegand module that can produce a 1½-volt pulse," he said. "Someday, I'll be getting eight- or 10-volt pulses," he added.

On my recent visit Wiegand reported successful generation of 12-volt pulses, using only slightly longer wire and a larger pickup coil. "And I wouldn't close the book on voltage limits just yet," he said. "However, 10 to 12 volts is the best operating area for most of the important industrial and automotive applications."

Double row of tiny Wiegand wires embedded in plastic card (foreground) produces pulses when passing magnets in a reader. Wire codes can't be altered.

Working wires

A Wiegand module can perform in temperatures ranging from about -70°C to +260°C. It can also withstand considerable vibration, and function in wet or dirty locations — so it's ideally suited to the hostile environment under an automobile's hood.

In 1976, the Echlin Co, an automotive-parts manufacturer, bought all rights to Wiegand's device, then moved him out of the rundown lab. He and Velinsky teamed up with Echlin engineers to find practical uses for the effect. They developed an automotive distributor that uses the wire to time spark generation (see photo).

The first production Breakerless Electronic Ignition (BEI) using the Wiegand wires is now being promoted to stock-car owners. The unit is standard high-performance BEI in every way — except that a Wiegand module fires the power transistor that fires the ignition coil.

The Wiegand module has other possible uses in autos. Both Colt Industries and Robert Bosch Co have licensed the effect for automotive applications.

The feasible uses of the Wiegand effect are as varied as the companies that have licensed it. One reason for this versatility: the pickup coil need not be wrapped around the wire; it can be placed nearby with the magnet in a read-head module. Since Wiegand systems feature non-contact pulse pickup, there's no mechanical wear between read-head and wire as in magnetic-tape readers. A further advantage is that no power source is needed to pick up the pulse. Combining these advantages with the Wiegand wire's greatest asset — non-rate-sensitive pulse production — makes the module especially useful when pulses are generated sporadically — as when keys or buttons are pushed.

In fact, one of the simplest uses of a Wiegand module with a magnetic read head is for keyboards and switches. A wire mounted on the shaft of a typewriter key or pushbutton switch travels past a magnet and read head whenever the key or button is depressed. No matter how fast or slow the keys are pushed, they produce uniform pulses every time. IBM has licensed the effect for use in electronic typewriters and typesetting systems where these features are an advantage.

Wired credit cards

The magnetic read-head module has other intriguing possibilities. A series of

Wiegand wires embedded in a plastic card produces a binary-coded decimal signal when slid past a magnet and read-head. The signal varies according to the length, number, and position of the wires, so many codes are possible.

Sensor Engineering Co, an Echlin division, has run pilot tests using Wiegand cards to open specially designed security doors at airports. And the Metropolitan Transit Authority of Boston has put Wiegand-coded cards to trial use in special subway turnstiles capable of reading the codes.

The coding potential of the Wiegand wire has also proven attractive to Refrigeration Engineering Ltd, a meat packer in Auckland, New Zealand. The company will install an automated conveyor system using Wiegand wires to identify carcasses during processing. And General Signal Corp, the latest licensee, will try this technology in railroad switches.

Finally, Emerson Electric plans to use the wires for industrial flow meters. Wiegand wires can be mounted in rotary blades that are driven by a passing fluid. As the blades rotate past a magnet and reader, the pulses produced serve as an accurate measure of the flow. And the reading can be made no matter what the fluid's direction or rate of flow.

Many lookers

The Wiegand Effect may become commonplace in the next few years. "The educational phase is behind us," says Velinsky. "We've brought a lot of people into John's laboratory over the last several years." Wiegand adds, "The more questions they asked, the less they understood. One researcher kept repeating that he saw it work but still did not believe it."

Yet more believers are turning up almost everywhere. Each of the automobile Big Three is looking at the effect now. Data-processing companies and industrial-equipment makers, including several companies in Europe and Japan, are also on the interested list. And at a recent industrial design show, Echlin got 9000 inquiries for additional information from those people who had watched Wiegand demonstrations.

The Wiegand effect may even show up in the home workshop. An insulated Wiegand module — a sensing coil wound around a short piece of Wiegand wire — is now a standard item in Sensor Engineering's catalog. The modules have pulse outputs ranging from 2.5 to eight volts. Who knows what uses today's basement tinkerers will devise for these powerful little wires?

From the US George Tillett reports

Video discs stole the show at Chicago, 1979

Although having to compete with a vast array of exotic hifi and other equipment, the new videodisc systems captured much of the interest at the recent Consumer Electronics Show at Chicago. Video cassettes also seemed to be faring better, with a new emphasis on compactness, simplicity of operation and much longer running and programming times.

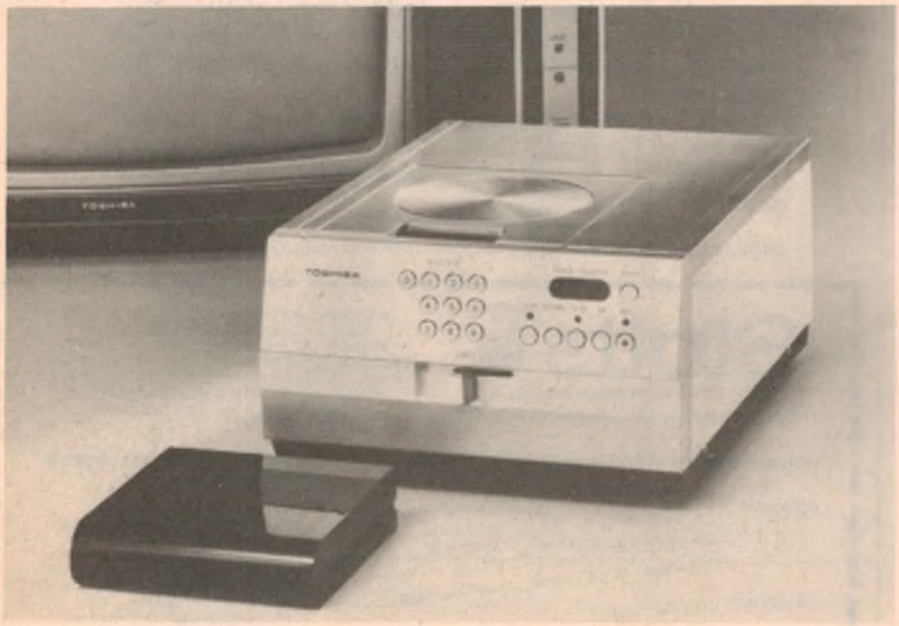
Video discs have been talked about for years and have even been marketed in a tentative fashion. They were largely set aside in favour of video cassettes, only to be taken up again when consumer interest in tape failed to live up to expectations. Now it does seem that they have finally arrived!

Those being demonstrated at the Chicago CES were from JVC, Magnavox and Pioneer. However, it is known that RCA is in the race too, and that several other companies are working hard on the project.

The Magnavox and Pioneer players use the Philips-MCA laser system, in which the discs rotate at 1800rpm, with a single frame per revolution. Each frame is numbered, so the user can find any picture by moving forward or backward slowly from any desired section. This feature is obviously ideal for educational purposes and it will also appeal to sports fans.

Playing time of the Magnavox unit (called "Magnavision") is up to two hours, in colour or black and white.

The Magnavision disc looks like an ordinary record but the information is conveyed by millions of tiny pits and picked up by a laser beam in conjunction with some pretty fancy optics. Also on the disc are sync pulses for tracking, and space for two channels of audio, which is recorded by means of an FM system.



Representing a completely different approach to video cassette recording, this new Toshiba LVR unit uses a fixed head which progressively traces 220 side-by-side tracks on an endless loop cartridge. Despite its utter simplicity, it offers a playing time of one hour, with an effective resolution of 240 lines and a signal-to-noise ratio of at least 42dB. It could hold the key to a really low cost VCR.

The MCA library now offers a choice of more than 200 disc titles, price (US) from $5.95 for 30 minutes playback to $15.95 for a two-hour movie. Among those being demonstrated were extracts from "Jaws" and a detective "who-dunnit" which had our hero, Peter Falk, speaking in Japanese at a touch of a switch!

But, you might ask, how good was the picture quality? Well, I thought it was excellent; better in fact, than I get from my own local network station!

The JVC system seemed to be equally as good, with excellent definition of detail, low background noise and good colour rendition. And the system is also a good deal more versatile.

JVC use a laser to produce their glass master disc, but this is the only similarity between their technology and that of Philips-MCA. The pits are recorded spirally, of course, but at a much lower speed: 900rpm. Having produced a glass master, JVC derive a metal master from it, using conventional techniques. From the metal master come the "mother" discs and, from them, the actual production stampers. The disc sold to customers is a PVC pressing but of a mix which is electrically conductive.

As distinct from laser optics, the JVC system uses a sophisticated kind of "phono" cartridge, which a capacitive electrode at the tip of a sapphire stylus. Because the pits passing beneath the electrode are in a conductive vinyl surface, they produce a variation in capacitance and can therefore be "read" by the stylus to produce the appropriate signal.

The stylus is mounted on the end of a cantilever arm, controlled magnetically, so the stylus can move transversely and longitudinally to perform functions such as the selection of a particular frame.

The stylus is much larger than an ordinary audio type and wear is minimal as it skims over the pits, instead of tracking within actual grooves. JVC claim a life of 2000 hours and state also that the system is insensitive to foreign particles.

Actually, the disc is not really handl-

ed at all, since it comes in a sleeve and the whole package is inserted into the player. Playing time is two hours and, as stated earlier, the rotation speed is 900rpm.

Picture quality was excellent but what really impressed me was the amazing control provided by an optional "trick play" unit. Speed could be divided or multiplied by 2, 4, 8 or 16; frames could be "frozen" or moved forward to backward — one a second if desired.

If you wanted a certain frame, the number (which appears in the corner of the picture — if required) is punched in a hand-held calculator-type unit (radio link) and, before you could say JVC VHD-AHD system, there it is!

Incidentally, VHD means Video High Density and the A stands for audio. These discs have PCM capability and some audio recordings were played, with first-rate fidelity and a signal to noise of 90dB!

RCA's new system was not demonstrated at the Show but it differs from the two systems described. For one thing, rotation speed is 450rpm and there is no "frame freeze". A stylus pick-up method is employed but, unlike JVC's system, it rides in a groove — which should make it a lot cheaper!

Unfortunately, "differs from" seems to be an all too familiar phrase in the present context. Even the Philips digital audio disc uses an entirely different system from the Philips video disc. Instead of rotating at 1800rpm, it uses a constant velocity system starting at 500rpm! Not only that, but it plays the opposite way round ie from the inside to the outside where the speed falls to 215rpm.

All this is bound to bring up the question of standardisation and it is to be hoped that we will not have a repetition of the great quadraphonic fiasco where the manufacturers couldn't even agree on the spelling of the word!

VIDEO CASSETTES

Taking a look at video tape players (VTR's) there is a definite move towards longer playing times: RCA's SelectaVision VDT 600 has a playing time of six hours and it can be programmed for seven days.

JVC introduced a VIDSTAR model using a rotary, two-head helical scan system which can record at a high density. Playing time is six hours with a standard two hour cassette. This model also has a seven day timer.

Toshiba uses a different method of increasing playing time. Speed is reduced by a third and, by using normal three hour tape, time is extended to five hours. Like Sony's Betascan, Toshiba use a "picture search" arrangement that enables the user to view the image while the tape is in the fast-forward or rewind modes. Another innovation is the audio dubbing facility which permits voice or sound recording over the pre-recorded audio signal.

Toshiba were also showing "The world's first fixed-head, fixed reel colour VTR", a basic machine whose virtue is its utter simplicity. It is named the LVR — the L standing for longitudinal. The system uses an endless loop cartridge, 100 metres long with no less than 220 tracks. A MPU controls the position of the head which has to move to the next track every 17 seconds. Playing time is one hour and a repeat mode provides 220 separate programs! There is also a fast random access feature. Definition is 240 lines with a minimum S/N of 42dB!

LARGE SCREEN TV

Television sales are down but many experts believe that 1979 colour sales will reach seven million. Projection TV is becoming rather more popular and the biggest interest is in all-in-one units. Significantly, Advent, who pioneered "separates", have introduced a one-piece model with a 60-inch screen.

Sony's new models in the conventional range feature a 26-inch tube with a "viewing area" 8% larger than 25-inch models — the largest up to now.

RCA are using an ingenious comb filter system with a Memory circuit to double process the picture, thus increasing the sharpness. The system is called a Dynamic Detail Processor and it involves a charge coupled device (CCD) that effectively increases the number of lines by about 25%.

Sylvania, like several other manufacturers — have suddenly realised the importance of good TV sound and some of their new models have two-way speaker systems with tone and filter controls.

I came away from all this with the definite impression that video is on the move!

Video cassettes were also on the move

Typical of the latest generation of video cassette recorders is this new JVC "Vidstar". Using a two-head, helical scan system, it can pack six hours of recording on to a standard two-hour video cassette. It has an audio dub facility and can be programmed for up to seven days ahead.

Toshiba's latest video cassette recorder uses a nominal three hour tape but has a two-speed facility which extends the record-replay time to five hours. It features audio dubbing and a picture search system which allows the image to be viewed while the mechanism is in fast forward or rewind mode.

"... a significant step forward in battery engineering"

Lithium cells — a new form of portable power

Since World War II, and due initially to the demands which that war created, there has been an increasing amount of research devoted to developing more efficient primary batteries. The result has been a whole new range of batteries and appliances with a portability and compactness undreamed of a few decades ago.

by PHILIP WATSON

Whereas the humble leclanche (zinc/manganese-dioxide) cell was once the only readily available primary cell, we now have the alkaline cell, the silver oxide cell, the magnesium cell, the zinc-chloride cell, and the mercury oxide cell. And, while not all are available at the local corner store, they all have their place, often in exacting commercial, military, or space applications.

The most recent development, and one which we are likely to hear a lot more about from now on, is the lithium cell. This article discusses this new development and what it is likely to mean to the average battery user in the next few years.

The introduction of a new battery to the market invariably creates some initial confusion, if only because direct comparison with existing types is not always valid. Most batteries are designed to suit a particular requirement, or section of the market, and it is necessary to identify this before judging the battery's worth or performance.

Unfortunately, the lithium battery is likely to cause more confusion than its predecessors, not only because it has quite different characteristics, but also because there are several versions of it.

In fact, the term lithium battery embraces a whole range of batteries, having quite different chemical compositions, different voltages, and different cost structures. It is not sufficient to specify "a lithium battery"; it is necessary to specify which particular type before attempting to assess its suitability to a particular application.

To date there are at least 12 types of lithium battery, either in production or under development. All use lithium as the anode, but use quite different cathodes and/or electrolytes.

Lithium is a silvery white metal, and is the lightest metallic element. Its atomic weight is 6.94, compared with aluminium at 26.97. It reacts violently with even minute quantities of water, which means that it must be stored and handled in a carefully controlled environment, and that the battery must be effectively sealed against the ingress of moisture. Similarly, all the other materials used in the battery must be free from water. (Hence references to "non-aqueous cells" and "non-aqueous electrolytes".)

There are two broad lithium battery classifications: those with solid and those with liquid cathodes. The solid cathodes are composed of various metal oxides, sulphides, or halides, including silver, manganese, lead, nickel, copper, etc. They are usually used with an electrolyte of a lithium salt in a solvent.

The liquid cathodes consist of such solutions as thionyl-chloride, sulphuryl chloride, or sulphur-dioxide (in solution).

With such a wide variety of types it is impossible to describe the batteries in detail; each type would warrant a separate description and list of suitable applications. However, the following points characterise the most popular types.

(1) A very high energy density. Energy/weight figures range from 790kJ/kg to 1188kJ/kg (220Wh/kg to 330Wh/kg). Energy/volume figures range from 1.8kJ/cm³ to 2.88kJ/cm³ (0.5Wh/cm³ to 0.8Wh/cm³). By comparison, a zinc/manganese-dioxide cell would contain 158kJ/kg (44Wh/kg) and 0.43kJ/cm³ (0.12Wh/cm³).

A situation where the price of a battery is of little importance. This miniature rescue beacon/transceiver — and the batteries which power it — provide the pilot's only link with a search and rescue team. (Tadiran photo.)

1. Chemical System	$Li/SOCl_2$	Li/SO_2	$Li/(CF)_n$	$Li/Ag_2C_rO_4$	Li/M_nO_2
2. Name	Thionyl-Chloride	Sulphur-Dioxide	Carbon-Monofluoride	Silver-Chromate	Menganese-Dioxide
3. Produced by	TADIRAN-GTE	MALLORY-POWER CONVERSION(PCI)	MATSUSHITA-(NATIONAL)	SAFT	SANYO
4. Open Circuit Voltage (Volts)	3.7	3.0	2.8	3.5	3.5
5. Operating Voltage (Nominal) (Volts)	3.4	2.7	2.5	3.0	2.8
6. Energy Output * (Whrs)	17.0	10.9	12.5	--	14.0
7. Energy Density * ("C" size)					
- (Wh/Kg)	330	260	270	--	265
- (Wh/cc)	700	460	520	--	580

This table compares the major characteristics of the most popular types of lithium batteries. The thionyl-chloride type has the highest energy density but the other types have their own advantages. The figures given are based on a typical "C" size cell. (From "Tadiran Technical Report".)

(2) With certain combinations, a low internal impedance and as a result, the ability to supply heavy discharge currents and maintain a virtually constant voltage to the point of complete discharge. (Internal impedance varies significantly from type to type.)

(3) Ability to work over a wide temperature range. Typical figures are from —55°C to +80°C. This is a wider range than that provided by any other battery to date.

(4) A long shelf life. Various reports quote between five and 10 years on the basis of retaining 80% of new capacity.

(5) A higher voltage per cell than other systems, ranging from 2.8 to 3.7V open circuit and 2.5 to 3.4 on load, according to the cathode and electrolyte used.

(6) High cost. Although this may appear as a deterrent, it must be considered in relation to the high energy content, and the advantages of long life and high reliability in specialised applications.

A number of firms are engaged in developing the various versions of the lithium battery; some well known in the battery world, and some better known in other electronic fields. The state of development ranges from laboratory research to large scale mass production.

Of those firms actually marketing lithium batteries, the following appear to be the most advanced.

Sanyo Electric Co Ltd of Japan: Sanyo are using a lithium anode/manganese-dioxide cathode ($Li/Mn0^2$) combination, with an organic electrolyte. The nominal on-load voltage is 2.8 per cell, and the energy density 936kJ/kg (260Wh/kg).

They are producing a wide range of cells, including both button and cylindrical types. The button cells range in capacity from 30mAh to 225mAh, in diameter from 7.9mm to 24.5mm, and in thickness from 1.5mm to 6.1mm.

In the cylindrical cells there is a standard "AA" size (1.5Ah), a "C" size (5Ah), and what appears to be a specially developed size, designated bH. This is 7.9mm diameter and 7.2mm high, with a capacity of 30mAh. It is described as being suitable for use in illuminated fishing floats, to power a LED. (Illuminated fishing floats and illuminated fishing rod tips are extremely popular in Japan.)

At the last report production was running at 500,000 cells per month, with plans to increase this to several million per month in the near future.

Matsushita Electric Ind Co Ltd (National) of Japan: National are using a lithium anode/carbon-monofluoride cathode (Li/(CF)n) combination with an organic electrolyte. The nominal on-load voltage is 2.5 per cell, and the energy density is given as 972kJ/kg (270Wh/kg).

They are producing three cylindrical cells, one button or "coin" type cell, and two "pin" type cells. Of the cylindrical cells one is a standard "C" size, while the other two are smaller but do not seem to match any of the current popular sizes. The "C" size has a capacity of 5Ah. The button cell is 23mm diameter, 2.5mm thick, and has a capacity of 140mAh.

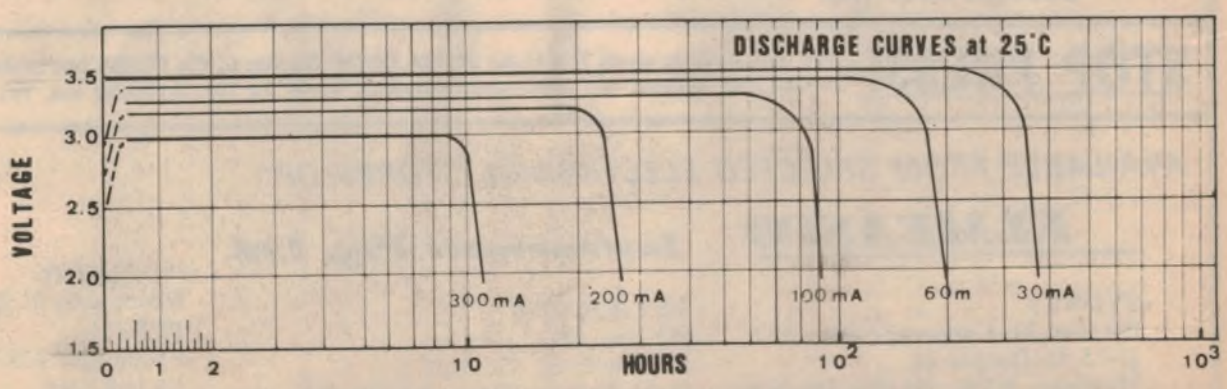
The "pin" type cells are both 4.2mm diameter; one is 25.9mm long and the other 35.9mm. Their capacity is 20 and 40mAh respectively. Both appear to have been specially developed for illuminated fishing floats and fishing rod tips.

Production of the button cells is running at 100,000 monthly, with plans to increase to 300,000 monthly. Batteries for fishing floats alone amounted to 2 million in 1976, 2.5 million in 1977, and was estimated to be between 3 and 4 million for 1978.

P. R. Mallory & Co Inc, of the USA: Mallory are using a lithium anode/sulphur dioxide cathode (Li/SO^2) combination. This gives a nominal on-load voltage of 2.7 and an energy density of 936kJ/kg (260Wh/kg). (P. R. Mallory & Co, Inc, are represented in Australia by Mallory Batteries Aust Pty Ltd, 297 Lane Cove Rd, North Ryde, NSW.)

Power Conversion Inc, of USA: Power Conversion appear to be using the same chemical combination as Mallory. Very little information is available about their current range of cells.

Societe des Accumlateurs Fixes et de



The excellent characteristics of the thionyl-chloride system are clearly illustrated by these discharge curves of a "D" cell. Note the constant output voltage, even at the highest rate. (From "Tadiran Technical Report".)

Quality Test Instruments at Affordable Prices

TTM303 15MHz Mains/Battery operated oscilloscope

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BRIEF SPECIFICATIONS:
The TTM Dual Trace Portable Scope Model 303 offers a high sensitivity of 5mV/DIV with DC to 15MHz bandwidth. The 3-inch CRT with 1.5kV regulated accelerating voltage gives a clear bright display.

This Portable Scope operates from standard line voltage (240V) or from the internal rechargeable Ni-Cad battery, that provides 2 hrs operation before recharging is required. It also operates from any external DC voltages of 11 to 30V, eg car batteries, standard "C" size cells, etc.

SENSITIVITY:— 5mV to 10V/DIV 1-2-5 step with fine control. BANDWIDTH:— DC: DC to 15MHz (-3dB). RISETIME:— 24ns. OPERATING MODES:— CH-A, CH-B and Dual Trace TIME BASE:— 1 usec to 500 mS/DIV with fine control. EXPANSION:— x 5 at all ranges. X-Y OPERATION:— X-Y mode is selected by SWEEP TIME/DIV switch. CH-A: Y axiz. CH-B: X axis. POWER REQUIREMENTS:— AC: 115/240V DC: 11-30V, 7.2VA. Battery: Ni-Cad Battery (up to 2 hour operation). SIZE: 113 (H) x 223 (W) x 298 (D) mm approx. WEIGHT:— 4.5kg.

Application BS610 15MHz No Parallax display oscilloscope

$625 EX. TAX
$718.75 INC. TAX

BRIEF SPECIFICATIONS:
The BS-610 employs a high brightness 140mm Rectangular CRT with internal graticule assuring easy and accurate observation of waveforms without any parallax.

External DC-Powered operation expands the versatility of this oscilloscope to FLOATING Measurements as well as field operation.

Other features including TV SYNC and HF REJ. make this scope ideal for research and development, production lines or in-the-field service applications from computers to electrical appliances.

SENSITIVITY:— 5mV to 10V/DIV on 11 ranges in 1-2-5 step with fine control. BANDWIDTH:— DC: DC to 15MHz (-3dB). RISETIME:— 24nS. OPERATING MODES: CH-A, CH-B, DUAL, ADD and CHOP. TIME BASE:— 0.5usec to 0.5sec/DIV in 19 ranges and X-Y in 1-2-5 step with fine control. MAGNIFIER:— x5 at all ranges. X-Y OPERATION:— X-Y mode is selected by SWEEP TIME/DIV switch. CH-A: Y axis. CH-B: X axis. POWER REQUIREMENTS:— AC: 115/240V DC: 11 — 30V, 7.2VA. SIZE:— 145 (H) x 280 (W) x 369 (D) mm. WEIGHT:— 6.7kg.

SP100 probes 100MHz, 10:1, 1:1, off posn. To suit TTM303 and BS610
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BRIEF SPECIFICATIONS:
10 VOLTAGE RANGES: 100uV to 1000 Vdc, 750 Vac.
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8 CURRENT RANGES: 1uA to 200mA
Basic DC Current Accuracy: +0.75%
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Lithium Cells

Traction (SAFT), France: SAFT are using a lithium anode/silver chromate cathode (Li/Ag^2CrA^2) combination. This gives a nominal on-load voltage of three per cell. They are also developing a lithium/copper oxide (Li/Cu0) type which has an on-load voltage of 1.5.

Israel Electronics Industries Ltd (TADIRAN) of Israel: Tadiran are using a lithium anode/thionyl-chloride cathode ($Li/SOC1^2$) combination. The nominal on-load voltage is 3.5 and the energy density is 1188kJ/kg (330Wh/kg).

They are producing four cylindrical cells: the standardsizes "D" (10Ah),5 "C" (5Ah), "AA" (1.7Ah), and a "½AA" size (650mAh) which is the same diameter but half the length. (Tadiran is represented in Australia by Technico Electronics, PO Box 50, Lane Cove, NSW 2066 and PO Box 118, Northcote, Victoria 3070.

GTE Sylvania Inc's Communications Systems Division, USA: GTE Sylvania are using a lithium/thionyl chloride combination similar to Tadiran's. Production details are limited but it is known that they are producing a double "D" cell; the same diameter as a standard "D" cell, but twice as long. It is apparently intended to replace two standard "D" cells in torches and other applications using an in-line package.

Union Carbide Corporation (Eveready) of USA: Union Carbide are working with two chemical systems: lithium/thionyl chloride ($Li/SOC1^2$), and lithium/sulphuryl chloride (Li/SO^2Cl^2). A number of cells are in limited production and samples are being distributed to appliance manufacturers for information and evaluation. The lithium sulphuryl chloride mix gives about 3.9V off-load and 3.7V on load. It also gives slightly higher energy density than lithium/thionyl chloride. (Union Carbide Corporation is represented in Australia by Union Carbide Aust Ltd, 157 Liverpool St, Sydney.)

Other chemical combinations being developed and evaluated include: Lithium/lead oxide; lithium/lead sulphate; lithium/iron sulphide; lithium/vanadium pentoxide; lithium/bromine; and lithium/iodine.

The reason for the various chemical combinations may not be immediately apparent, since it would seem natural to select the one giving the highest energy density. In practice this is not the only consideration. Material cost, ease of handling, stability in service and similar factors must all be considered.

In fact, the development of lithium batteries has not been without problems. Some early versions, particularly those using sulphur dioxide, were prone to generate gas if short circuited, and could explode violently.

Similarly, thionyl chloride is highly corrosive and cells using it must be hermetically sealed. A very high standard of quality control must be maintained to ensure that every cell is safe to use.

Failure to fully cope with these problems by some early manufacturers caused several incidents which resulted in all lithium batteries being tagged as potentially "leaky" or "explosive", regardless of their type or standard of manufacture.

The lithium/sulphur dioxide version, in particular, appears to be the black sheep of the lithium battery family. It has recently been reported ("Electronics", 15/3/79) that the US Federal Aviation Administration has ordered the removal of lithium/sulphur dioxide batteries from all aircraft emergency locator transmitters, following at least six explosions, plus several spontaneous fires and corrosive leakage problems.

This Tadiran "D" size lithium cell is typical of the present state of the art. Generating 3.4V on load it has a capacity of 10Ah at 60mA.

At the other end of the scale, polycarbon-monofluoride, silver chromate, and manganese dioxide are regarded as relatively "safe" materials, and a good deal simpler to work with. On the other hand they have higher internal impedance, limiting their use in some roles.

Some idea of what a modern lithium cell can withstand in the way of abuse is given in a detailed technical report issued by Tadiran. This lists a series of tests as laid down by the US Army Electronics Command, and the results of submitting random samples from batch production to these tests.

The tests are far too extensive to detail in this article, but they include vibration, shock, combined vibration and shock, thermal shock, altitude, pressure, and impact tests.

The thermal test consisted of 2 hours at —40°C followed by 2 hours at +70°C, repeated for a total of 12 hours. The pressure test is at 4 atmospheres for 12 hours, the altitude test at 15,000m (50,000ft), and impact test is of 14,000G.

Following each test the cells were subjected to a number of checks, including voltage, capacity, weight, dimensions, X-ray, observation for electrolyte leakage, etc. None of the tests produced any significant change in any of the cell parameters.

The Tadiran cell is designed to be proof against explosion in the event of a short circuit and, in fact, no release vent is provided. The makers have evolved a series of tests, more severe than the army tests, which include short circuit tests, compression test, high temperature test (150°C), hot plate tests (250°C), and "charging" tests. None of these will cause a cell to explode.

How does the lithium battery compare with, say, the alkaline battery on a simple watt-hours per dollar basis? This is not an easy comparison to make, since the capacity of either cell will vary according to the rate of discharge. However, most published data seem to be in fairly close agreement that a lithium/thionyl-chloride "D" cell will deliver about four times the energy of an alkaline "D" cell.

A typical price for a thionyl/chloride type "D" cell is between $6 and $7 each, depending on the quantity. On this basis, comparing it with an alkaline cell at around $1, the power bought in a lithium cells costs between 1.5 and 1.75 times as much.

This may not make it a very attractive proposition as far as the average user is concerned. What must be remembered, however, is that the purchaser is buying more than just so

	CARBON-ZINC	ALKALINE-MANGANESE	MERCURY	SILVER/SILVER II	MAGNESIUM	LITHIUM TADIRON/GTE
1. Energy Density						
a. wh/lb.	30	35	45	70	50	190
b. wh/cu/ in.	2	3	7	8	4	13
2. Voltage						
a. open-circuit	1.5	1.5	1.35-1.4	1.7	1.9	3.65
b. operating	1.25	1.25	1.25	1.5	1.7	3.40
3. Voltage Stability	poor	poor	good	good	fair	excellent
4. Operating Temp. Range	-5 to +50	-20 to +70	-10 to +55	-10 to +55	+10 to +65	-55 to +80
5. Shelf-life (yrs.) (To 60% Capacity)	1	2	2.5	2	2	more than 6

This table compares the performance characteristics of the most popular primary batteries, including a typical lithium type, lithium/thionyl-chloride. The table on the previous page expands this comparison by listing a range of lithium types. (Table compiled from data in Tadiran literature.)

Lithium Cells

much power; he is buying that power compressed into a certain size package — and a very much smaller package than has ever been possible before. In many cases that fact alone is worth much more than the extra cost.

Against this background it is interesting to speculate on the future role of lithium batteries. As with all newly developed batteries, the cost tends to be high in the initial stages. This is partly due to the high development costs and partly to limited demand. Eventually prices tend to fall as the product finds a place in the market and demand increases.

Also, for these same reasons, the first applications tend to be specialised ones; applications where performance is the primary consideration, with cost very much a secondary factor. Defence, aerospace, research, and meteorology are typical areas where these requirements apply.

Hand-held communications equipment can be vitally important in military exercises, yet the design of such equipment invariably has to be tailored around available battery systems, with these constituting one of the most serious constraints. A battery which offers anything from three to five times the energy density of currently available systems could change the whole concept of hand-held equipment.

There are many other situations also where the cost of a battery is less important than its performance. In any unattended application, the cost, in time and transport, of reaching a site is normally many times that of the battery to be replaced. In these circumstances a battery which reduces such visits by even two to one would more than justify a higher cost.

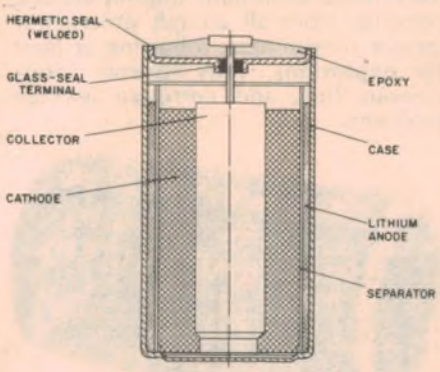
Another example is research into animal behaviour, using miniature transmitters carried by the animal, usually on a collar, to transmit biological and other data while the animal roams free. Fairly obviously there is a limit to the weight which the animal should be asked to carry but, on the other hand, the researcher may want to collect data over a long period, often many months.

In these circumstances replacing the battery means tracking the animal and capturing it; a procedure which at best is costly and, at worst, may be quite impractical. Also, capturing the animal during the study period may well disturb the very behavioural pattern which is being observed.

Weather balloons, used by meteorologists to study the upper atmosphere, carry miniature transmitters which relay the conditions observed by the on-board sensors. Again, there is an obvious weight limit, and the batteries to power the transmitter, and possibly other equipment, constitute a significant proportion of the total load. This is aggravated by the need to allow for reduced battery performance at the low temperatures of high altitudes.

Here the lithium battery scores in two ways. It starts off with a much higher energy content for a given weight, and its performance is less impaired by low temperatures. If longer operating time is not required, smaller batteries may be fitted and the load capacity used in other ways.

There are also many medical applications, including cardiac pacemakers. This provides an extreme example of battery replacement problems, since replacement involves major surgery.



The construction of a typical lithium cell — in this case the Tadiran lithium/thionyl-chloride version. Note the welded seal at the top of the case.

One version of the SAFT lithium/silver chromate cell has been used, since its introduction in 1971, in cardiac pacemakers throughout the world. According to the Australian firm "Teletronics" (prosthetic division), who are among the world's leading pacemaker manufacturers, this cell has created the enviable reputation that not a single failure has occurred in a pacemaker during that time, anywhere in the world. This is on the basis of over 120,000 implants using lithium batteries.

Even more promising versions for this application are now being adopted, particularly the lithium/iodine and lithium/bromine types. Both can offer energy storage in the region of 4Ah in an acceptably small pack. At a typical current drain of 22uA this promises around 20 years operation, although realisation of this depends on what shelf life can be achieved.

These are just a few of the specialised applications where the new cell is making its debut. But what of the more conventional applications; portable radios, cameras, calculators, torches, etc?

Here there are two major problems to be overcome. One is the significantly higher price, possibly coupled with a natural customer suspicion about the validity of the performance claims. The other is the fact that the cell develops approximately twice the voltage of conventional cells.

This means that the cell is not directly compatible with conventional cells in existing equipment. While there are several ways in which this can be overcome — such as the double cell developed by GTE Sylvania, or by the use of dummy cells — it is a characteristic which can confuse the non-technical user.

In fact, it looks as though these cells will find their way into the appliance market by a quite different route. It is no coincidence that several of the companies making these battieres — like Sanyo, National and Tadiran — are basically appliance manufacturers rather than battery manufacturers.

(Tadiran produces a wide range of electronic products, including military and civil radio communication systems with emphasis on hand held transceivers, rescue beacons, etc.)

The logical approach is for these firms to develop new equipment designed to use these cells exclusively — and to take advantage of their superior characteristics — thus introducing the cells via the improved equipment which they make possible.

Once established in this role the cells may well find more general acceptance by the general public for use in older appliances, minor problems notwithstanding.

Nor is research being confined to primary batteries. A number of organisations are seeking to exploit the high energy and low weight characteristics of lithium in the development of a secondary battery. Among those working on the idea are Bell Telephone Laboratories, in the US; The Max Planck Institute for Solid State Research, in Stuttgart, Germany; and Exxon Enterprises Inc, Sommerville, US.

The latter company appears to have actually marketed a lithium secondary cell, using a titanium-disulphide cathode and a non-aqueous electrolyte. It is a button cell of 70mAh capacity at a discharge rate of 1mA; a small beginning, but one which could have important consequences.

Most researchers, regardless of their approach, seem to be aiming at a battery having up to 10 times the capacity, for a given size and weight, of the conventional lead-acid cell; something which electric vehicle engineers would regard as a major breakthrough. Unfortunately, a tremendous amount of work remains to be done before researchers can even confirm whether such an achievement is possible.

In the meantime, the primary lithium battery is being hailed by some authorities as "The battery of the 80s". Whether this prediction is justified remains to be seen, but at least it represents a very significant step forward in battery engineering.

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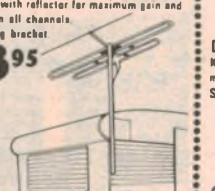

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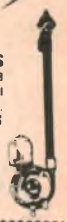

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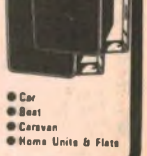

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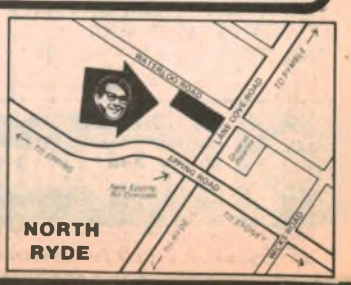
- **Purchasing and importing department**
- **Administration** (including management & accounts)
- **Advertising & Marketing** and, of course our huge
- **Bulk warehouse and distribution centre**



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The manufacturer of this quality keyboard went broke and we bought the lot. You reap the benefit! This keyboard must have cost twice as much to manufacture as the price we're asking for.
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What a great idea! Double adaptors can be dangerous: use one of these 4 way safety shutter outlets on a 2 metre cord for top safety.
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Cat P-5610

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Here's the greatest aid around for the hobbyist, experimenter or designer. It's a Bumboard - rows of connected holes (just poke the component leads in) with a front panel for pots, switches etc. Once you've finished, strip it down for re-use!
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Use to connect computers to peripherals.
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(Universal backshell available: Cat P-2692 ..... $2.60)

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If you use mics, you'll know how easy it is to lose the mounting brackets. Or the nuisance in transferring mics from stand to stand. The solution: these spare brackets. Fit most mics (spring lit) with standard thread. Handy!
Cat C-1264
ONLY **$1.95**

WHO WANTS A WHISTLE?

Certainly not you if you are trying to listen to a tuner — and all you are getting is whistles from other stations!
The cure: build a Dick Smith Whistle filter and install it in your tuner. Easy to build, easy to install, and it effectively removes inter-station whistles.
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Cat Z-9012 ..... **$2.50!!**

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It's so easy! Simply list the items you want, with their catalogue number(s) and post it off with your cheque to our mail order centre (address below). Don't forget to include post and packing (charge is on total value of your order as per the table.)

ORDER VALUE:	P&P
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Note: these charges apply to goods sent by Post in Australia only. Large and bulky items cannot be sent by post.
If you prefer, we will despatch your order by Comet Road freight anywhere in Australia for only $6.00 — that's below what it costs us! Large & bulky items are normally sent by Comet unless you specify differently (eg by rail or air — you pay freight on delivery).

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Normal price for these is at least $3.00 each: look at our prices.

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3300uF 50 volt: Cat R-4577 ..... 60c ea (10 up 50c ea)

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Cat S-7005
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NEW KITS
(and new kit components)

Remember: parts for most kits in most of the electronic magazines are normal stock lines. So even if a bit isn't listed, we may be able to help you anyway. Call in and ask us!

INFRA-RED REMOTE CONTROLLER (See Oct. EA)

CQY89A Infra-red diodes	Cat Z-3235	$1.50
BPW34 Photo transistors	Cat Z-1954	$3.50
Printed circuit boards (pair)	Cat H-8365	$5.95

DISCO STROBE (similar to ETI September)

Complete kit	Cat K-3750	$29.50
Printed Circuit Board	Cat H-8572	$1.95
Flashtube	Cat S-3882	$2.95
Trigger transformer	Cat M-0104	90c
Discharge Capacitors (each)	Cat R-2855	$3.75
Reflector	Cat K-6016	$4.50

WINDSCREEN WIPER DELAY (See September EA)

Printed circuit board	Cat H-8364	$2.50
Other components for this project are normal stock lines		

AUTO CHIME (See September EA)

Complete kit	Cat K 3502	$29.75
Printed Circuit Board	Cat H-8363	$3.70
TMS-1000 Integrated Circuit	Cat Z-6825	$16.50

INDUCTION BALANCE METAL DETECTOR (See ETI)

Short form kit (not including former or dowell for rod	Cat K-3100	$35.50
Printed circuit board only	Cat H-8578	$1.50

PLAYMASTER STEREO EQUALIZER (See May EA)

Complete kit including instructions	Cat K-3500	$99.50
UA4136 Quad Op Amps	Cat Z-8105	$1.95
PC Boards (set of 3 high quality boards)	Cat H-8360	$12.95
Slider pots	Cat R-1980	85c
Knobs to suit slider pots	Cat H-3782	50c

9kHz WHISTLE FILTER FOR TUNERS (See Feb EA)
Complete kit, including instructions ..... Cat K-3496 $19.75
(SEE MORE DETAILS ON OPPOSITE SIDE OF THIS PAGE)

INTERSIL LCD EVALUATION KIT (See Feb EA)
(As used in EA digital voltmeter) ..... Cat K-3450 $39.50
(See bottom of opposite page for more information on this product)

MICROWAVE OVEN LEAKAGE DETECTOR (See July ETI)

Printed Circuit Board	Cat H-8619	$1.95
5082 2800 Schottky Hot Carrier Diode	Cat Z-3230	$2.90
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123a Bathurst Street, Hobart Tas. Ph 348 232
Peter Brown Electronics
9 Doveton Street North, Ballarat Vic. Ph 323 035
Coastal Electronics
43 Vulcan Street, Moruya NSW. Ph 742 545
Crystal TV Rentals Pty Ltd
86 Crystal Street, Broken Hill NSW. Ph 6897
Delta Electrix
67 Queen Street, Ayr, Nth Qld. Ph 831 357
Elektron 2000
44 Brown Road, Broadmeadow, Newcastle NSW. Ph 691 222
Fred R Hayes Electrical
28 Station Street, Bowral NSW. Ph 611 861
D & M Harrington,
6/1 Machinery Drive, Tweed Heads South, NSW. Ph 364 589
Hutchesson's Communications
5 Elizabeth Street, Mt Gambier SA. Ph 256 404
Keller Electronics
218 Adelaide Street, Maryborough, Qld. Ph 214 559
Lismore Kitronics
Cnr Magellan St & Bruxner Hwy, Lismore NSW. Ph 214 137
M&W Electronics
48 McNamara Street, Orange NSW. Ph 626 491
Power & Sound
147 Argyle Street, Traralgon, Vic. Ph 743 638
Stevens Electrical
135 Goldsmith Street, Mackay, Qld. Ph 511 723
Sumner Electronics
95 Mitchell Street, Bendigo, Vic. Ph 431 977
Sound Components
78 Brisbane Street, Tamworth NSW. Ph 661 363
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68 William Street, Gosford NSW. Ph 247 246
Trilogy Wholesale Electronics
40 Princes Hwy, Fairy Meadow, Wollongong, NSW. Ph 831 219
Tropical TV Services
249 Fulham Rd, Vincent, Townsville Qld. Ph 791 421
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113 Horton Street, Port Macquarie NSW. Ph 835 486
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	162 Pacific Highway,	GORE HILL	Phone 439 5311		656 Bridge Road, RICHMOND Phone 428 1614
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FORUM

Conducted by Neville Williams

I CHALLENGE YOU TO MAKE THAT POINT!

In the July issue, we questioned some of the circumstances and attitudes surrounding the use of computers. Our remarks evoked a few giggles, some sympathetic nods of agreement — and one angry letter that challenged us to put the blame where it really belonged! Hence the above heading.

In fact, the letter started off in the most disarming fashion, calculated to put any author at his ease, and perhaps even to preen a little:

Dear Mr Williams,

As a long-time reader of your magazine, I always peruse "Forum". I find it a rare island of common sense in a sea of emotive journalism, where the views are biased by the connections that each magazine has.

Now there's a perceptive reader for you. A man of sound, common sense, who can recognise quality when he sees it! I must hurry on . . .

"I don't always agree with you, but grant you the right to your own opinion. You obviously do your homework on facts. I have always appreciated your manner of expression, being logical and sensible — until now!"

What's this? What's he mean by "until now"? I'm always logical and sensible. It's part of my act! But I am beginning to wonder about this man's judgment . . .

"Your July 'Forum' did you no credit. You wrote of the consumer interface with the computer as if the computer itself were the villian. If I saw that article in a sporting magazine or a womens' journal, I would shrug my shoulders. But you, Mr Williams, know better.

It's not the computer at fault but the designer of the programs or the people running an inefficient system. In almost all cases they are people employed by the company concerned, in your case an insurance company.

I challenge you to make that point next month!"

Say, this correspondent is starting to get hot under the collar; he really means what he says:

"I am a computer professional, employed by one of the large mainframe manufacturers and one of my duties is to advise our customers on the design of computer systems.

"Against this background, I must support your stand that the kind of situation you describe is neither necessary nor excuseable. Thus far we are in agreement.

"However, I take exception to your manner of ending the discussion. You seem to be demanding the elimination of the computer as the impersonal villain in all these matters.

"We don't need more of that sort of rubbish being printed. The public is confused enough by sensationalist statements by people who don't know what they are talking about and the computer manufacturer (who cannot tell his customer how he must run his business) gets it in the neck!

"I am fed up with our industry being made the scapegoat for all the stupidity committed by system designers. I commend to you the more rational approach that the public thump the counter and demand that the company design a more workable computer system."

The writer of the letter gives his full name and address but requests that we publish no clue in the magazine. As he says "The computer business can sometimes prove to be a small world!"

We respect that stipulation but we could not meet his request to put his point of view in the next issue. What with printing schedules and postal strikes, this happens to be the next issue available.

The motivation behind his letter is revealed in the sentence "I am fed up with our industry being made the scapegoat . . ." He sounds fed up. He reacts fed up!

I must admit that it's not pleasant to be laughed at, either individually or as part of a group. And I must admit, too, that the computer industry has been the butt of innumerable cracks in newspaper columns. We've all seen them; we've all laughed at them. Maybe we've added a few of our own!

But it's unrealistic to expect not to be ridiculed when the aberrations are so apparent. And it's likewise unrealistic for our correspondent to expect the public to distinguish between the weaknesses of hardware, software and company egg-heads. If someone says "we can't do it because we're on computer", the computer gets the blame,

AND I CHALLENGE YOU TO PAY UP!

A big (Melbourne) city store sent a customer a bill for $00.00. He made the mistake of ignoring it.

There came a first warning, polite but cool. Then a second, cool but polite. Then a third, turning nasty and threatening prosecution — all for a measly $00.00.

So the customer despatched a cheque for $00.00, telling his bank manager to let it through. Back came a cordial reply from the store (friends again) thanking him for his payment of $00.00!

whether it be as a machine or as the emblem of a total system.

But our correspondent's phrase "elimination of the computer" makes me wonder whether he is also sensitive to the massive present-day criticism of the computer as the "villian" which puts people out of work. It's criticism that would be all the more cutting to someone in the industry because it is very difficult to dismiss.

I hadn't thought of it before but I can well imagine that, when someone in our correspondent's position arrives to discuss a new computer installation, he is not likely to be met by a welcoming committee. In many situations, the computer man and his gadgetry would represent a direct threat to current methods, current skills — and current jobs.

But, whatever the reason, our correspondent is very defensive, as evidenced by his complete overreaction to what I said in the July issue. Let's just look again at the theme in that article:

I mentioned the ludicrous situations which can arise with computer orientated systems and detailed one in particular which involved a member of our own technical staff. I went on to suggest reasons why problems may occur at the public interface.

I quote from page 25, column 1: "It would seem that one major source of hassle lies in the fact that many computer systems have not been set up to cope with an adequate range of real-life situations. They work fine as long as the anticipated routines are followed; what they frequently can't handle are the unexpected 'human' exceptions to the rule."

Everyday exceptions were suggested in the following pars, leading to the observation: "Clearly, in such situations, there is an access barrier between the staff and the system".

Possible reasons for all this were suggested and, summarised, they included:

- A lack on the part of the programmer.
- A lack on the part of the person spelling out the operational requirements.
- Insistence by management that the system be commissioned too rapidly.
- A deliberate decision by management to reduce traditional (and mildly troublesome) services coincident with introduction of a computer system.
- A diffidence on the part of office

"Helping to perpetuate the myth . . ."

Dear Sir,

I take exception to your Forum "Being bossed around by a computer". I am aghast at a learned journal helping to perpetuate the myth of the computer "taking over the world".

One of the more difficult tasks of — dare I suggest — those taking a more professional approach in the computer industry, is to kill the myth that the people buying a computer put themselves in a position of relative subservience to that machine. If "we are compelled to fit in with them", it is our fault, not theirs. A computer is only a machine; it takes a series of commands from a human and obeys them.

If a computer will not handle a correction to details in an insurance policy, it is because a human overlooked that capability when giving instructions to the computer. If a computer demands payment of $0.00 under threat of legal action, it is because a human has overlooked the condition of no outstanding debt. If a computer produces a bill for $1000 instead of $10, it is probably due to a human having erroneously constructed a calculation for that figure.

To be fair, you did suggest that a human was ultimately responsible, and that a computer can even be used as a scapegoat. But this vital point was buried well into the article.

A computer is only another tool in our technological arsenal. If a computer appears to dominate our existence, then it is obviously poorly programmed. Consider, for example, two public utilities in Melbourne, and the matter of changing one's address. At the customer desk of one, it is necessary only to nominate the old and new addresses, confirm the name, and everything happens automatically in seconds. At the other, the computer has first to retrieve the original information, after which various pieces of paper are then generated manually. The job takes minutes, not seconds.

For those who insist on suggesting a computer fault, it should be pointed out that, with the current generation of "self-checking" hardware, the chances of a fault going unnoticed and causing the kind of problems suggested above must be diminishly small.

I implore you to be more critical of the analysts, &c, responsible for systems design and implementation and to cut the finger pointing at the poor, defenceless, "robot dictators". They exist only in the minds of the public and, the sooner the public is appropriately educated (conditioned), the better.

B. J. Glen Iris, Vic.

FORUM: "I CHALLENGE YOU" — continued

staff to question or interfere with the automatic responses of a computer. By default "the inscrutable grey box is king".

Frankly, having summarised what appears in the July issue (page 25, column 2) it seems to say exactly what our correspondent insists that I should now admit to — plus a good many other things as well. Nowhere did I blame the computer as a machine, and nowhere did I even vaguely suggest that computers should be "eliminated".

The closing paragraph read: "Computers are fine as repositories of information and for jobs like sorting and number crunching. As robot dictators . . . yuck!"

In my book, that doesn't mean that computers should be eliminated; simply that they should be seen as electronic servants, not electronic masters!

So I have the frustrating situation of being accused of writing "rubbish" by someone who overlooks what I actually said and attacks me for something that I didn't say!

Maybe "Forum" for July was poorly written, so that it failed to communicate.

Or maybe our correspondent fell into the trap that ensnares us all at times: we become so touchy about a pet subject that we react without really stopping to hear — or read — what the other fellow says.

In so doing, we are the poorer, because there is likely to be some truth, even in those arguments that we tend to reject outright. Maybe I should take my own advice, maybe the theme in the July "Forum" wasn't as lucid as I thought it was!

It was after writing the foregoing material that I received two more letters on the subject, both from Victoria. The first contained a clipping from the Perth "Daily News", which appeared more or less coincident with publication of our July issue. Slightly abbreviated, it is reproduced in a panel headed, "And I challenge you to pay up!"

On reading the item, forwarded by R.C. of Keilor East, we wondered what the next step would be if the customer involved had continued to ignore the stupid correspondence. Where, along the line, would commonsense have intervened?

We must also confess to some speculation as to what the next step would be in a fully computerised debt collecting procedure. Maybe the defaulting party might be summoned by the computer, for a certain time and place, to appear before the "beak".

I am not referring to a human magistrate, often referred to by that term.

I have in mind an officially endorsed grey box, full of bits and chips: the Brainless Electronic Asessor of Klaims!

But, seriously, one can hardly blame the public for taking a dubious and disrespectful view of a system that can produce such a ridiculous result, even occasionally. Nor can we expect the public to be selective in blaming a particular part of the system. We stand by the remark in the July issue: "Computers have become, at the one time, a symbol of progress and an excuse for just the reverse."

The other letter mirrors very closely the correspondence referred to at the very beginning of the article, and qualifies for much the same kind of comment. It is reproduced in a separate panel, in a slightly abbreviated form.

Again, the writer reveals an over-defensive, over-sensitive attitude to criticism, allegedly of a mere machine. I never mentioned or even hinted at the "computer taking over the world", yet I and "Electronics Australia" stand condemned for helping to perpetuate such a "myth".

The writer sees, as a further "myth", the idea that "people buying a computer put themselves in a position of relative subservience to that machine."

It may indeed be a myth that people need to be subservient to a computer. The theme of our July article was that, unfortunately — and too frequently — they are subservient. By inference, it is so whenever the staff or the public forfeit human, commonsense interaction because of a computer system.

Don't blame the machine, pleads R.C. Blame the analysts and others who fail to instruct it properly.

I did, of course, virtually exclusively.

And I didn't "bury" the statement in the middle of the article — a term that implies grudging acknowledgment of something that I would have preferred not to admit. The possible explanations flowed naturally from the initial statement of a problem, as seen by the public. I might have reversed the order had I been writing a public relations release for a mainframe manufacturer — but I wasn't.

As seen by the public, the computer industry does have an image problem, which won't be solved by ignoring it or by quibbling over "man or machine?" It will only be solved by everyone in the industry co-operating to the degree that is necessary to ensure that the public is not faced with stupid and frustrating situations.

It is precisely because these situations have continued that we proceeded to the conclusion in July, which still stands:

"Maybe it's time we started thumping the counter and demanding a more human response to our human problems."

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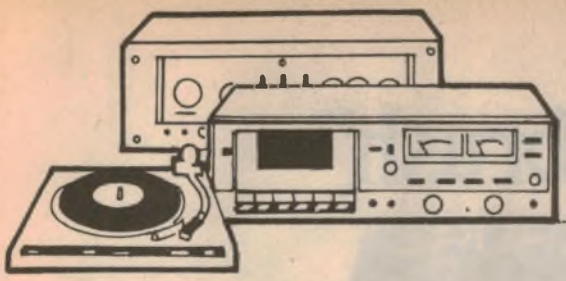


Hi Fi Topics

HIFI TECHNOLOGY IS STILL RACING AHEAD

The range of space-age technology which is being incorporated into new hifi modules is not only amazing in itself, but in the alacrity with which it is being taken up by manufacturers from around the world. This came through loud and clear at the recent Chicago Consumer Electronics Show.

by GEORGE TILLETT

("Electronics Australia" correspondent in the United States)

This year's Summer Consumer Electronics Show (SCES) set a new record, with well over 60,000 trade visitors tramping up and down the crowded aisles of Chicago's huge exhibition centre at McCormick Place. Unlike the previous two Shows, there was no segregated "esoterics group", as it seems that several exhibitors objected to the name — probably because it suggested something "way out" and bizarre (hence — unsaleable); or maybe they realised that today's esoterica will be tomorrow's run-of-the-mill products!

Be that as it may, most of the high end manufacturers were congregated at the venerable Pick Congress hotel while the more affluent had demonstration rooms at the McCormick Inn.

TAPES AND DECKS

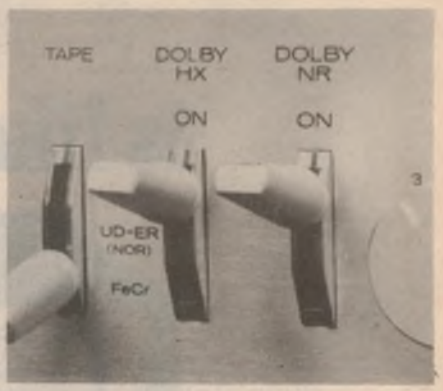
Big news at the January Show in Las Vegas was the introduction of metal tapes and now, less than six months later, almost every tape recorder company had at least one cassette deck suitable for these wonder tapes; some like Akai and Pioneer had four or five models.

One of the most interesting of these "metal tape compatible" decks was the Nakamichi 680 which can play at half speed (2.38cm/sec) in addition to 4.8cm/sec. The upper -3dB point at the slow speed was at 15kHz, while the response at 1⅞ips is extended beyond 20kHz. The metal tape used at the demonstration was made by TDK but Nakamichi propose to market their own brand soon.

The 680 is a luxury deck with three motors: one for tape drive, one for hub control and the third for transport functions. It has a built-in calibration generator, azimuth head adjustment, monitoring capability, dual function (peak-average) fluorescent level indicators and provision for cable or wireless remote control.

Many of the new decks are using bar-graph indicators instead of VU meters. Some are LCD, others consist of a row of LED's.

Microprocessors are also being used extensively. For example, one of the new BIC two-speed (4.8 and 9.5cm/sec) decks use one for program control and digital display, while Phase-Linear's Model 7000 employs a microprocessor for automatically setting the bias, equalisation and levels for nine operating parameters — including



With noise reduction systems popping up all around, Dolby interests are not resting on their laurels. Alongside the normal Dolby NR (Noise Reduction) switch, the "HX" facility here extends the high frequency "headroom", thereby lowering distortion.

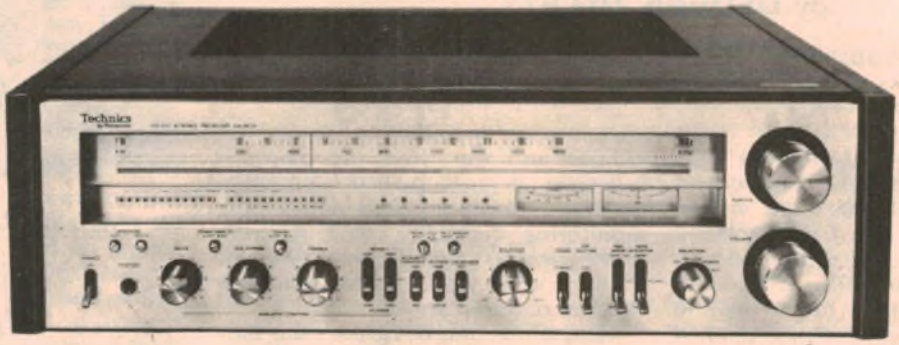
different kinds of tape.

Eumig are known in Europe for their photographic equipment but they recently entered the audio market with a line of sophisticated cassette decks. Their new model, the FL-1000, has some unusual features. For instance, the tape transport mechanism doesn't have a flywheel and an optical servo system is employed to ensure constant speed.

Announced by Eumig (USA) Inc, this new and sophisticated cassette deck is identified as type FL-1000uP, the "uP" indicating the use of an inbuilt microprocessor to effect various control functions. The tape transport system eliminates the usual flywheel and employs an optical sensor to control tape travel, yielding a wow and flutter figure of 0.035% RMS. (See text).

fact: calling this a "brush"

is like calling this a "radio"



we call it a Dynamic Stabilizer ...critics call it a major innovation

True, the device on the front of a V15 Type IV cartridge bears a superficial resemblance to a cleaning brush. In reality, it is a complex, exquisitely engineered subassembly which performs several complex functions that measurably enhance the quality of record reproduction!

Each one of its 10,000 conductive carbon fibers is positively grounded to discharge ever-present static electricity from the surface of your records. This eliminates static clicks and pops, as well as the tracking distortion produced by the varying electrostatic attraction between the record surface and the tone arm.

What's more, the Dynamic Stabilizer incorporates Shure-developed viscous damping that results in a uniquely efficient suspension system which maintains precise cartridge-to-record distance and uniform tracking force—even on severely warped records. The stabilizer also acts as a shock absorber to cushion the stylus in case you accidentally drop the tone arm onto the record.

Finally, the tiny carbon fibers are so fine that 10 of them can fit *inside* a single groove to sweep free minute dust particles.

This integrated approach to pure sound reproduction extends throughout the design of the V15 Type IV. It sets a new standard of high trackability at ultra-low tracking forces—even on records that are warped, dusty, and charged with static.

If faithful reproduction of *all* your recordings is of paramount importance to you, we invite you to audition the V15 Type IV with the Dynamic Stabilizer. Or, write for the complete story (ask for AL569).

V15 Type IV...the stabilized cartridge

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AE133/FP

Wow and flutter is quoted at 0.035% RMS. Many control functions are achieved by a microprocessor and, among other features, is a 14-segment fluorescent level display, two mixable inputs with master fader and reverb. A built-in test generator provides two frequencies: 400Hz and 16kHz (that certainly shows how cassette decks have progressed!).

IMPROVED DYNAMICS

Dolby were showing off their HX "Headroom Extension" which automatically varies a recorder's bias level and equalisation to optimise the response at the high frequency end. The effects of tape saturation are considerably reduced and the net result is a lower distortion. The HX technology is intended for use with Dolby B systems and will be available to all Dolby licensees.

Tandberg's "Dyneq" system was also attracting a lot of attention and, as used in the Model TCD 440A, it also reduces saturation effects and improves signal-to-noise. It works by automatically adjusting the record pre-emphasis to obtain the maximum high frequency response without distortion. The system is patented but the company is said to be willing to consider licensing agreements.

NEW AMPLIFIERS

DBX (who prefer to be known as dbx) now have an ambitious encoded disc program with the co-operation of many well known recording companies. Recordings that meet stringent technical and/or musical standards are re-mastered to produce dbx encoded discs. A simple playback decoder is required for playback but this is relatively inexpensive. So far, 25 records have been issued (re-issued?) and I for one was most impressed with the increased dynamic range and silent background.

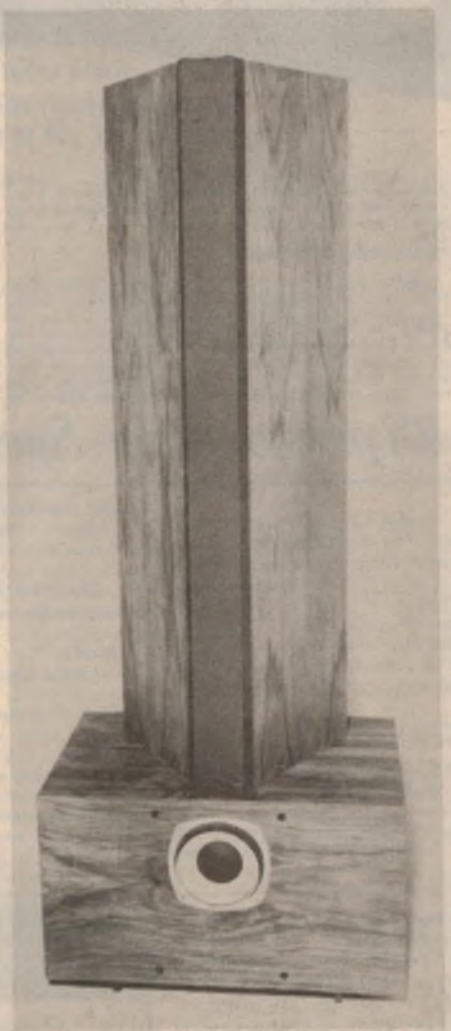
One of the sensations at the January Show in Las Vegas was the Carver "magnetic field" amplifier which is claimed to be 94% efficient. Precise details are not available but the circuit involves a voltage, or rather energy storage "in a relatively small lightweight and low cost magnetic field coil, thereby eliminating the need for a power transformer and electrolytic capacitors". The unit represents less than an 18cm cube and weighs only 4kg. Rated power output is 200 watts per channel and I can confirm that heat dissipation is insignificant.

One of the most interesting features of the design is the constant impedance output, so parallel loudspeaker connections cause no problems. Since the Las Vegas Show, minor circuit changes have been made and the amplifier will be available later this year.

Amplifiers with "Class A" output stages are still popular with some audio enthusiasts, although most of them are low powered models. An exception is

400 WATTS IN ONE SMALL BOX

For a 200 plus 200 watt unit, Carver's new Magnetic Field power amplifier looks impressively small — unless, of course, they have managed to locate a domestic cat two or three times normal size! Efficiency is said to be 94% — a startling figure.



For a mere $3600, an American audiophile can buy a pair of these METRON SUFT-FET-2 systems by Cerwin-Vega. The 72 transducers in the tower cover the range 200-30,000Hz, while the sub-woofer gets down to 20Hz. (See text).

the Threshold Model 4000 which has a rated output of 200 watts per channel. The power supply uses a 1 kilowatt transformer and the 48 output transistors have a dissipation reserve of six kilowatts! A Class A cascode circuit is used throughout and a matching cascode preamplifier is now available. The input stage is a little unusual, as the open loop curve is shaped to complement the RIAA characteristic, resulting in a constant amount of feedback over the audio range.

SPEAKER SYSTEMS

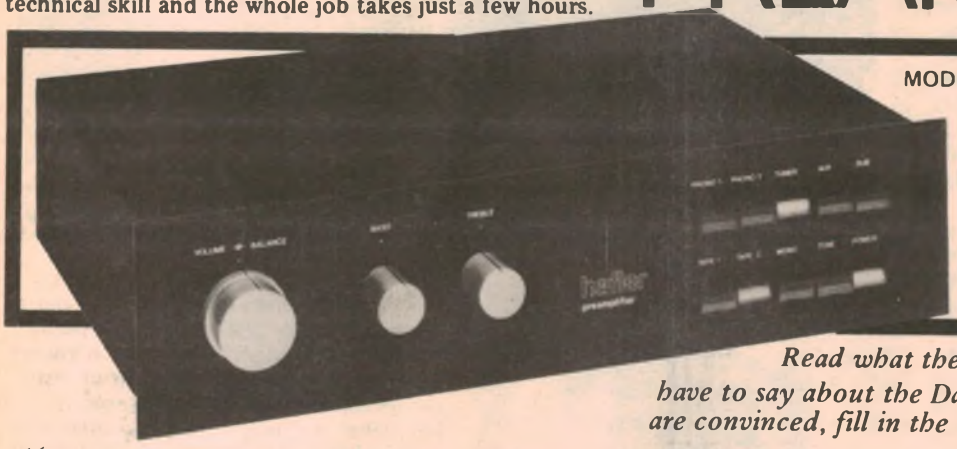
How to get bass from a small box is a problem that has long plagued loudspeaker designers and one method that has had a certain amount of success is the use of servo-feedback-which involves a built-in amplifier.

Now, KLH have come up with another variation — the use of a "bass computer-equaliser" which is controlled by the signals present at the loudspeaker terminals. The unit is connected in the tape-in, tape-out circuit or between the preamp and power amplifier and low frequency lift is dynamically controlled so that maximum displacement of the speaker cone is not exceeded. The attack time of the processor is so fast, say KLH, that mechanical overload is most unlikely. There are three systems in the associated range of loudspeakers, the smallest measuring 32cm by 22cm by 15cm and the -3dB point is at 40Hz.

The Canadian Jumetite corner horn which made its appearance in January is now in production. Mid and high frequencies are handled by a ribbon unit which is loaded by a 122cm curved horn. Crossover point is unusually low at 600Hz but the ribbon is exceptionally robust. It measures 7.6cm long, by 1.9cm wide and is .007mm thick. Horn and reflector are made of cast gypsum

*David Hafler proves, once again, that 'world' class doesn't have to cost the 'earth'. Introducing THE hafler PREAMPLIFIER

Audio pioneer David Hafler, is back on the scene. After his great success with the now — famous Dynaco Kit preamplifiers and power amplifiers he now follows up with a product bearing his own name — the DH — 101 preamplifier. David Hafler has one overriding philosophy . . . the best at a reasonable price. The DH —101 is acknowledged as one of the best preamplifiers in the sound world. It is now available in Australia. The easy to assemble kit is priced at a remarkable low $375. The assembly procedure requires no great technical skill and the whole job takes just a few hours.



MODEL DH — 101 IN KIT FORM, ONLY

$375

Read what the leading International Hi-Fi press have to say about the David Hafler DH — 101 then if you are convinced, fill in the coupon below to ensure delivery.

"The specifications of the DH — 101 are extensive. They can best be described as 'state of the art' — and then some!' 'Our conclusion is that if one is looking for a preamplifier with perfect electrical performance, enough input and control flexibility for almost anyone, and a minimum of gimmickry — and selling, at least in kit form, for a truly 'bargain basement' price — the Hafler DH — 101 fills the bill admirably. It looks to us as though the Hafler touch has, if anything, become even more refined with the passage of time.
STEREO REVIEW

"but its performance is literally 'state of the art'. Its distortion is virtually unmeasurable . . .' 'All noise levels are inaudible and, with 'A' weighting, are very difficult to measure'. '. . . quite possibly the most highly refined preamplifier one can buy (in terms of sheer performance)'. '. . . we have been informed by those who have built the kit that it is very simple, and that even a neophyte should be capable of assembling a properly performing preamplifier in a few hours or so.
POPULAR ELECTRONICS

"This unit has much of the punch and definition of the finest solid state preamplifiers that I have listened to. But the most amazing thing about the Model DH — 101 is not the bottom end, but what the unit does in the midrange and top. This is the first preamplifier I have heard that not only spreads an orchestral stage to an extreme left and extreme right, but also spreads this stage in a near perfect rectangle to the rear'. 'Like the very finest preamps that I have listened to, the Hafler has phenomenally good definition and inner detail.
ABSOLUTE SOUND

"The overall sound quality of the Hafler preamp is first rate. It has absolutely no irritating qualities, is very clean, very quiet, very neutral'. 'The audiophile who either can't or won't spend several weeks pay for a preamp no longer has to settle for something less than the preamp of his dreams.
AUDIO CRITIC

"In sum, we were surprised that this preamplifier is not being offered to the audiophile at twice its recommended retail price, because even at that level it would be worth every cent.
STEREO BUYERS' GUIDE — AMPLIFIERS

*the David Hafler DH-101 preamplifier: Specifications

PHONO PREAMP SECTION

Type: Discrete transistor (no integrated circuits) **Rated output:** 3 volts 10 Hz to 100 kHz **Maximum output:** 7 volts 20 Hz to 20 kHz **Distortion:** Less than .0006% @ 1 kHz and 3 volts out **Slew rate:** 12 volts per microsecond **Phono overload:** 180 mV @ 1 kHz, 1.8 volts @ 20 kHz **Phono cartridge interaction:** @ 20 kHz none **Hum and noise:** "A" weighted 86 dB below 10 mV 1 kHz input **Frequency response:** Complies with RIAA specification 40 Hz to 15 kHz ± 0.5 dB **Hi-pass filter:** In accordance with proposed RIAA revision (IEC publication 98, Amendment No.4, Sept 1976) **Gain:** 34 dB @ 1kHz **Input impedance:** 47 kΩ in parallel with 270 pf*

*Input capacity can be modified to conform with cartridge requirements. Above value must be added to capacity of connecting cables to get total cartridge load.

TONE CONTROL SECTION AND HIGH LEVEL AMPLIFIER

Type: Discrete transistor (no integrated circuits) **Rated output:** 3 volts 10 Hz to 100 kHz **Maximum output:** 7 volts 10 Hz to 100 kHz **Distortion:** Less than .001% 20 Hz to 20 kHz **Slew rate:** 12 volts per microsecond **Rise time:** 2 microseconds **Hum and noise:** "A" weighted 90 dB below 1 volt **Frequency response:** +0.0, −0.25 dB 20 Hz to 20 kHZ **Gain:** 20 dB ± 1 dB **Input impedance:** Greater than 25 kΩ **Square wave and pulse response:** Excellent! **Bass control:** Type: Moving inflection with variable turnover Amount: ± 12 dB @ 50 Hz **Treble control:** Type: Shelving with fixed turnover frequency Amount: ± 10 dB @ 20 kHz

GENERAL SPECIFICATIONS

Number of semi-conductors: 28 transistors, 2 integrated circuit power supply regulators, 4 diodes, 1 LED **Inputs:** Two phono, tuner, auxiliary, two tape recorders **Outputs:** Two tape (buffered) and one program **Provision for patching in external equipment Controls:** Volume, balance, bass treble, dub, switching of inputs, mono-stereo, tone control defeat, power on-off **Intermodulation distortion:** At normal levels of operation IMD, whether SMPTE or CCIF, from phono input to preamplifier output is below the residual of currently available instruments **AC voltage:** 100-130 and 200-260, 50/60 Hz **Power consuption:** 3.5 watts **AC convenience outlets:** 2 switched, 5 amp continuous, 72 amp surge; 2 unswitched, 5 amp continuous **Designed to requirements of Underwriter Laboratories Specification UL-1270 Size:** 13.75" wide x 3.25" high x 8.38" deep (35 x 8.25 x 21.3cm) **Shipping weight:** 9 lbs. (4 Kg)

All specifications are subject to change without notice

Guarantee: The parts in a DH — 101 kit are warranted for a full year from the purchase date. If a defective component is found on a circuit board or in a kit, simply return the individual part to Concept Audio prepaid together with the serial number and the date of purchase, and it will be replaced at no charge. If you cannot locate what is wrong with your DH — 101, return it to Concept Audio along with a copy of the dated bill of sale and a cheque for $25. If the difficulty is a defective part, the unit will be returned to you together with your $25. If the problem is found to be an error in your assembly of the unit, the unit will be put in proper working order and then returned to you freight prepaid. This warranty is void if the kit has not been completely assembled or if other than rosin core solder has been used. Units assembled with acid core solder or paste flux will be returned unserviced.

Stop Press: Just released! The David Hafler DH — 102 Moving Coil pre-Preamplifier, specifically designed to be installed within your DH — 101 as an integral part of the unit. Coming soon! The David Hafler DH — 200 Power Amplifier. Details available as soon as possible.
The David Hafler DH — 101 is also available pre-assembled for just $475. Telephone Concept Audio (02) 938 3700 for your nearest retailer.

POST TODAY

To David Hafler, C/— Concept Audio Pty. Ltd., 22 Wattle Road, Brookvale, N.S.W. 2100, Australia.
Telephone: (02) 938 3700

Yes, I am convinced that the DH — 101 is truly outstanding Please rush my kit as soon as possible. I enclose $375.

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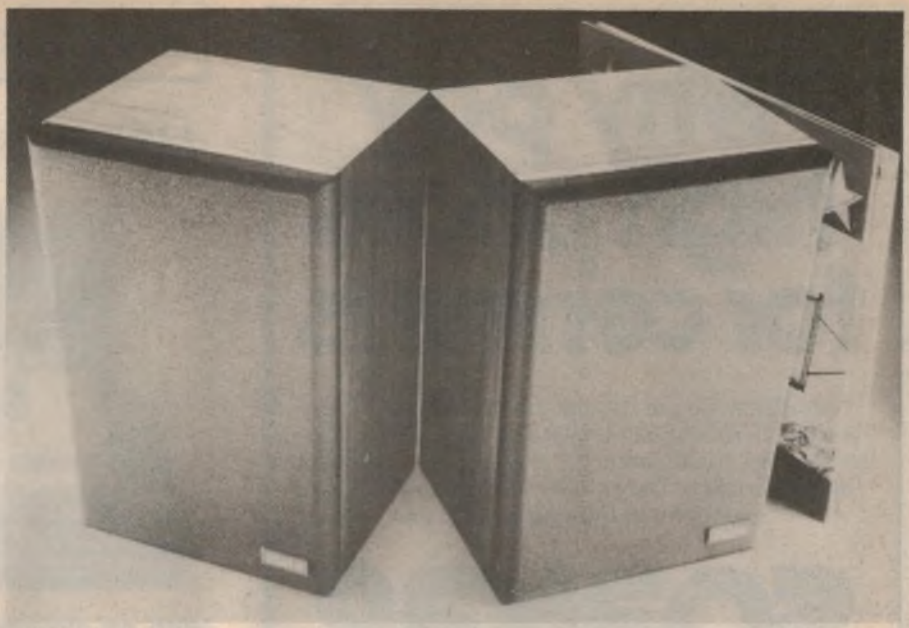
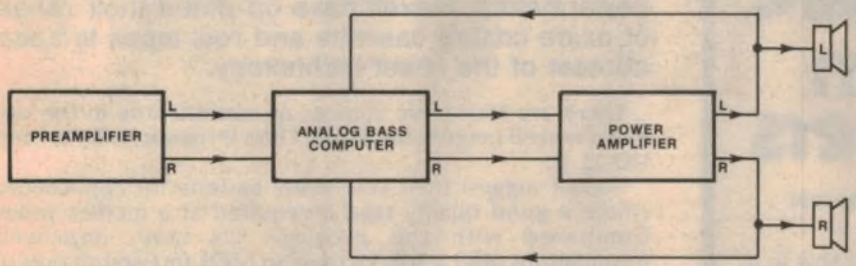
DH/EA

which is lacquered. Frequencies below 600Hz are handled by a pair of 10-inch bass drivers.

Cerwin-Vega (loud is beautiful) were showing a most unusual system called the Metron Suft-Fet which consists of a pair of mid-high frequency towers with a matched pair of bass cabinets containing a 38cm bass driver and an 20cm upper-bass unit. Each tower contains 72 thin-film planar transducers which Cerwin-Vega call Spiral Uniform Force Thin Film Electromagnetic Transducer — hence the name Suft-Fet. The spiral refers to the voice coil configuration and these flat transducers are claimed to have a response from 200Hz to 30kHz. A smaller model uses 36 Suft-Fets and a third system is "in the works".



No taller than an ordinary record sleeve, these KLH-4 speaker systems nevertheless have a 3dB-down point at 40Hz. They operate in conjunction with a "computer" module which plugs into the tape input/output sockets of any amplifier and "tailors" its behaviour to suit the speakers. (See text).

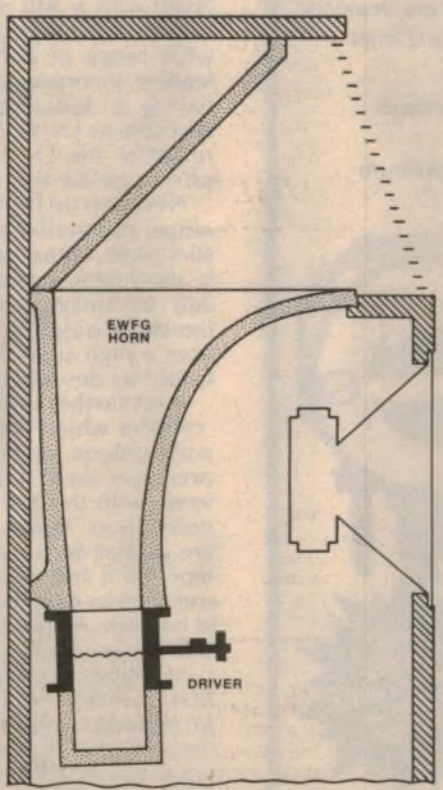


Decca were demonstrating an add-on ribbon tweeter which is housed in a small enclosure measuring just over 12.7cm deep by 10.2cm high and 10.2cm wide. Dynamic mass is only 10 milligrams and the recommended crossover is 7kHz. I can testify that the reproduction is "delicate, clean and non-fatiguing" but I am less certain about Decca's claim that it is "cold icicle making". Maybe it was the stifling heat of the Pick Congress Hotel!

Bose have built up a reputation as makers of "direct-reflecting" loudspeakers and now they have carried this concept to auto-sound. Their model 1401 direct-reflecting loudspeakers come complete with a 100 watt equaliser amplifier. An adjustable vane on the rear speakers allows the high frequencies to be "splashed" from the rear windows!

ALSO NOTED:

A new tangential turntable has now appeared — the Phase-Linear 8000. It uses a Hall Effect motor with servo-controlled direct-drive and the arm is controlled magnetically . . . Sanyo now use freon in their amplifier heat-sinks (yes, that's the gas used in refrigerators) . . . The Hill "Plasmatronic" loudspeaker is now in full production; this is the system that uses a massless plasma driver with helium gas . . . A tape recorder which can play for 24 hours with a C180 cassette has been introduced by Norwood. In addition to the slow speed, the deck will also function at 1⅞ips. The slow speed is intended to be used with "talking books" and the company has a large library available . . . Talking books are one thing, but how about a talking watch? Windert were demonstrating a Talking Clock that actually speaks the time — "Ten twenty-seven and sixteen seconds" — in English, French, German or Spanish. A talking watch will be available later this year.



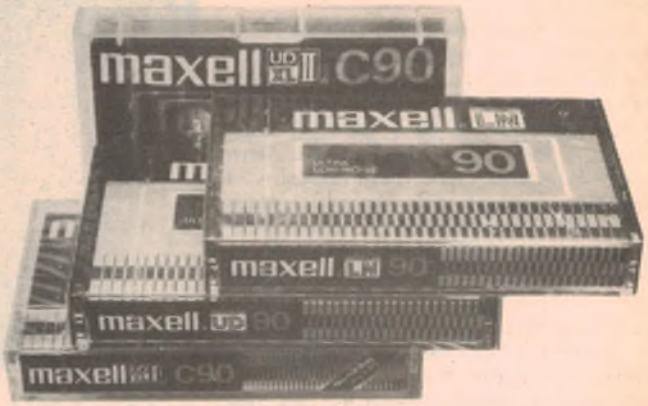
New from Canada is the Jumetite loudspeaker which uses a robust, horn-loaded ribbon source to cover the frequency range down to 600Hz. Frequencies below 600Hz are handled by 10-inch dynamic drivers. (See text).

IN BRIEF

SANYO AUSTRALIA announce the appointment of Mr Makoto Okano, as Product Co-ordinator for Audio products, at SANYO's Marketing Head Office at Lane Cove in Sydney. Mr Okano's appointment follows a period of duty in the Oceania Division, at SANYO Trading Co, Head Office in Osaka. He relieves Mr Kazu Sugimoto, who is returning to Japan after three years' duties in Australia.

PHILIPS in Australia have picked up the trend which has been reported from the USA, towards the provision of better quality sound from TV receivers. Their new KH609 "Hi-Fi Deluxe" receiver has a 2-way speaker system, with integral enclosure, driven by a 10W amplifier with separate bass and treble controls. The receiver is also equipped with cordless remote control, with provision for muting and easy return to pre-set picture and sound parameters.

MAXELL RANGE UP-DATED



With an already high reputation for quality and performance, Maxell have up-dated their range of oxide coated cassette and reel tapes to keep abreast of the latest technology.

There are four basic choices of cassette tape in the up-dated maxell range: Low Noise, Ultra Dynamic, UD-XL I and UD-XL II.

Maxell suggest their Low Noise cassette for applications where a good quality tape is required at a modest price. Compared with the previous LN tape, improved formulations offer a 3dB increase in MOL (maximum output level) with a 2dB margin at 12.5kHz. It also offers a wider tolerance in respect to bias level, ensuring good results on a wide range of decks. A quality housing is used and the leaders incorporate direction and timing cues, as well as having a non-abrasive cleaning action. LN cassettes are available as LN 46, LN 60, LN 90 and LN 120. Recommended retail for the LN 60 is $2.25, although some retailers may offer it below this figure.

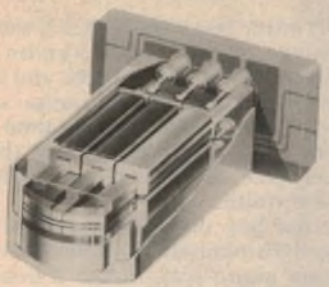
Next step up from the LN series is the UD (Ultra-Dynamic) range, also available in the same playing times. RRP for a UD 60 is $3.90. Using a gamma ferric oxide coating, the UD tape is also highly tolerant of bias variations but shows about a 2dB advantage over LN tape in respect to MOL and increased output in the 15kHz region on a quality deck. It uses a high precision shell and the same "four function" leader as described for the LN tape.

A yet further step up in quality is provided by the UD-XLI cassette which Maxell describe as "ultra sophisticated .. with unique epitaxial magnetic formulation and super-precision shell". They are available only in C90 and C60 form, with the latter retailing at $4.85. As indicated by the description "epitaxial", the particles used in UD-XLI tape are gamma-ferric oxide coated with cobalt ferrite. The new tape has a 1dB advantage in MOL over the earlier product and a 3.5 to 4dB advantage over Maxell LN tape. It operates to best advantage with conventional ferric oxide bias setting and the accompanying 120us equalisation.

At slightly greater cost ($5.10 for a C60) Maxell offer UD-XLII cassette, also using a cobalt ferrite coating but with the formulation adjusted to take full advantage of the "chromium" setting on many decks. Due to the 70us equalisation, high frequency noise is reduced by an extra 4-5dB, with the new formulation comparing more than favourably with typical chromium oxide tapes.

For further information on the new range of Maxell cassettes and on Maxell open reel tapes contact: Mr W. Topic, Hagemeyer (Australasia) B.V., 25-27 Paul St, North Ryde, NSW 2113. Tel. (02) 887 1444.

AKAI ELECTRIC Co. Ltd of Japan has announced a new breakthrough in the use of its new Super GX head material — the provision of separate record and playback facilities within the one head assembly, as illustrated. Using three separate pole pieces and three separate coils for each of the twin tracks, the new Akai head provides recording gaps 4 microns wide and playback gaps 2 microns wide.



Akai claim that the new glass and ferrite core material offers an improvement of 3dB in MOL (maximum output level) compared with earlier GX material and 1dB better than the Sendust formulation. Heads using Super GX are suitable for all tapes from the ordinary low noise variety to metal particle tape. The twin head structure combines this advantage with that of separate record/replay functions, without the physical complications of having to accommodate a third head in a cassette system originally designed for two.

ANTENNA ENGINEERING AUST PTY LTD. have supplied a diplexer which will allow two Adelaide FM stations to share the same antenna system when they go to air. The two stations are to be operated by the Progressive Music Broadcasting Association and Ethnic Broadcasters Inc, with frequencies on 102.3 and 103.3MHz. Isolation for the

respective transmitters will be 70dB at the channel centres and a minimum of 40dB at the channel edges. Power rating of the diplexer is 10kW per channel, although the power involved in this particular installation is only 2.5kW per channel. The diplexer was designed by Bryon Dunkley-Smith and manufactured by Antenna Engineering Pty Ltd, who are located at Garden St, Kilsyth, Vic 3137. Telephone (03) 728 1777.

SMITHS INDUSTRIES PTY LTD have announced the release of their new high-performance Roadstar GP series of car cassette radios. The RS-2500GP offers AM/FM facilites, while the RS-2580GP adds one shortwave band. The RS-2800GP provides AM and two SW bands but no FM coverage. The cassette player features a sendust head for quality and long life, and both automatic eject or reverse play at the touch of the appropriate button. For information contact Mr Colin Hines of Smiths Industries at 46-52 Ferndell St, Guildford NSW 2161.

LIBERO SYSTEMS — NEW FROM TEAC

Illustrated on the left is the Libero 7000 system, being offered by TEAC through selected hifi dealers. As shown, it comprises a TEAC BX-500 amplifier, TX-500 tuner, CX-270 cassette deck, PX-500 turntable and SX-500 loudspeakers. They are mounted in an LX-350 rack, with protective glass doors. An alternative horizontal rack is available. The Libero 5000 and 3000 systems offer TEAC quality at a lower price. For details: TEAC Aust Pty Ltd, 165 Gladsone St, Sth Melbourne, 3205.

Audiosound 8022 Motet

Those in the market for a very compact loudspeaker system should consider the new Audiosound 8022 Motet. It is a two-way system with a 100mm bass driver and a 25mm dome tweeter, coupled together via a complex crossover network. Frequency range is quoted as 45Hz to 20kHz +6dB and power handling is 40 watts maximum on program signals.

With the current popularity of recreational vehicles and to a lesser extent, caravans and boats, there is considerable demand for a very compact loudspeaker system which is still reasonably efficient while producing hifi sound quality. Audiosound seem well placed to cater to this market with their new model 8022 Motet.

Main feature of this minuscule system is the woofer. It must be one of the smallest woofers ever produced. While it has a nominal diameter of about 100mm, its effective cone diameter is much smaller because it has a fairly substantial roll surround. So with a diameter of about 68mm, the effective piston area of this driver is only about one-third of the area of the photograph on this page!

And while the enclosure itself may not be the smallest ever used for a high fidelity loudspeaker system, it is not much larger than the average shoebox. Overall dimensions are 240 x 370 x 220mm (W x H x D).

Actually, the enclosure with its small tunnel port is reasonably large for a woofer of this size. This follows the procedures set out by Neville Thiele and Richard Small and used by Audiosound in their other loudspeaker systems.

The cabinet is made of chipboard, with a synthetic veneer on four sides. The removable grille cloth frame is slightly proud of the cabinet front and is bevelled to improve the appearance. The logo and other labelling is screen-printed onto a black anodised strip of aluminium, which is attached to the grille clothe frame.

The tweeter is a well-known 25mm dome unit which has been modified by Audiosound to improve its propagation characteristics.

As with other Audiosound loudspeaker systems, the crossover network is quite complex, consisting of 6dB/octave networks for the woofer and tweeter together with impedance equalising networks for both these drivers. Crossover frequency is 3kHz.

On the rear panel there is a recess for a pair of spring-loaded terminals which are coded to show polarity (red for positive). Also on the rear panel is an adhesive panel which carries the specifications and serial number.

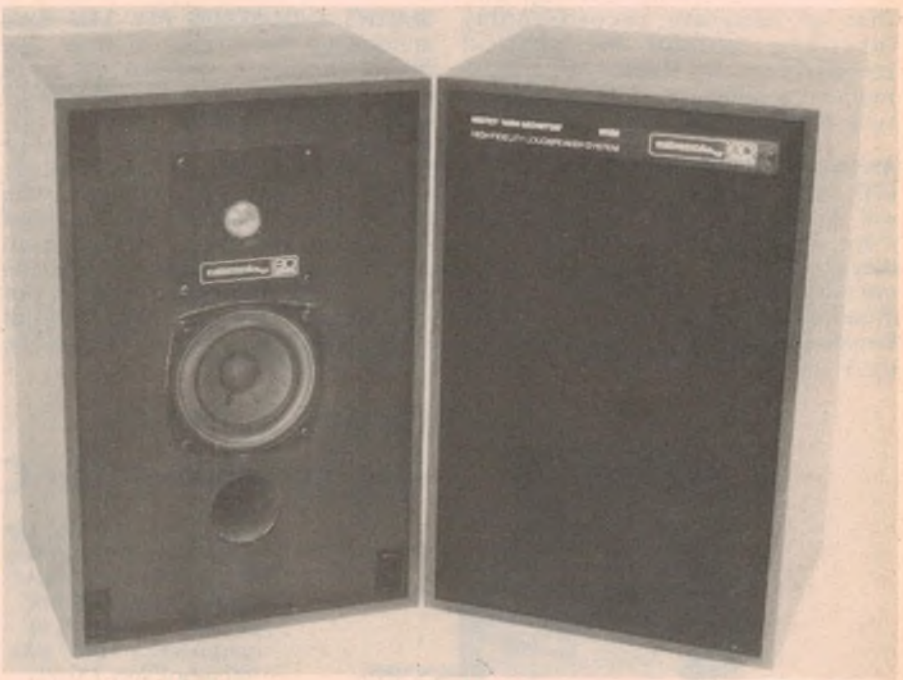
The impedance curve is not particularly smooth, but at least it does not dip too low. The minimum points are about 6.6 ohms at 9kHz and just under 6 ohms at 29kHz. At the bass end, there is a peak above 40 ohms at 95Hz and 28 ohms at 40Hz.

Audiosound quote the overall free-field frequency response of the Motet 8022 as 45Hz to 20kHz within ±6dB. Our tests indicate that, at the treble end, the response is smoothly maintained right up to the limit of audibility and beyond. But at the bass end the response appears to taper gradually below 300Hz and has little in the way of usable response below about 80Hz.

On music the Motet 8022 is very impressive in the treble region. The reproduction is very smooth and sweet, particularly on violins and other stringed instruments. At the same time there is little tendency to accentuate the treble end, or to emphasise unduly disc surface noise.

At the bass end, the response is not so well maintained but power handling is quite impressive. In fact it bears out the Audiosound claim that the Motet 8022 will stand well over 18 volts RMS for short durations when fed from a sine wave source ranging from 70Hz to 3kHz.

Modest bass boost can be applied, but if you want room shaking volume with organ records then the Motet is not for you.



Note the small diameter of the woofer in the compact Audiosound 8022 system.

Our overall impression then, is quite favourable. The Motet is a fine performer within the limits set by its compact enclosure. It should satisfy the needs of many people who have little space to spare — and not too much money. At $229 a pair, they represent good value.

Further information and demonstation of Audiosound equipment can be obtained from Audiosound Electronic Services, 148 Pitt Road, North Curl Curl, NSW 2099. (L.D.S.)

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* See review in September Electronics Today Int.'

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- DOLBY * noise reduction system electronically rids sound of annoying tape hiss – try and find any other cassette deck with feature at this price.
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DUE END SEPTEMBER

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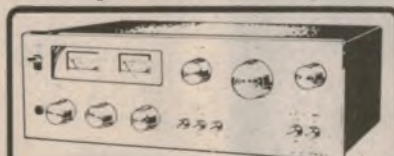
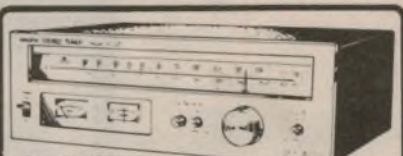


Cat. A-1300

Integrated Stereo Amplifier

- Contains 35 transistors and 12 diodes
- Dimensions (mm) 400(w) x 135(h) x290(d)
- Illuminated power meters
- 30 Watts RMS per channel
- Modern styling
- Weight 6.2kg
- Matches above unit

$249



Cat. A-1500

Superb Stereo Tuner

- Dimensions (mm) 400(w) x 135(h) x290(d)
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- Contains 5 transistors, 3 diodes, 3 ICs, 1 FET and 1 LED
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- Matches unit above

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Stereo infra-red remote control

Build it for your hifi system

If you are a keen hifi enthusiast, you are sure to be interested in our new infra-red remote control system. With it you can adjust your sound level up and down at will, without ever leaving your seat and it has negligible effect on signal quality. Best of all, it is easy to build and surprisingly low in cost.

by RON DE JONG

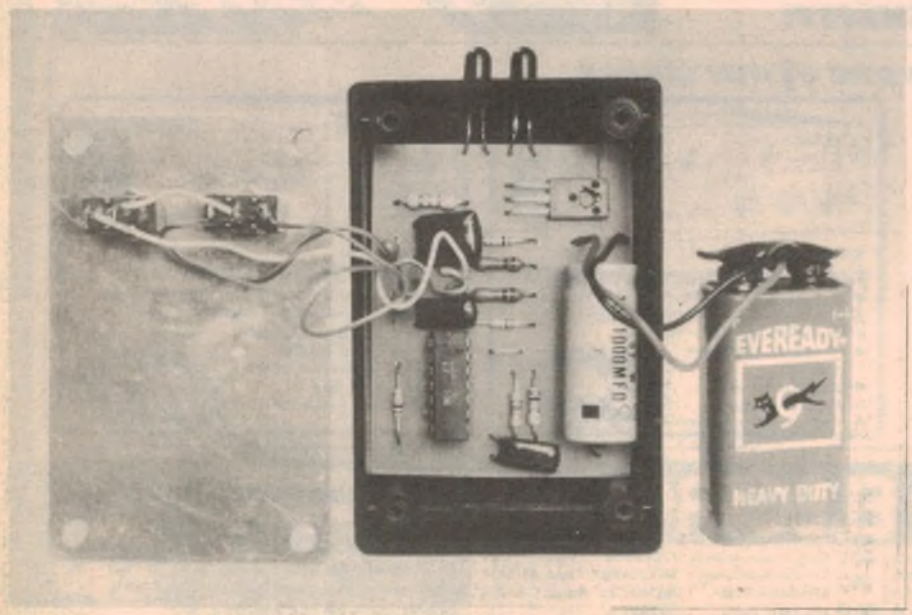
Remote controls are very popular with colour television receivers and are also available as an optional accessory with some of the latest tape and cassette decks. But there is only one remote control that we know of which can be added to a stereo amplifier or receiver. For this reason alone, we are sure that our new remote control system will find wide acceptance.

There are a lot of situations in which a remote control can be very convenient. Imagine reclining on the sofa and your favourite piece of music suddenly bursts from the FM airways — without a moment's hesitation you advance the volume to let the music really blast out. Then the station announcer returns and you ease the level back — all without even getting up.

It's also great at parties, where it's usually difficult to even reach the stereo let alone control it with any degree of certainty!

You can also use the remote control to mute the amplifier while you answer the telephone or callers at your home —no need to race for the volume control, just quickly stab the "down" button on the remote control module a couple of times and the volume is reduced to an unobtrusive level.

The remote control isn't just for stereo systems either. It can be used for setting the volume level of your TV — even to the point of cutting off the sound completely, particularly during commercials. The applications don't stop there either: the remote control could be adapted to switch appliances on or off, or maybe even used to control a light dimmer. We have no doubt that our readers can dream up many more interesting applications.



Inside the assembled transmitter unit. It's very simple and uses just one IC, a couple of LEDs, a Darlington transistor and a handful of other components.

The infra-red remote control system comprises two parts: a small hand-held module with two buttons is the transmitter while a larger cabinet with an inscrutably dark front panel is the receiver. This sits on or next to your amplifier or receiver and is hooked up so that it controls the volume level.

Behind the dark panel of the receiver are eight light-emitting diodes. Spread out behind this red perspex panel, these LEDs show the volume setting which has been selected by pressing the "up" or "down" buttons on the transmitter module.

Only one LED is lit at any time. Each time you press one of the transmitter buttons, the light will move across the panel of the receiver, one step at a time. The lowest volume level is indicated by the LED at the extreme left-hand side of the receiver panel while the highest volume level is set by the extreme right-hand LED.

When you reach the highest volume level, continued pressing of the "up" transmitter button will not change the level — you must press the "down" button to shift the level. Similarly, when you reach the lowest volume level, continued pressing of the "down" button will not change the level. Hence the volume level will not suddenly change from the lowest to the highest in one sudden jump — a big advantage for your ears (and nerves)!

Performance of the infra-red remote control system is summarised in an accompanying panel. The maximum range of the transmitter for reliable

The completed prototype, shown here with Playmaster hifi equipment. Eight LEDs behind the red perspex panel of the receiver (top) show the volume level that has been selected.

operation of the receiver is over 20 metres. This means that it will be more than adequate in domestic situations. You will be able to use it not only by pointing the invisible infra-red beam of the transmitter directly at the receiver but you can also operate by pointing the transmitter module at the ceiling or walls. You can even use it around corners or from other rooms.

There are several ways in which the infra-red remote control system can be used with your stereo system. For example, if you have a separate control preamplifier and power amplifier you will be able to connect the remote control receiver between the two. Or if your amplifier or stereo receiver has preamplifier outputs and power amplifier inputs you can remove the normal bridging links between these inputs and outputs and connect the remote control receiver in the same way.

The most common method will be to use the "tape monitor" facility which is provided on most stereo amplifiers and AM/FM receivers. The basic idea is to connect the remote control receiver as though it was a tape deck. The tape record outputs of the amplifier are connected to the inputs of the control receiver while its outputs are connected back to the tape monitor inputs on the amplifier.

Many of the more pretentious amplifiers have facilities for monitoring from two tape decks. This makes it easy to connect the remote control unit to the "tape 1" monitor while still retaining monitor facility at "tape 2".

When using your infra-red remote control, your amplifier's volume control becomes the master control. Use it to set the maximum volume level with the remote control set for the highest level.

If your amplifier does not have provision for two tape decks but you still wish to have a tape monitor facility, then it will be necessary to add this to the remote control. This is easily done with the aid of a circuit shown elsewhere in this article.

The total circuitry for this infra-red remote control system is relatively simple and low cost. The hand-held transmitter uses a mere handful of components, comprising one CMOS IC, a Darlington transistor and a couple of infra-red light-emitting diodes plus a few resistors and capacitors. The receiver includes ten low cost ICs, a photodiode and eight ordinary LEDs. All that will not set you back by more than about $45.

Let's look at the transmitter circuit first: This uses a 4011 quad NAND gate and three of the gates, 1a, 1b and 1c, are arranged as a standard three-gate CMOS oscillator with the exception that one of the inputs of gate 1a is used to "enable" the oscillator. The oscillator runs at 10kHz and is enabled, ie, it runs, whenever pin 2 of the 4011 is high. Pin 2 is controlled by gate 1d which pulls pin 2 high when either one of its inputs, pin 12 and 13, are pulled low.

Normally both inputs of gate 1d will be high by virtue of the 100k pull up resistors at each input. If one of the buttons is pressed, however, the resistor capacitor network associated with that button generates a short pulse as follows. Looking at the "up" button for example, there is initially no voltage across the .068uF capacitor since both sides have been pulled up via the 10k and 100k resistors.

When the "up" button is pressed however the switch side of the capacitor goes low and because the voltage across the capacitor cannot change instantaneously the pin 13 input of gate 1d will also go low, forcing the output of 1d high and enabling the oscillator.

Eventually the voltage at the input of the gate will reach ½Vcc as the .068uF capacitor is charged via the 100k pull up resistor and the output of gate 1d will again return to zero and disable the oscillator. The period for which the oscillator is enabled is dependent on the time constant of the .068uF capacitor and 100k resistor and is roughly 5ms. The pulse length generated by the "down" button circuit is similarly dependent on the 100k resistor and 0.15uF capacitor in its circuit and is about 1ms.

The 1uF capacitors across the "up" and "down" buttons provide debouncing. If the switch momentarily opens due to contact bounce the voltage across the switch will not immediately

Specifications:

TRANSMITTER

RANGE: greater than 20 metres
SIGNAL: down pulse — 1ms burst at 10kHz; up pulse — 6ms burst at 10kHz
ESTIMATED BATTERY LIFE: greater than one year

RECEIVER

Specifications of the audio section at maximum selectable output level.
FREQUENCY RESPONSE: 10Hz to 20kHz ±1dB
S/N RATIO: 75dB with respect to 100mV input
THD: typically .035% at 1kHz and 10kHz with respect to 100mV
MAXIMUM INPUT VOLTAGE: 5V RMS
ATTENUATION STEPS: 0, -3, -7, -12, -18, -25, -33, -42dB
POWER CONSUMPTION: 5 Watts

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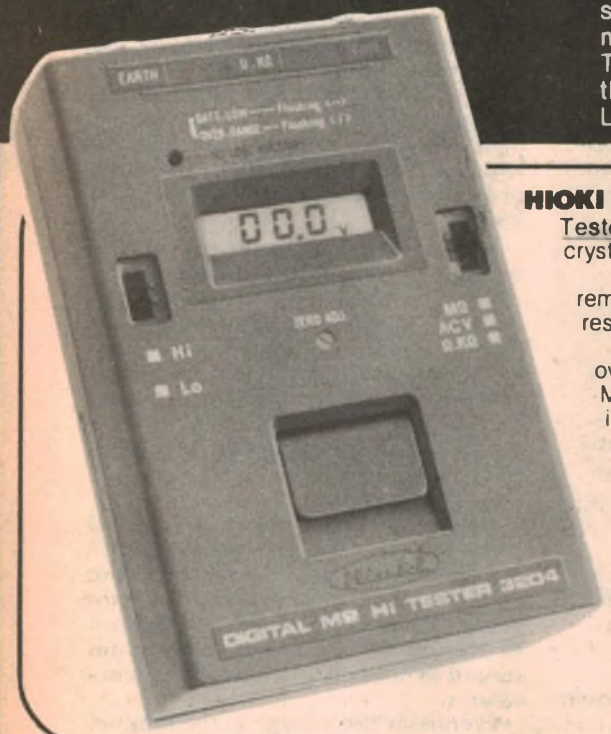


HIOKI 3204 B Believed to be the world's first production Digital Insulation Tester, the Hioki 3204B offers wide test ranges, high accuracy and a FE liquid crystal display.

Designed to meet Australian requirements, this 500 Volt instrument remains within specified lower terminal voltage limits when connected to low resistance loads. Output voltage is typically 495 Volts into 2 Megohms.

The model 3204B is Semi-Auto Ranging and includes display hold, overreading indication, battery check and overload protection facilities. Measurements facility for AC voltage to 500 Volts included. The instrument is supplied with one lead with probe and one red lead with clip.

Specifications

Reading Ranges and Tolerances

Function	Range Lo	Hi	Tolerance
MΩ	1.999MΩ 19.99MΩ	199.9MΩ 1999MΩ	±2%rdg. ±3dgt. 500MΩ under: ±4%rdg. ±2dgt. 501MΩ over: ±5%rdg. ±2dgt.
Ω-kΩ	199.9Ω 1999Ω	19.99kΩ 199.9kΩ	±1%rdg. ±0.5%f.s. ±1dgt.
ACV	199.9V · 500 V (Hi or Lo)		±1%rdg. ±1%f.s. ±1dgt. (40Hz-70Hz)

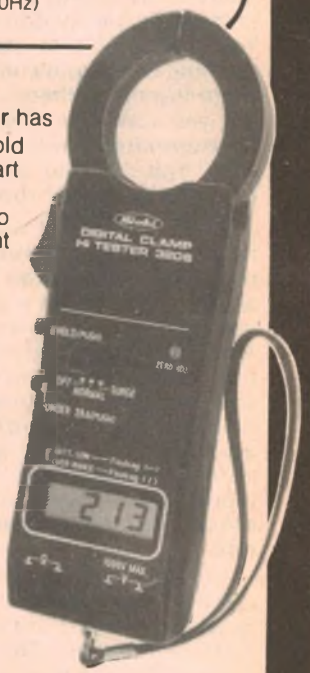
HIOKI 3205 Digital Multi Tester
Compact multimeter featuring Semi-Auto Ranging, electronic and fuse protection and approximately 40 hours continuous operation with alkaline batteries. Among the many advantages are overrange indication, auto polarity and automatic battery condition indicator.

Specifications

DC V 0-200mV/2000mV/20V/200V/1000V 10MΩ
AC V 0-200mV/2000mV/20V/200V/1000V 10MΩ
Ω 0-200/2000/20k/200k/2M/20M
DC A 0-200μ A/2000μ A/20mA/200mA
AC A 0-200μ A/2000μ A/20mA/200mA

HIOKI 3206 Digital Clamp Tester has FE liquid crystal display, reading hold facility and surge hold for motor start readings. A special 0-20A range provides 0.01A resolution. This Auto Ranging instrument enables current measurements to be made without breaking the circuit. In addition, voltage and resistance measurements can also be made.

The circuit design ensures low battery power consumption providing approximately 100 hours continuous use with alkaline batteries. Overrange indication and battery exhausted warning are among the many features of this instrument.



Specifications

AC A 0-19.99 (Push Button)
0-199.9/1000A (Auto)
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Surge Voltage 0-1000V
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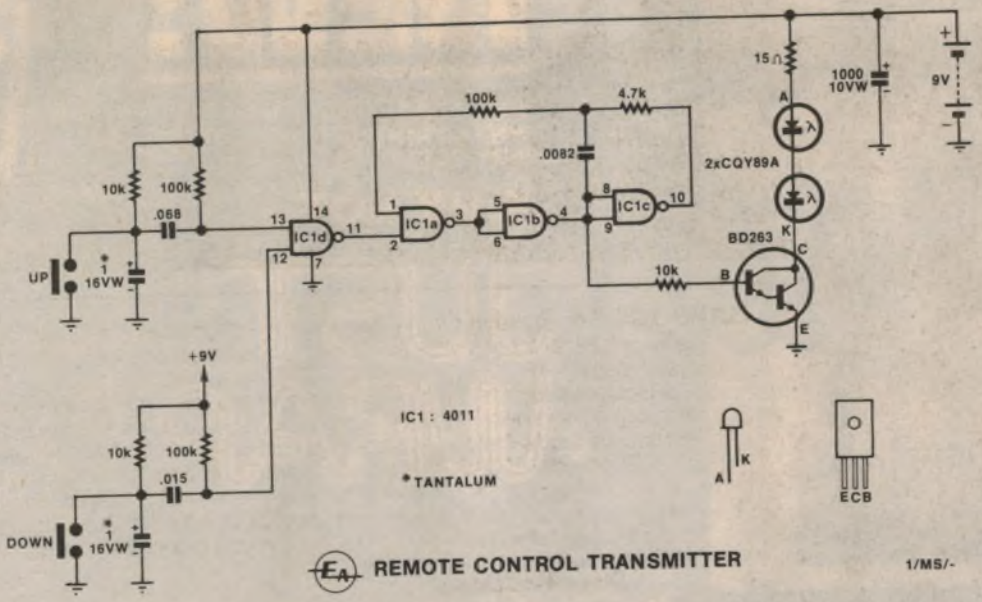
Stereo infra-red remote control: for your hifi system



The transmitter circuit consists of a CMOS oscillator and a Darlington transistor output stage driving two infra-red LEDs.

change because of the time constant of the 10k pull up resistor and the 1uF capacitor. The time constant selected is long enough to prevent any multiple pulses but is short enough to allow either button to be pressed several times in rapid succession.

The CMOS oscillator drives an output stage consisting of a BD263 Darlington transistor and two infra-red light-emitting diodes. A 10k resistor limits the base current of the Darlington and prevents the output of the oscillator from being unduly loaded. The Darlington provides the necessary gain and high current capability to drive the LEDs while the 15 ohm series resistor limits the LED current to a safe value and prevents damage to the LEDs.

Even so, the peak current is more than 300 milliamps which is more than the battery could supply on its own. Most of that peak current is supplied by the 1000uF capacitor which means that the battery has an easier job. When the buttons are not being pressed, the current drawn from the battery is very low, typically around 10 microamps, so we have omitted a power switch. Even with very frequent use, we estimate that the battery should last for more than one year.

The infra-red diodes used are Philips type CQY89A or Siemens type LD271. These are plastic-pack devices and are similar in appearance to the more usual red LEDs with the difference that the plastic pack of the CQY89A is very deep blue while the LD271 is light blue.

Let us now turn to the receiver circuit which consists of four main sections: preamplifier, demodulator, display and audio attenuator. The transmitted pulse from the handheld unit is detected by a photodiode. The signal from the photodiode is amplified and filtered by op amps.

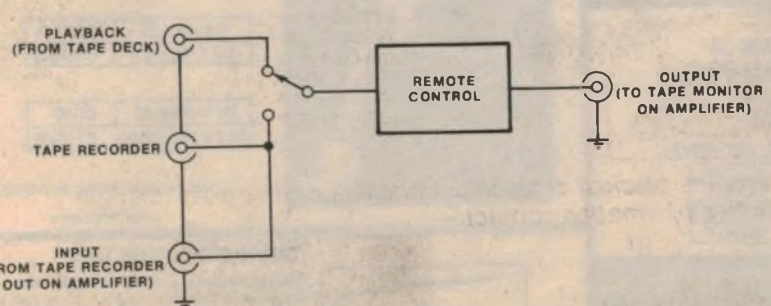
Filtering is necessary to remove the large amount of ambient noise which is picked up by the photodiode from sources such as fluorescent lights. Most of the "noise" due to this source is centred about 100Hz but there are harmonics extending right up the audio range to beyond 1kHz.

The photodiode is reverse biased via a 220k resistor connected to the cathode.

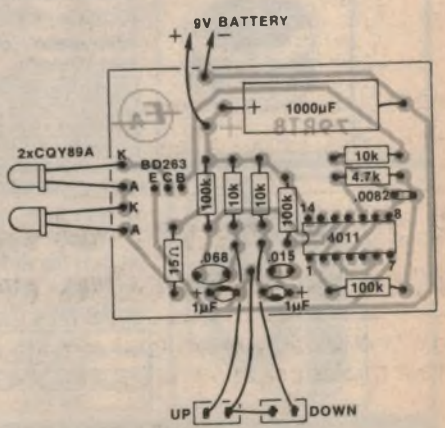
The reason for reverse bias is to improve the switching speed of the diode and, more importantly, to reduce the effects of ambient light on the sensitivity. The biasing network is decoupled by a 10uF tantalum capacitor and 100k resistor, to reduce the effect of supply ripple, and also eliminate any feedback from the following stages.

The output of the photodiode is coupled to op amp 1b which is arranged as an inverting amplifier. The .0022uF capacitor in series with the input provides DC isolation and also rolls

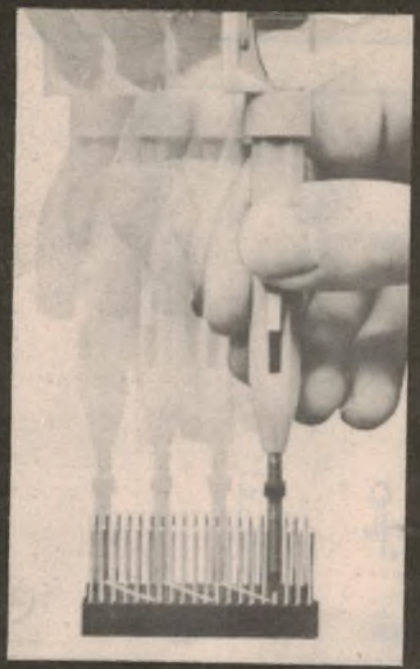
The receiver circuit (following page) consists of four main sections: preamplifier, demodulator, display and audio attenuator. ▶



Use this circuit if you wish to retain tape monitoring facilities. The circuit could be built into the remote control receiver or into a separate box.



The component overlay diagram for the transmitter. The CMOS IC should be the last component soldered into circuit.



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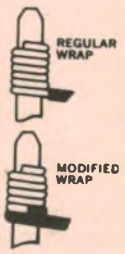

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Regular Wrap	WSU-30
Modified Wrap	WSU-30M

ROLLS OF WIRE

Wire for wire-wrapping AWG-30 (0.25mm) KYNAR® wire, 50 ft. roll, silver plated, solid conductor, easy stripping.

30 AWG Blue Wire, 50ft. Roll	R 30B 0050
30 AWG Yellow Wire 50ft. Roll	R 30Y 0050
30 AWG White Wire, 50ft. Roll	R 30W 0050
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- Strips 1" of insulation.
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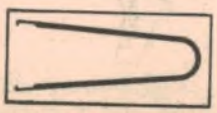

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Extractor Tool	EX-1

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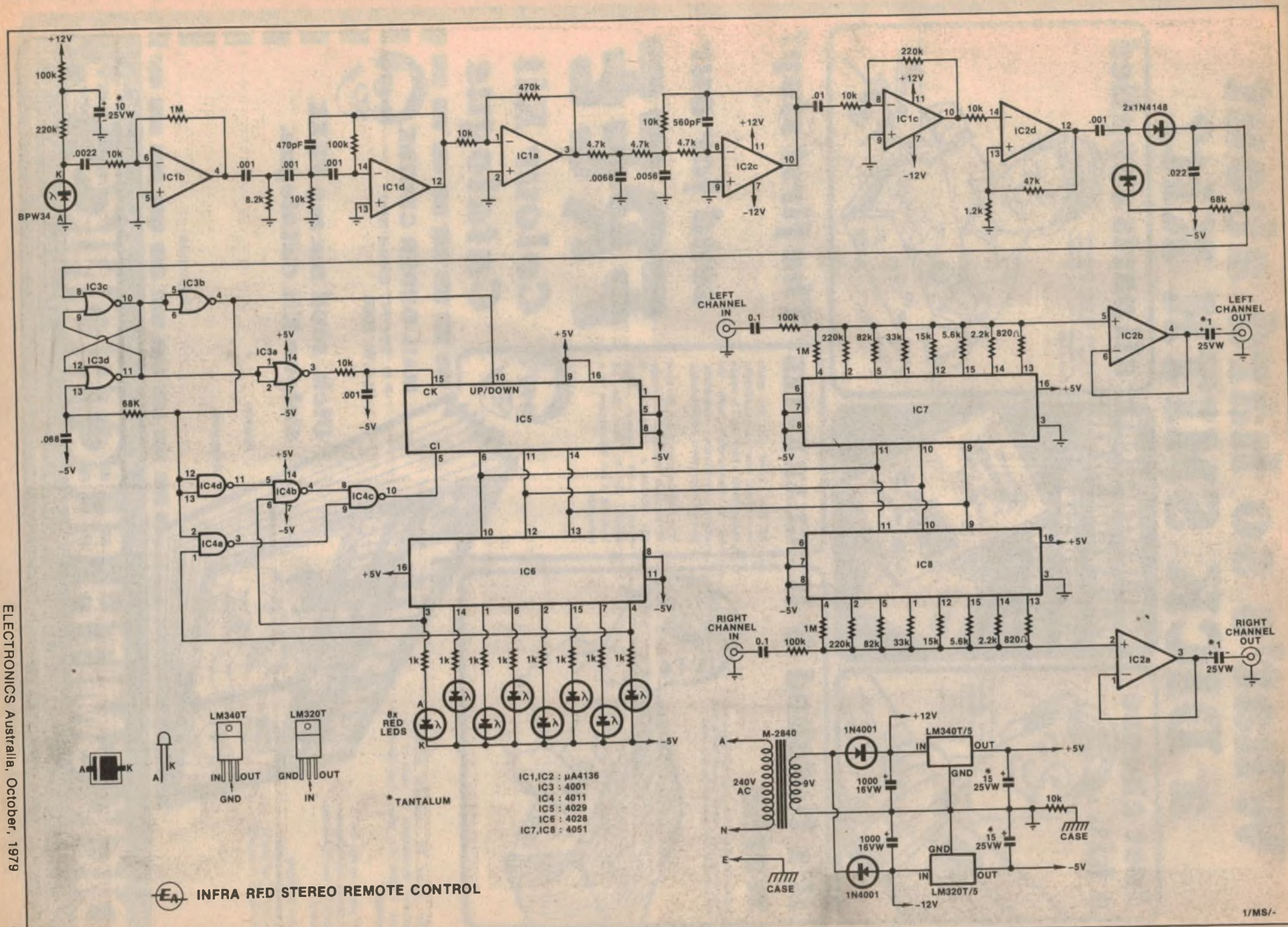
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220k
.0022
10k
1M
IC1b
.001
8.2k
470pF
100k
IC1d
470k
IC1a
4.7k
.0068
.0056
560pF
IC2c
.01
220k
IC1c
IC2d
2x1N4148
.022
68k
-5V
BPW34
IC3c
IC3b
IC3d
IC3a
68K
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IC4c
IC4a
IC6
IC7
IC8
LEFT CHANNEL IN
LEFT CHANNEL OUT
IC2b
RIGHT CHANNEL IN
RIGHT CHANNEL OUT
IC2a
1k
8x RED LEDS
LM340T
LM320T
IN
OUT
GND
*TANTALUM
IC1,IC2 : µA4136
IC3 : 4001
IC4 : 4011
IC5 : 4029
IC6 : 4028
IC7,IC8 : 4051
M-2840
240V AC
9V
1N4001
1000 16VW
LM340T/5
LM320T/5
CASE
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1/MS/-

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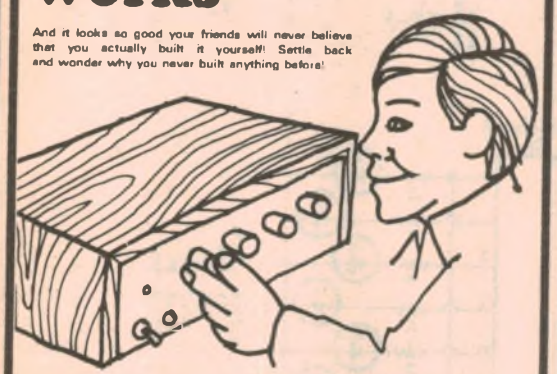

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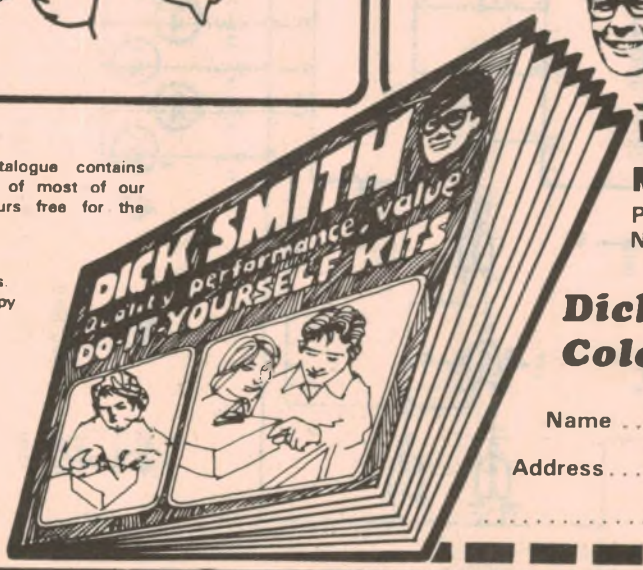

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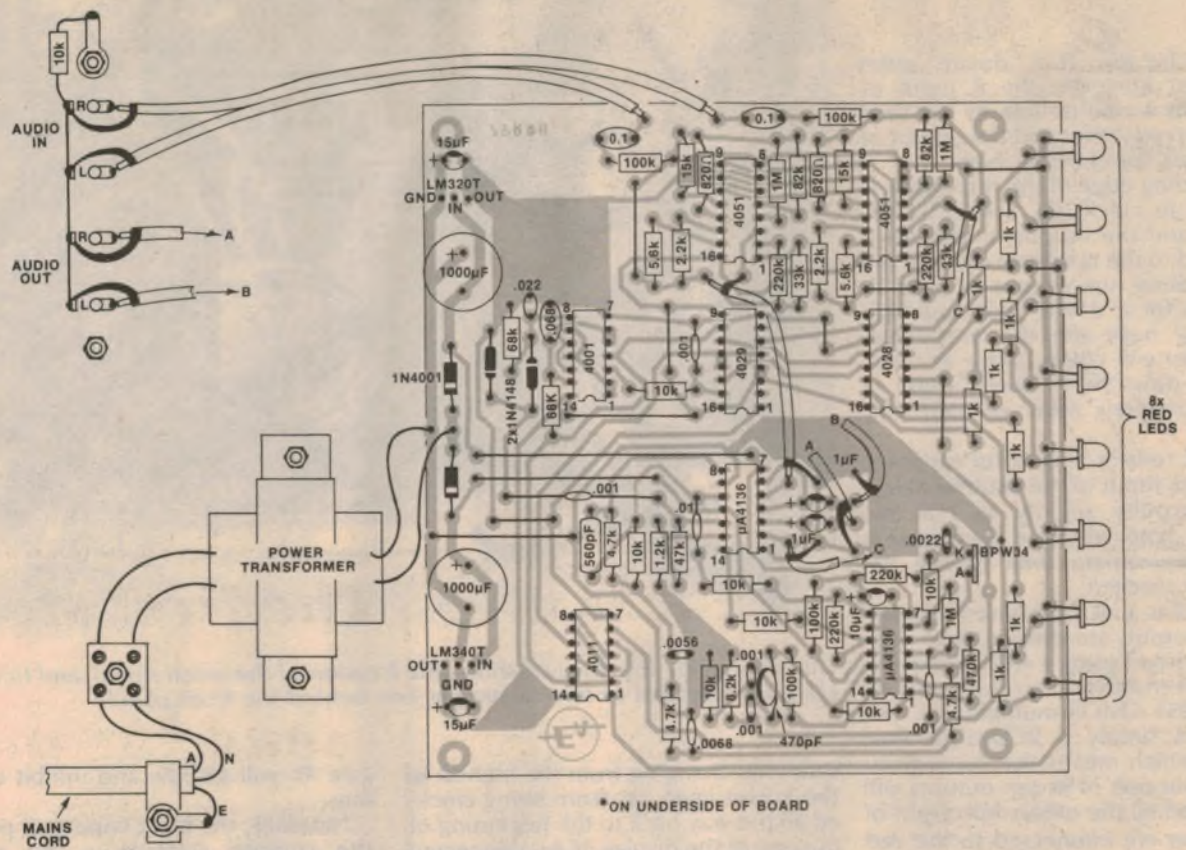


The wiring diagram for the receiver. Note that a metal shield is required over the audio buffer section (see text).

off the frequency response below about 8kHz. The attenuation provided is sufficient to prevent any 100Hz "noise" from overloading the first stage.

In the following stage, op amp 1d is arranged as a third order high pass filter with rolloff again at about 8kHz. The rate of attenuation is 18dB per octave which almost completely removes any vestiges of low frequency interference. The attenuation at 100Hz for example is about 40dB due to this stage alone.

The low pass filter is in turn followed by another inverting amplifier and then by a third order low pass filter which rolls off the response above 12kHz. The combined effect of the low and high pass filters is to pass only a quite narrow range of frequencies between eight and 12kHz, i.e. 2kHz either side of the nominal transmitter frequency. The narrow bandwidth of the amplifier minimises the effects of interference and it also reduces any noise contributed by the op amps themselves. It is wide enough, though, to allow for a reasonable margin of error in the transmitter frequency so no tuning is necessary.

Low pass filter IC2c is followed by op amp IC1c connected as an inverting amplifier driving, in turn, op amp IC2d connected as a Schmitt trigger. The Schmitt trigger output is normally high or low and switches to the opposite polarity only when the input signal exceeds a certain threshold. Thus the Schmitt trigger helps ensure that the receiver response is the same whether the transmitter is close or distant.

An interesting feature of the rectifier following IC2d is the fact that the .001uF coupling capacitor is 22 times smaller than the filter capacitor at the output of the rectifier. So any one cycle of the transmitted signal, or even interference, will charge up the filter only fractionally and some seven cycles are in fact required before the output voltage of the filter reaches a voltage sufficient to trigger the following CMOS logic. This provides a reasonable measure of interference suppression without effecting the sensitivity of the receiver.

The output of the rectifier filter will appear as a pulse to the CMOS circuit and with the filter time constant used the duration of the pulse will be approximately the same as when the signal was originally transmitted. As noted above the "down" pulse is about 1ms long while the "up" pulse is about 6ms long. This difference in pulse length is decoded by the three CMOS NOR gates which follow the filter.

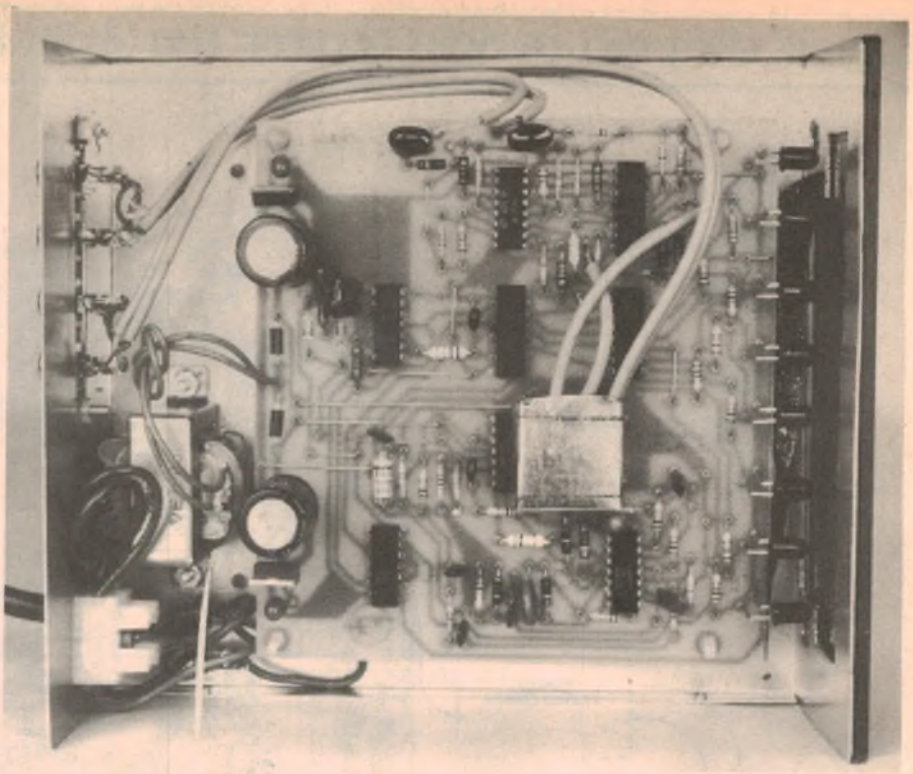
The NOR gates are arranged as an RS flipflop. Pin 8 input of gate 3c and pin 13 input of gate 3d correspond to the R and the S inputs respectively. Normally both inputs are low but when a pulse arrives due to a signal transmission the flipflop is set, with the output of gate 3c low and the output of gate 3d high. The flipflop would remain in this state if not for gate 3b. The output of this gate goes high and resets the flipflop via the 68k resistor and 0.68uF capacitor which comprise a time delay circuit.

The flipflop is reset about 3.5ms after the leading edge of the pulse signal which is after a "down" pulse would finish but before an "up" pulse has ended. So if an "up" pulse was received the R input of the RS flipflop will still be high immediately after the flipflop is reset and the output of gate 3c will

We estimate that the current cost of parts for this project is approximately

$45

including sales tax.



This view inside the receiver shows the location of the metal shield, and how the LEDs are arranged to form a straight line behind the front panel.

therefore be low. If a "down" pulse is received however, the R input of the flipflop would be low by the time the flipflop was reset and the output of gate 3c will therefore be high.

The leading edge of the reset pulse is also used to clock IC5, a 4029 CMOS counter, and the output of gate 3b is connected to the up/down input of the counter. Since the output of gate 3b will be low for a "down" pulse and high for an "up" pulse after the reset signal, the counter will count up for an "up" pulse and down for a "down" pulse — which is precisely what we want it to do.

The 10k resistor and .001uF capacitor at the clock input of the counter delays the reset pulse slightly so that the up/down signal will have been present for an appropriate time before the counter is clocked.

The 4029 is a four bit binary counter and the outputs are used to drive both a display circuit using a 4028 IC and the audio attenuation circuits which employ 4051 CMOS multiplexers. The 4028 IC is simply a BCD-to-decimal decoder which means that for a given binary input one of its ten outputs will be high and all the others low. Eight of the outputs are connected to the red LEDs mounted across the front panel.

The purpose of the LED display is of course to show the current volume level selected. It also confirms visually that you have indeed changed the volume level when using the remote control transmitter.

To prevent the volume level from suddenly changing from the highest to the lowest level, i.e. from being clocked all the way back to the beginning or the end of the display, IC4 is connected so as to inhibit clocking of the counter in the wrong direction. If the counter is being clocked up and it is already at the highest level the output of gate 4a will go low forcing the output of gate 4c high and inhibiting counting. Similarly if the counter is being clocked down when it is already at its lowest level, gate 4b will go low and inhibit counting.

Naturally, the most important part of the remote control is the audio attenuation circuit which consists of two eight-channel analog multiplexers and two op amps, one each for the two stereo channels. The attenuation is passive, performed by a voltage divider consisting of a 100k resistor in series with the input signal and one of eight resistors which is selected by the 4051

PARTS LIST FOR THE REMOTE CONTROL

1 Metal case, 160 x 70 x 184mm (W x H x D)
1 Power transformer 9V, M-2840 or similar
1 Plastic "zippy" box, 83 x 54 x 28mm
1 PC board, 129 x 123mm, coded 79RR8
1 PC board, 47 x 61mm, coded 79RT8
1 Piece of dark red perspex, 156 x 67mm
1 Piece of Kodak 87 infra-red filter (see text)
1 Mains cord and plug
1 4 way RCA panel socket
2 Momentary-contact push buttons
4 20mm Richco supports
1 9V transistor battery, Eveready 216 or similar
½ Metre of figure-8 shielded audio cable
1 two way mains terminal strip

SEMICONDUCTORS
2 4011 CMOS ICs
1 4001 CMOS IC
1 4029 CMOS IC
1 4028 CMOS IC
2 4051 CMOS ICs
2 uA4136 op amps
1 LM340T-5 regulator
1 LM320T-5 regulator
2 1N4001 diodes
1 BD263 Darlington transistor
2 CQY89A or LD271 infra-red LEDs
1 BPW34 or BP104 photodiode
8 Large red LEDs
2 1N4148 diodes

RESISTORS
(5% tolerance, ¼ or ½W)
3 x 1M, 1 x 470k, 4 x 220k, 7 x 100k, 2 x 82k, 2 x 68k, 1 x 47k, 2 x 33k, 2 x 15k, 11 x 10k, 1 x 8.2k, 2 x 5.6k, 4 x 4.7k, 2 x 2.2k, 1 x 1.2k, 8 x 1k, 2 x 820 ohms, 1 x 15 ohms.

CAPACITORS
2 1000uF/16VW electrolytics
1 1000uF/10VW electrolytic
2 15uF/25VW tantalum
1 10uF/16VW tantalum
4 1uF/25VW tantalum
2 0.1uF metallised polyester (greencap)
2 .068uF metallised polyester
1 .022uF metallised polyester
1 .0082uF metallised polyester
1 .0068uF metallised polyester
1 .0056uF metallised polyester
1 .0022uF metallised polyester
5 .001uF metallised polyester
1 560pF polystyrene or ceramic
1 470pF polystyrene or ceramic

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used provided they are physically compatible.

Japan-made replacement semiconductors!

2SA 329	0 66	2SC 772	0 56	2SC 1520	2 08	HA1199	3 84
2SA 483	7 00	2SC 784	0 52	2SC 1550	1 65	HA1306W	4 44
2SA 484	3 91	2SC 789	1 84	2SC 1624	1 89	HA1322	5 02
2SA 493	0 78	2SC 799	9 89	2SC 1628	1 70	HA1342AR	4 58
2SA 495	0 44	2SC 815	0 73	2SC 1669	2 36	HA1452W	2 90
2SA 496	1 24	2SC 828	0 30	2SC 1674	0 49	SAS560S	5 32
2SA 550	1 30	2SC 829	0 32	2SC 1675	0 37	SAS570S	5 32
2SA 562	0 52	2SC 839	0 40	2SC 1678	2 48	TBA810SH	4 14
2SA 564	0 40	2SC 840	3 11	2SC 1728	1 42	M5115AP	7 59
2SA 606	3 44	2SC 867	12 07	2SC 1760	1 39	M5152L	2 08
2SA 607	3 92	2SC 897	5 48	2SC 1909	4 14	M5153P	8 40
2SA 634	1 28	2SC 930	0 39	2SC 1951	1 42	M51513L	3 54
2SA 640	0 64	2SC 933	0 43	2SC 1957	0 98	M51515L	6 67
2SA 671	1 87	2SC 945	0 28	2SC 1964	0 25	M51841P	3 30
2SA 673	0 56	2SC 959	2 32	2SC 1969	6 90	M5320P	1 03
2SA 678	0 84	2SC 960	2 72	2SC 1974	2 76	M53273P	1 84
2SA 683	0 72	2SC 973	32 20	2SC 1975	2 95	M53274P	1 84
2SA 684	0 73	2SC 995	2 72	2SC 2028	1 27	M53393P	5 98
2SA 697	0 78	2SC 1000	0 46	2SC 2029	2 40	UPC554C	2 95
2SA 705	1 03	2SC 1011	16 36	2SC 2091	1 44	UPC574J	1 61
2SA 706	2 12	2SC 1013	1 10	2SC 2092	3 54	UPC575C2	2 79
2SA 715	1 37	2SC 1017	1 42	2SD 198	3 30	UPC1009C	6 00
2SA 719	0 56	2SC 1018	1 89	2SD 199	5 06	UPC1020H	4 03
2SA 725	0 54			2SD 213	12 42	UPC1025H	3 11
2SA 733	0 49	2SC 1034	12 65	2SC 234	1 42	UPC1028H	2 83
2SA 740	4 37	2SC 1060	1 65	2SD 235	1 77	UPC1156H	3 80
2SB 54	0 52	2SC 1061	1 65	2SD 313	1 72	TA7045M	3 57
2SB 56	0 52	2SC 1096	1 42	2SD 315	2 22	TA7074P	8 51
2SB 324	0 66	2SC 1098	1 54	2SD 325	1 34	TA7120P	1 58
2SB 435	2 10	2SC 1114	11 04	2SD 330	1 70	TA7200P	5 29
2SB 507	4 56	2SC 1116	1 17	2SD 350	9 66	TA7201P	5 59
2SB 514	2 12	2SC 1128	1 17	2SD 358	1 75	TA7202P	5 87
2SB 523	1 51	2SC 1129	1 30	2SD 359	0 98	TA7203P	5 18
2SB 526	1 58	2SC 1162	1 30	2SD 360	1 10	TA7204P	3 80
2SB 527	1 70	2SC 1166	0 76	2SD 361	1 58	TA7205P	4 10
2SB 528	1 84	2SC 1169	4 14	2SD 380	12 65	TA7214P	9 62
2SB 529	1 30	2SC 1172B	13 23	2SD 388	6 56	TA7222P	4 56
2SB 536	1 70	2SC 1173	1 17	2SD 389	1 68	TA7310P	2 17
2SC 372	0 32	2SC 1175	0 71	2SD 525	2 36	LA1201	2 95
2SC 380	0 40	2SC 1195	8 74	2SD 526	1 88	LA3300	4 65
2SC 403	0 61	2SC 1211	0 54	2SK 19	0 90	LA3301	3 42
2SC 458	0 40	2SC 1212	1 42	2SK 30A	0 90	LA3350	4 65
2SC 461	0 42	2SC 1213	0 52	2SK 40	1 03	LA4030P	3 80
2SC 495	0 83	2SC 1226	1 15	2SK 49	1 12	LA4031P	3 68
2SC 496	1 08	2SC 1239	4 32	3SK 45	2 08	LA4032P	4 83
2SC 509	1 34	2SC 1243	1 22	BA 301	1 89	LA4050P	3 91
2SC 535	0 52	2SC 1295	7 13	BA 511A	3 54	LA4051P	4 32
2SC 536	0 37	2SC 1306	2 12	BA 521	4 14	LA4400	4 95
2SC 538	1 10	2SC 1307	7 59	AN214Q	3 66	LA4430	4 14
2SC 563	1 34	2SC 1312	0 37	AN 214P	3 78	STK011	9 66
2SC 620	0 61	2SC 1317	0 46	AN 239	11 50	STK015	11 04
2SC 645	1 20	2SC 1318	0 66	AN 217	3 07	STK016	13 62
2SC 674	0 61	2SC 1345	0 54	AN 241	3 54	STK024	20 04
2SC 681	4 90	2SC 1358	15 76	AN 245	7 59	STK433	12 88
2SC 710	0 39	2SC 1364	0 54	AN 247P	6 90	STK439	19 55
2SC 711	0 37	2SC 1407	1 10	AN 264	3 30	MB3705	3 45
2SC 712	0 39	2SC 1419	1 44	AN 277	3 54	MB3708	3 45
2SC 730	6 44	2SC 1444	4 97	AN 313	9 78	MB3712	3 30
2SC 732	0 46	2SC 1446	1 54	AN 315	4 26	MB3713	3 30
2SC 734	0 61	2SC 1447	1 58	AN 331	9 66	PLL02AG	12 19
2SC 735	0 46	2SC 1448	2 95	AN7115	3 68	SG613	13 80
2SC 738	0 49	2SC 1449	0 86	AN7150	4 26		
2SC 741	0 42	2SC 1475	1 17	HA1137W	5 02		
2SC 756	3 91	2SC 1509	0 88	HA1156W	3 54		

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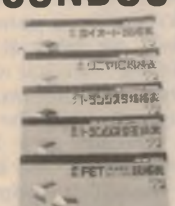

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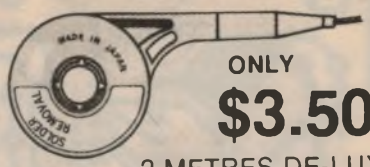

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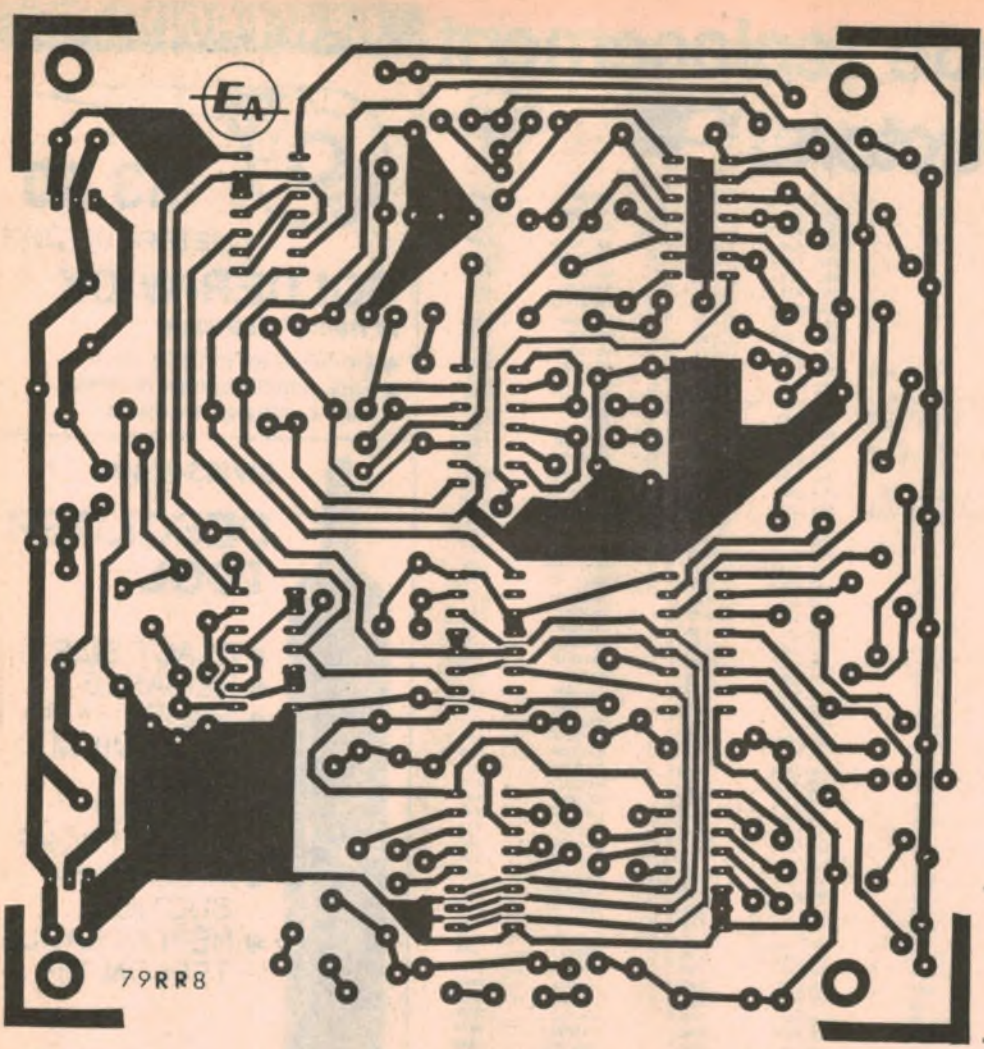


At left is an actual size reproduction of the artwork for the receiver PC board. Commercial boards will be available from the usual components suppliers.

provide a split 10V supply for the CMOS circuitry.

Well, while the circuit might be regarded as relatively complicated, the construction is fairly straightforward. For the receiver we used an inexpensive case which is available from Dick Smith Electronics and other parts suppliers. Approximate dimensions are 160 x 70 x 184mm (W x H x D).

The first step in the construction of the receiver is to make the cutout in the front panel for the display LEDs and the photodiode. The cut out should be wide enough so that all the LEDs are visible and it should also be cut very close to the bottom of the case so that the photodiode has as large a window as possible. Then with the cutout complete, blackout the rest of the front panel with black paint or insulation tape and then attach the red perspex panel using double sided tape or glue. Alternatively, if a more robust arrangement is desired, the perspex can be attached by four small screws at the corners.

multiplexer (in each channel).

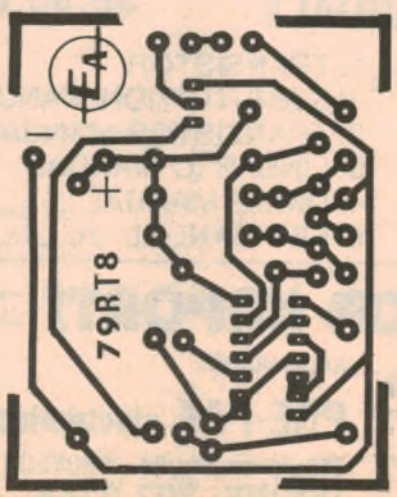
The larger the value of the resistor selected the less the attenuation, and the smaller the resistor the greater the attenuation. The resistors are therefore arranged in such an order that when the counter is clocked up, a higher value resistor is selected and when clocked down a lower value resistor is selected.

The attenuation at the highest volume level can be regarded as 0dB although it is actually about 0.4dB due to the 1M resistor (which is necessary to bias the op amp IC2a or IC2b). From there down, the attenuation increases in approximate steps of 3, 4, 5, 6, 7, 8, and 9dB giving a maximum attenuation of -42dB at the lowest volume level. This should be more than adequate for most situations.

The reason for using this apparently strange series of attenuation steps rather than having say 3dB per step is that greater control is desirable at higher volume levels. Most volume controls actually work in this fashion anyway.

The attenuated signal output from the 4051 multiplexers is buffered by an op amp in each channel. These are connected as "voltage-followers" to provide unity gain. The output of the op amps is coupled via 1uF tantalum capacitors to the output sockets.

The power supply uses two half-wave rectifiers to provide plus and minus 12V rails which are used to power the uA4136 quad op amps. These require a fairly high supply voltage in order to cope with large audio signals. The 12V rails also feed positive and negative 5V regulators, LM340T and LM320T, to



Actual size artwork for the transmitter.

The red perspex for the front panel can be obtained from suppliers of cut to order plastics. We obtain ours from FX plastics 77 Sydenham Rd, Marrickville and they can supply the perspex in a minimum of 900 square cm at a cost of $2.27 plus a $2.00 cutting charge. Its probably a better idea though to obtain the perspex from kit supplies as this is more than required.

Next assemble the components onto the PC board but leave the photodiode and the LEDS to last. When mounting the LEDs for the front panel display, the leads should be bent at right angles close to the body so that when the LEDs are inserted into the board they will point straight toward the front panel. The LEDs should also be mounted about 15mm above the board so that when the board is mounted on the plastic board supports, the LEDs will be slightly over half way up the panel. Solder only one lead of each LED and adjust them individually so that they're all in a straight line and then solder the remaining leads.

The photodiode is a Philips type BPW34, though again there is an equivalent Siemens device with the type number BP104. The BP104 has an integral infra-red filter so it is relatively

(continued on p125)

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Types of characters	Alpha-numeral, symbol, graph
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Character height	2.4 ± 0.2 mm (0.094 ± 0.008")
Input voltage	24V ± 5%
Current	300mA
Life	MCBF 1 x 10^6 lines
Dimensions	90.5(W) x 110(D) x 42.5(H) mm 3.56(W) x 4.33(D) x 1.67(H) inch
Weight (approx.)	370 g (0.814 lb)

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Light trigger for slave flashguns

Uses a low-cost silicon solar cell!

The way to get professional-looking flash shots is to use two flash units, for improved modelling and controlled filling-in of shadows. Here is an improved slave flash trigger unit which will operate the second flash automatically. It's very sensitive, yet much cheaper than commercial slave units.

by IAN POGSON

Photographic shots taken with a single flash gun tend to either look very "flat", due to front-on lighting, or very contrasty due to excessive shadows. The best way to avoid these problems is to use two flash guns, with the second gun used to fill in the shadows from the first and provide good modelling. This is the technique used by professionals, and it can easily be used by amateurs to give the same results.

It is possible to trigger the second flash gun from the camera shutter contacts, like the main gun, but this requires a splitter unit and involves an extra cable. Rather than do this, the more usual approach is to use a photoelectric "slave trigger" unit for the second gun. Pointed towards the main gun, it automatically triggers the second gun a few microseconds after the main flash. From a photographic point of view, this is near enough to "simultaneous" not to worry about.

Photoelectric slave trigger units have been described previously in the magazine, in the May 1975 and March 1977 issues. Both were and are capable of doing a good job, but like similar relatively simple units available commercially they have some limitations.

One problem is that they are DC coupled, and this makes them sensitive to ambient lighting. In fact if the ambient light level is high enough, it can trigger the flash directly. In any case it tends to affect the triggering sensitivity.

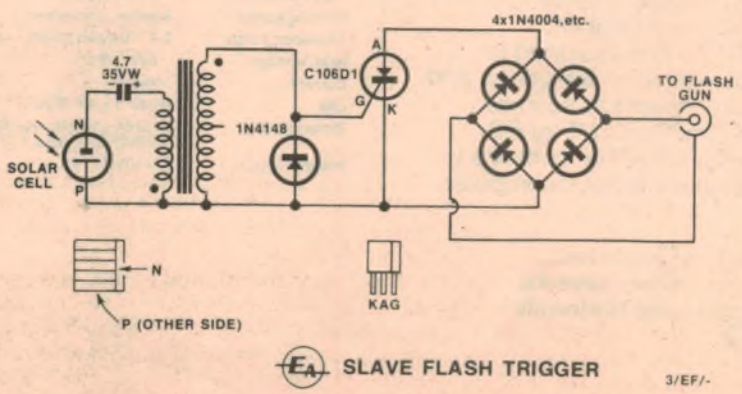
Apart from this problem the 1975 design uses an LASCS (light activated silicon controlled switch) device which is rather expensive. And the 1977 design used an LASCR (light activated silicon controlled rectifier), which now seems to be unavailable.

With the above points in mind, we set out to produce a new unit which was not DC coupled, had adequate sensitivity for all likely situations and could be made from readily available components.

The approach we first tried used a type MEL12 photo Darlington transistor, AC coupled to the gate of a C106D1 SCR. When the Darlington device was supplied with 9V DC from a battery, it worked very well. However when we tried to derive the required DC supply from the flash gun trigger circuit itself via a voltage divider, success was not ours. This was due to the leakage current through the MEL12 photo Darlington transistor. It was possible to make it work, but only under conditions approaching total darkness!

So we decided to try using a photovoltaic device to trigger the SCR. After much searching, we decided to try a silicon solar cell which is listed in the current Dick Smith catalog. The next question was how we could couple between the solar cell and the gate of the SCR. At this stage we had the opportunity of examining a high quality commercial device, and this provided

The completed prototype. A thin piece of glass should be glued over the cutout to protect the solar cell.

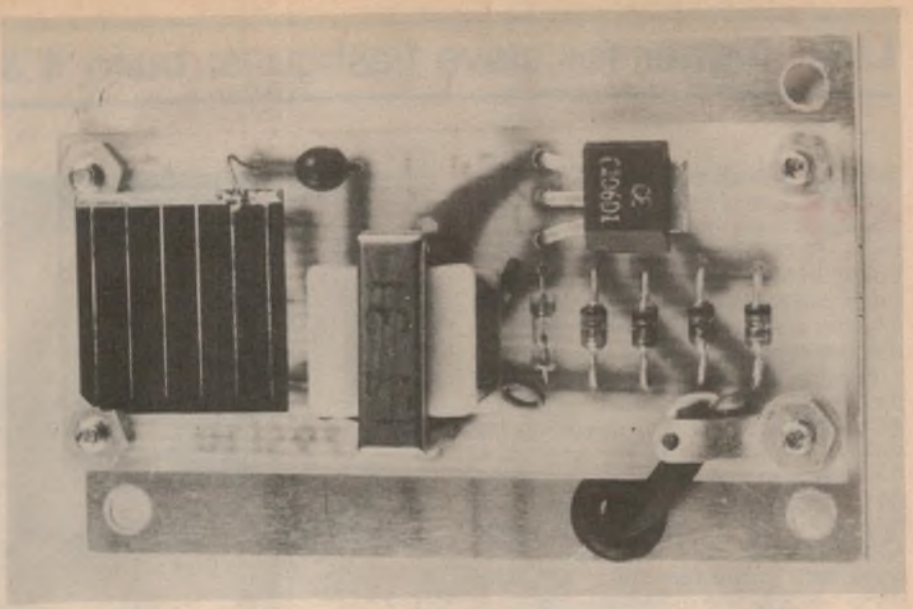


The circuit uses a low-cost solar cell as the light sensor.

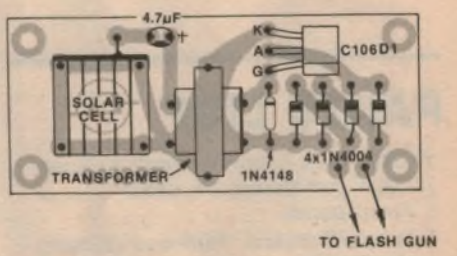
We estimate that the current cost of parts or this project is approximately.

$11.50

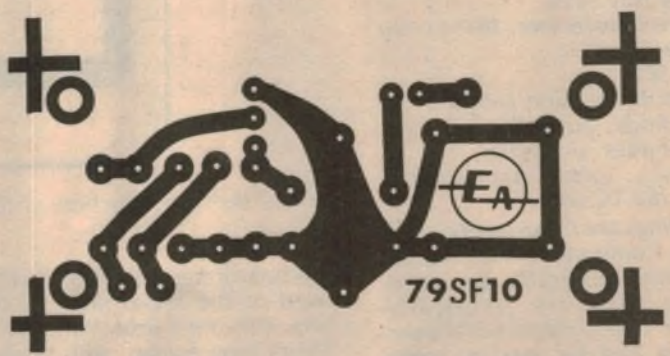
This includes sales tax.



ABOVE: view showing the assembled PC board. The board is fixed to the aluminium lid of the zippy box.



RIGHT: The component overlay for the PC board. See text for solar cell mounting details.



Here is the PC artwork, reproduced actual size.

the answer: a step-up transformer.

One of the very small transistor output coupling transformers seemed a possibility, so we tried one with a 1000 ohm primary to an eight ohm secondary, a turns ratio of about 11 to 1. Using it back-to-front and with appropriate phasing, we were rewarded with conspicuous success.

A second transformer was also tried, the one which appears in the picture of the prototype. This is a type LT-31 with an impedance ratio of 200k to 1k, or a turns ratio of about 14 to 1. This transformer worked just as well as the first one, suggesting that the type of transformer required is not unduly critical.

After several test firings, we were convinced that the arrangement had very good possibilities. The sensitivity was very high indeed, being helped along by the rather large area of the solar cell when compared with other light sensitive devices. We even tried it with the cell in subdued sunlight and it still triggered the slave flash gun!

The final circuit we evolved is not as simple as the previously described units but it is still quite straightforward. First of all, there is the solar cell performing as the light sensitive device. This looks into the low impedance winding of the transformer. You will also see that we have introduced a capacitor in series with the cell. This has been added as a precaution against possible saturation of the transformer, in extreme cases where the unit is used in very bright ambient light. The capacitor used is a 4.7uF 35VW tantalum.

The transformer steps up the voltage pulse from the cell, to a level which will ensure reliable firing of the gate of the SCR. The diode across the transformer secondary is also added as a precaution against any possible reverse spike from the transformer which may cause spurious triggering.

The SCR is effectively across the trigger circuit of the slave flash gun and it takes the place of the camera flash contacts. Interposed between the SCR and the trigger circuit are four silicon power diodes in a bridge arrangement. This has been added to make the device suitable for use with trigger circuits of either polarity. Most units we have checked have the centre contact positive, but there are probably exceptions to this. Both the SCR and the diodes must be able to withstand the full voltage at the trigger terminals. This is normally about 225 volts, but it may be either higher or lower than this value.

The unit is housed in a small zippy box which is readily available. There is nothing critical about the housing, so long as it protects the components from damage — particularly the solar cell.

All of the components are mounted on a small printed circuit board, which measures 77 x 32mm and is coded 79SF10.

As mentioned earlier, we used a solar cell from Dick Smith Electronics and we understand that they have adequate stocks. Since making the slave flash unit, we have also obtained a solar cell from Davred Electronics Pty Ltd of 104-106 King Street, Newtown, NSW 2042, who can supply them for $2.40 each. These cells are virtually the same size as the one used on the prototype. We have tested one in the prototype and it seems to do the job very satisfactorily.

A lead is required to go from the printed circuit board output to the flash gun to be triggered. We bought an extension flash gun lead and cut off the unwanted socket, leaving the plug on the other end which will mate with the flash gun lead.

While the construction of the slave flash unit is quite a small job, there are at the same time a few points which are worthy of comment.

The printed board has been made so that it will take either of the transformers which we have mentioned. The C106D1 SCR does not need the heat sink flag built into it; indeed,

its size is a small embarrassment so we cut it off, as may be seen in the picture. The leads were then bent over so that the body of the SCR is parallel with the board. In order to anchor the lead from the board to the flash gun, we clamped it under a solder lug which is fixed under the adjacent board fixing screw.

Possibly the most important part of the construction and that which requires the most care, is mounting the solar cell on the board. We stood it off the board, so that its surface was at the same height as the transformer. To do this, we used two pieces of 26 gauge tinned copper wire. The two pieces were bent in the form of a "U", with sharp corners. The dimensions are such that the middle part of the wire is a little shorter than the metal backed dimension of the cell. The two pieces are soldered at each corner of the cell, leaving it with four "legs", so spaced as to fit the mating holes on the board.

Great care must be taken with this operation, as any rough or careless handling may result in fracture of the cell. The flexibility of the 26 gauge wire will allow some judicious bending where necessary, to position the cell in the proper position over the board. With the four legs soldered and adjusted, another piece of 26 gauge TC wire is then used to make the connection from the board to the contact strip on the front face of the cell. The same care should be exercised and as little solder as possible should be used here.

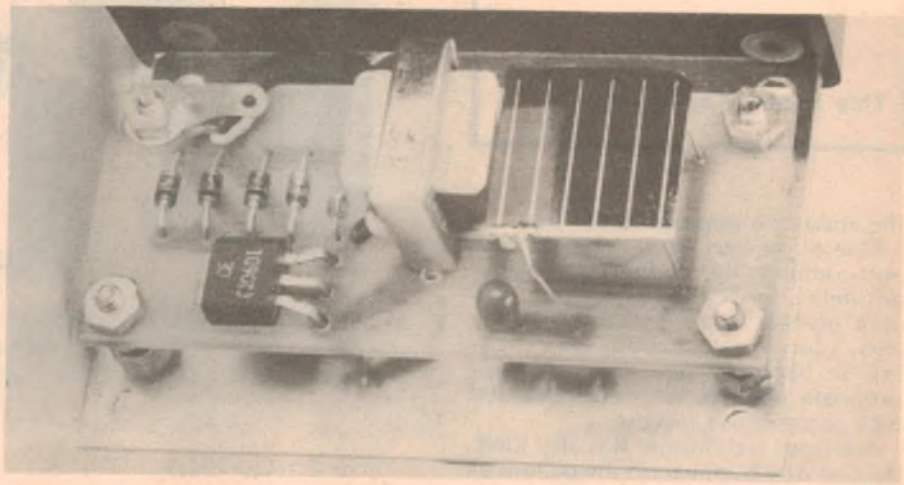
With the components mounted on the board, the assembly now has to be fixed to the metal plate of the zippy box. We used four ⅛in Whitworth x 13mm long screws, with three nuts on each screw so that the screws may also double as stand-offs. The height of the stand-offs must be adjusted so that the face of the solar cell clears the opposite face of the zippy box by about 1.5mm.

So that light may reach the cell when the board assembly is mounted in its zippy box, a hole must be cut in the box centred over the cell. We cut out a hole 17mm square. This masks off a little of the cell right around its edges, but this still leaves more than ample sensitivity. If you prefer, you may drill a number of holes about 5 or 6mm in diameter over the area instead of cutting a square hole. This allows somewhat less light into the cell, but for most purposes it should still be adequate.

Whether you settle for a cutout or a group of holes for the solar cell "window" the cell should be protected from accidental damage by fixing a piece of clear plastic between the cell and the opening(s). A suitable piece of clear plastic sheet may be glued into place. Or a thin piece of glass could be used if available.

We made a front panel for the prototype using Scotchcal and this gives quite a nice professional finish. Up until recent times, if readers wished to make a similar front panel for any of the projects, they were usually left to their own devices. However, we understand that Radio Despatch Service are taking steps to make and supply Scotchcal panels for our projects. Readers who are interested should contact Radio Despatch for further details; their address is 868 George Street, Sydney.

To check the unit, connect it to a flash gun. Then with a second flash gun to act as the primary unit, activate both guns and fire the primary one. The slave gun should also fire. A series of tests may be carried out by moving the slave flash trigger unit to various positions with respect to the primary flash gun, to check the sensitivity and possibilities offered by the slave flash trigger. We think that you will be surprised at just how well the trigger will do the job.

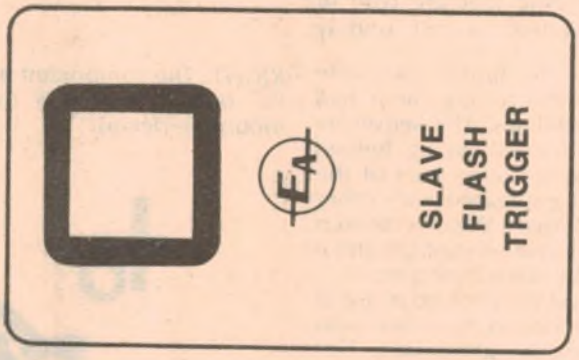


Another view inside the prototype. Note how the solar cell is stood off the PC board.

PARTS LIST

1 Zippy box 83mm x 54mm x 28mm
1 Flash gun extension cable
1 Front panel
1 Printed board 76mm x 32mm, code 79SF10
1 Solar cell (see text)
1 Miniature transformer, 10-1 to 14-1 (see text)
1 C106D1 SCR
1 4.7uF 35VW tantalum capacitor
1 1N4148 diode, or similar
4 1N4004 diodes, or similar
Screws, nuts, solder lug, rubber grommet, 26g TC wire.

NOTE: Ratings are those used on the prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, provided the ratings are not exceeded.



Actual size reproduction of the front panel artwork.

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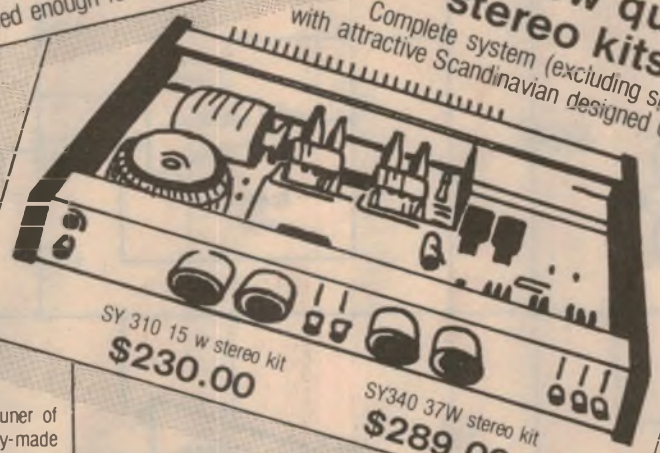

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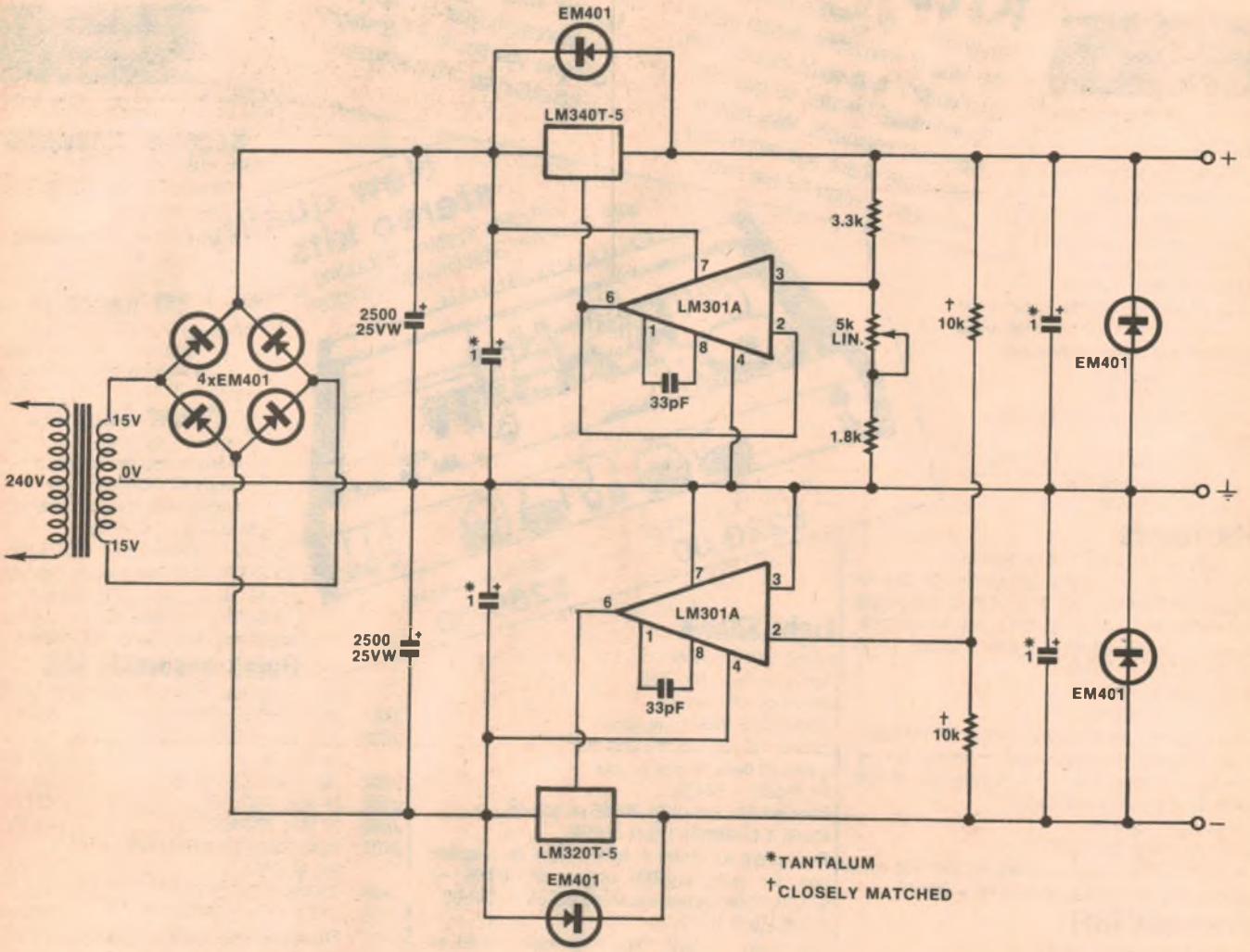
Circuit & Design Ideas

Conducted by Ian Pogson

Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

Tracking dual voltage regulator



This circuit is for a tracking dual voltage regulator that may be constructed from readily available components. The voltage range obtainable is +8V to +15V, giving a usable 250mA at +15V and higher output currents at lower voltages.

For currents up to 250mA only marginal heatsinking of the three terminal regulators is required, about 25°C/W. For currents above this a 10°C/W heatsink is needed for each device. The regulator will tolerate short circuits but prolonged short circuits are to be avoided, even if the three terminal regulators are well heatsinked. This is because of excessive dissipation in the power transformer.

Provided that the system is operated within its limits good regulation, ripple rejection and trackability will be achieved. Provided also that the 10k voltage divider resistors are closely enough matched, trackability should be better than +10mV over the +8V to +15V range.

(By Mr L. Murakami, Unit 19 Annette Lodge, 368 Military Road, Tennyson, SA 5022.)

Note on opto-coupled magnet driver for teleprinters

I wish to correct two errors in the "Opto-coupled magnet driver for teleprinters" which appeared in Circuit & Design Ideas for June, 1979, page 72.

(1) The formula for calculating TR2's peak voltage is nonsense! I cannot think how it happened but I did not see the error until it appeared in print. The line should read "The value of Vcc + ((Vcc x R4)/R5) governs the peak voltage appearing at TR2's collector," etc. I regret any inconvenience that this may have caused readers.

(2) The short circuit around D5, D6 must have been a drafting error and should be erased.

(By Mr W. Gummerson, 13 Hindmarsh Road, Liverpool, NSW 2170.)

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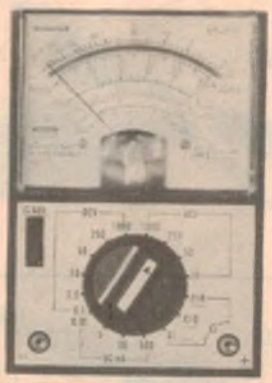

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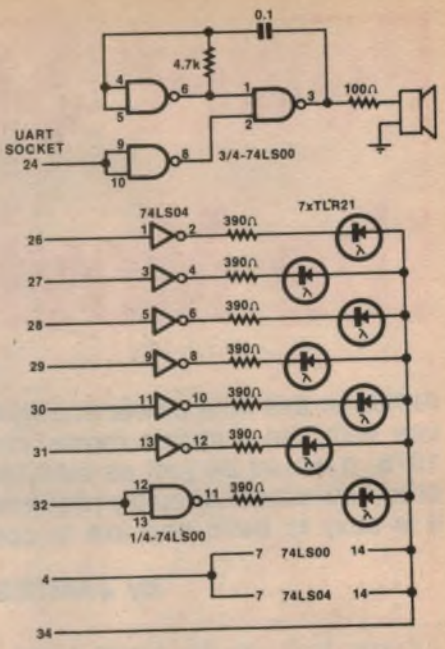


Having built the EA Terminal Keyboard as described in April 1978, I found that when typing in a program via an electric keyboard it is very easy to miss a character, resulting in much unnecessary debugging. This is especially true when there is no hard copy printout, as most keyboards give no indication of character acceptance. The simple sub-unit to be described gives audible and visual indication of keyboard output, the visible signal taking the form of a seven bit LED display of the ASCII coded signal. It can be built into the keyboard housing or it may be built in a small plastic utility box to stand alongside the keyboard. Power requirements are very low and can easily be met by the existing keyboard supply.

The monitor sub-unit uses two Low Power Schottky chips on a 50mm x 25mm board. The seven bit connections are taken from the keyboard input to the UART (after inversion to active high logic). Bits one to six are applied to the six inputs of a 74LSO4. The seventh bit is inverted by a spare gate of the 74LSOO used for the audio monitor.

The connections are best made at the UART socket pins (taking due precautions not to damage the UART) using a short length of 10-wire rainbow ribbon cable. The +5V supply, earth and audio keying signal account for the three extra wires.

A negative pulse at the output of any buffer will earth the associated LED series resistor, causing the LED to glow. The seven LEDs should be mounted on the board in a neat row (TLR 21 LEDs are ideal as seven will fit across one 25cm end of the board).

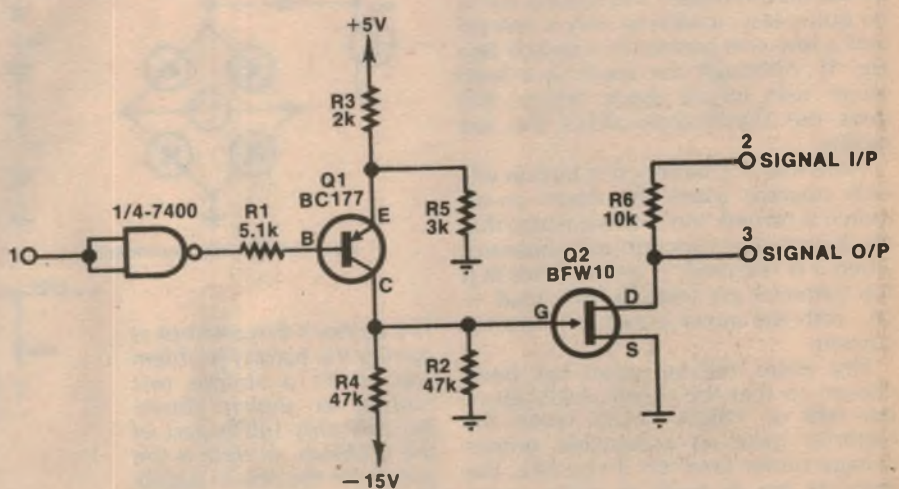
The audio monitor uses a simple oscillator to drive directly a small loudspeaker via a series resistor. One stage of the oscillator is keyed by an inverted pulse taken from the UART. The "Complete" flag at pin 24 is ideal as it requires no processing. The tone length at each key operation will depend on the baud rate selected.

The oscillator frequency is determined by the capacitor and resistor combination. Values given provide an acceptable tone and level from a 5cm 8ohm loudspeaker. The loudspeaker may be mounted in the keyboard console if the monitor is built in. Alternatively, if a separate unit is made it can be fitted in the botton of the plastic case. There is no need in either case to mount it conventionally with a grille as long as a few small (3mm) holes are provided in front of the diaphragm.

Note that Clear, Shift and Control keys are not directly encoded into the UART so no monitor output is produced when these keys are operated but this does not affect the usefulness of the monitor sub-unit.

(By Mr R. V. Taylor, 7 Robin Street, Salisbury East, SA 5109.)

A TTL compatible audio switch



It is necessary at times to switch an audio signal without introducing any clicking noise. This could be done by using a switch or a relay but when the switching is to be done at high speeds, then electronic switching becomes the more desirable way to go. The circuit shown can switch audio very effectively at fast speeds without any clicks and it is also TTL compatible.

A BFW10 FET device is used as a switch due to the very high off resistance and very low on resistance offered by the source-drain channel. This particular FET has a high pinch-off voltage. Therefore, to turn it off reliably, the gate must be at least 7V negative with respect to the source. To turn it on the gate must be slightly above +1V. This is done by the voltage level shifting transistor Q1, which is directly driven by the output of any TTL gate, such as the 7400.

When the TTL gate output is low transistor Q1 is in full conduction and due to the high resistance of R4, the net voltage at the gate of the FET is positive, which turns the FET solidly on. Resistor R6 and the FET channel resistance which is very low, form a voltage divider and this attenuates the signal of point 2 so that there is no output at point 3. On the other hand when the TTL output is high, the emitter-base junction of transistor Q1 is reverse biased and transistor Q1 is off. This gives approximately 7.5V of negative bias to the gate of the FET and turns it off. The signal now passes to point 3 virtually unattenuated.

Measurements showed that when the FET was on, the attenuation was about 45dB. High operating speeds are also possible as there is no capacitance in the circuit to delay the operation. Care should be taken to connect point 3 to a high impedance circuit, such as an op-amp voltage follower, otherwise unwanted insertion loss will be experienced. If higher than 45dB attenuation is required, then R6 should be changed to 100k.

(By Mr Vijay Pradhan, Head — Communications Group, The Tata Power Company Limited, 42 Saki Vihar Road, Anderi East, Bombay, India.)

Power Supply For the Movie Mixer

Although this little power supply has been designed specifically for use with the author's movie mixer, as described in September 1978, it would be just as suitable for operating preamplifiers and other low-power circuitry requiring a well-filtered supply of 18V DC. It is easy to build and low in cost.

by JAMIESON ROWE

If you built up the Movie Mixer design I described in the September 1978 issue, you've probably found as I have that there are decided disadvantages in having a battery power supply. Not that the Movie Mixer has a heavy current drain (it draws only 9mA or so); nor is it particularly critical in terms of battery voltage. It's simply that the batteries always seem to reach the end of their working life halfway through a recording session, at 8.30 one night or at 4.30 on a Saturday afternoon when all the shops are shut!

After this had happened to me a couple of times I decided to add a "battery test" button to the mixer so that the condition of the batteries could be read on the inbuilt meter. This turned out to be quite easy, involving only a resistor and a low-cost pushbutton switch (see Fig. 1). Although the meter is a level meter with inbuilt diode bridge, this does not significantly affect the test facility.

Note that the battery test button will only operate when the mixer on-off switch is turned "on". This ensures that the battery test function only operates when it is required; it also ensures that the batteries are tested under load — i.e., with the mixer drawing its normal current.

The series resistor value has been chosen so that the meter reads above the 0dB or "100%" mark when the batteries have an acceptable output voltage under load. Or if you like, the batteries are in need of replacement when the meter reads less than 100%. Logical enough, I think you'll agree!

This little addition to the basic mixer design certainly allows you to monitor battery performance, and replace them when they're tired. But it can still be a nuisance having to replace them — particularly if you do a fair amount of your mixing at home with the projector, and within arm's reach of a power point.

Replacing the batteries altogether with a mains supply is a little drastic, as this means that you can't use the mixer with your camera away from the mains. So it seems to me that the answer is to retain the batteries, and simply fit a switching-type power inlet socket so that an external power supply may be used when desired. This allows the battery life to be extended without sacrificing the mixer's flexibility.

I have been using this approach now for quite a few months, and it seems to work very well. The little power supply I made to power the mixer produces a well-regulated and smoothed output of 18V DC, and runs the mixer with no discernable difference in performance compared with the batteries. So if you have a Movie Mixer and the idea of a power supply appeals to you, it may be of interest.

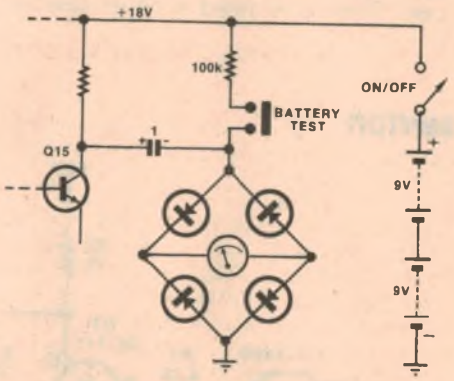


FIG. 1 : BATTERY TEST MODIFICATION

The author's first attempt at solving the battery problem was to fit a simple test button, as shown above. But this only solves part of the problem. At right is the wiring for the power supply input connector.

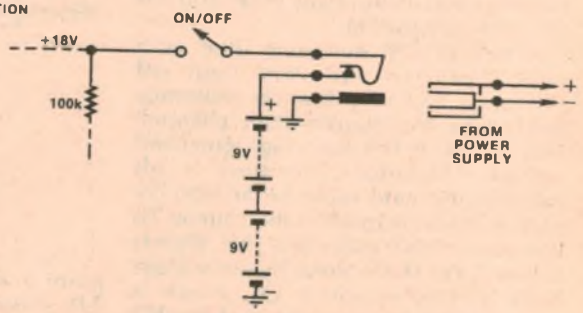


FIG. 2 : WIRING OF POWER SUPPLY INPUT SOCKET

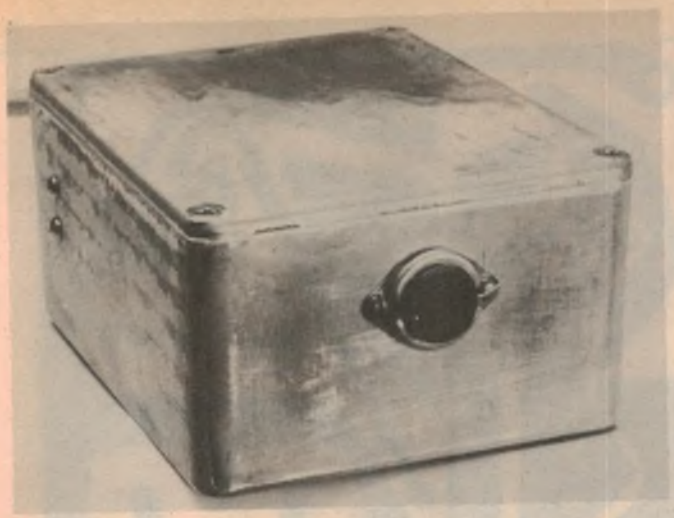
In passing I should perhaps add that the supply would also be suitable for powering any other equipment which requires 18V DC at low current (say up to 50mA or so). It has good regulation (0.16% at 18mA) and low ripple (4mV p-p at 18mA), making it very suitable for use with preamps, active filters and similar audio equipment. Its output is also floating with respect to mains earth, to avoid earth loop hum troubles.

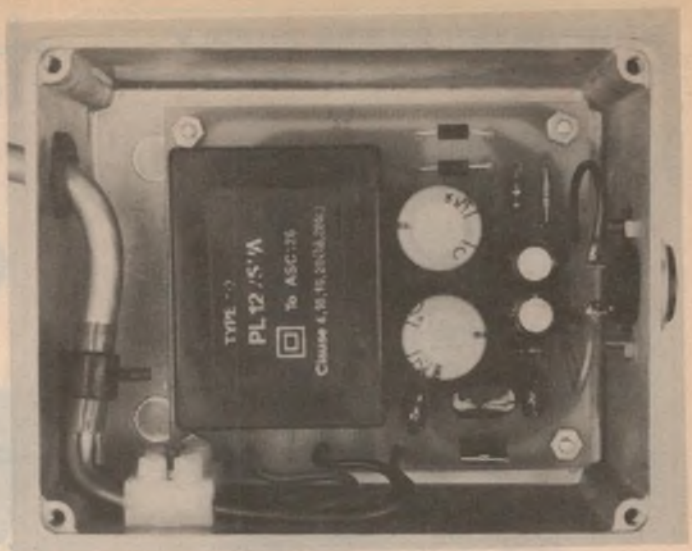
There is nothing particularly special about the supply, as you can see from the circuit diagram. It consists of a standard voltage-doubler rectifier, running from a readily-available 12.6V transformer. The output from the rectifier is then passed through a regulator circuit using a 12V three-terminal IC regulator, with resistive "bootstrapping" to produce the desired 18V output.

It may seem strange that I have used a 12V regulator IC, when the supply is designed to produce an output of 18V. Why not use an 18V regulator? Simply because 12V regulators are much more readily available, and it is quite easy to use one to get 18V output by using the resistive bootstrapping circuit shown.

In effect the resistive voltage divider across the output of the supply causes the regulator IC to raise its own "ground reference" above the negative rail — in this case, by an extra 6V. And because the divider is across the output, this reference voltage is regulated by the IC itself, so that the regulation is not seriously degraded.

More exactly, the regulator produces its normal 12V output across the 1k resistor which forms the upper leg of the divider. This establishes a known current through the resistor, and the same current together with the



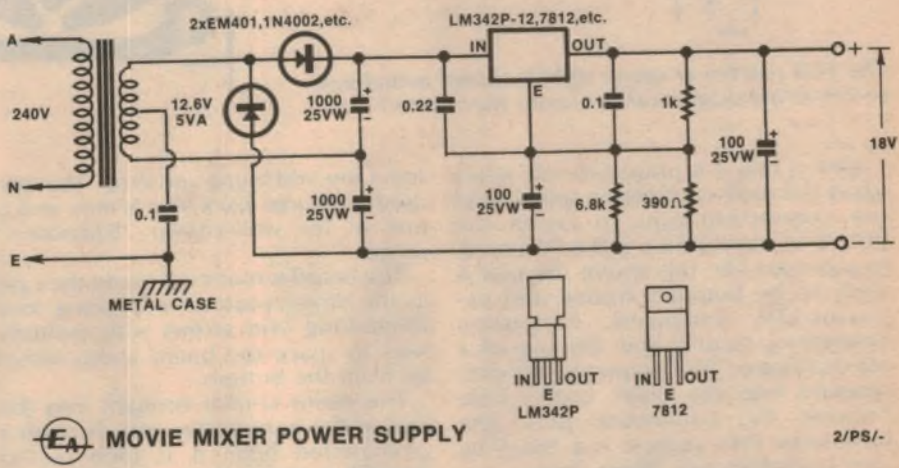


Outside and inside views of the power supply.

We estimate that the current costs of parts for this project is approximately

$26.50

This includes the cost of the output cable and plug/socket combination for connection to the Movie Mixer. It also includes sales tax.



The circuit of the power supply, which as you can see is quite straightforward. It uses a readily-available IC regulator.

regulator IC's common lead current flows through the lower leg of the divider (the 390 ohm and 6.8k resistors in parallel). By choosing the values in the lower leg so that they develop a drop of 6V, the overall output becomes 18V.

The reason for using two resistors in parallel as the lower leg of the divider is that this makes it easier to adjust the output voltage by a small amount if desired, to compensate for spread variation of the IC output voltage. In fact you can regard the 6.8k resistor as a "padder", whose value may be altered as necessary to set the supply output to 18V.

Actually the Movie Mixer is not all that critical when it comes to supply voltage; it can operate from 17V or 19V just as happily as from the nominal 18V. This is likely to be the case with other pieces of equipment also — particularly if they have been designed to operate from batteries.

So if you want to save the price of a resistor, you could replace the 390 ohm and 6.8k resistors with a single one of say 330 ohms, and put up with the voltage you get. It will probably be near enough. The only reason I have provided the second resistor is to allow the output to be set to exactly 18V for those applications which are more critical.

The 100uF capacitor across the lower leg of the divider is to minimise output ripple, by allowing the regulator IC to sense the ripple across the entire output. The second 100uF capacitor across the output is to improve the supply's transient performance, ensuring that it can deliver current peaks under signal conditions. The 0.22uF and 0.1uF capacitors around the regulator IC are the usual bypasses to ensure stability.

Note that as mentioned earlier, the output of the supply is left floating with respect to mains earth to avoid earth loop problems. This allows the power supply and Movie Mixer to be connected to a projector or tape recorder without producing hum due to double earthing.

The only reference back to mains earth within the supply circuit is via a 0.1uF capacitor connected from the centre-tap of the transformer. This represents a relatively high impedance at mains frequency (about 30k), but acts as a bypass to any noise which may tend to be coupled into the supply via primary-secondary capacitance.

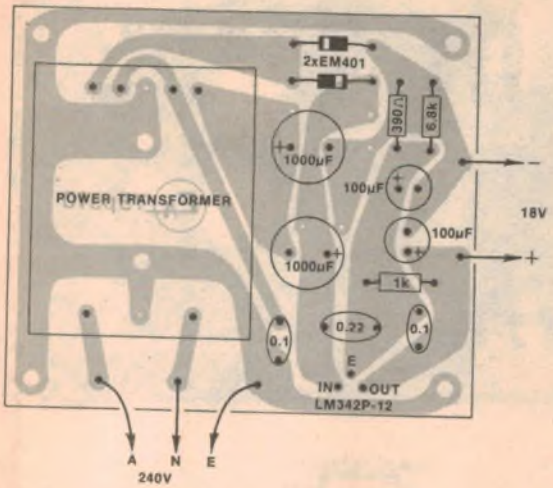
Needless to say the case of the power supply is also connected to the mains earth, for safety.

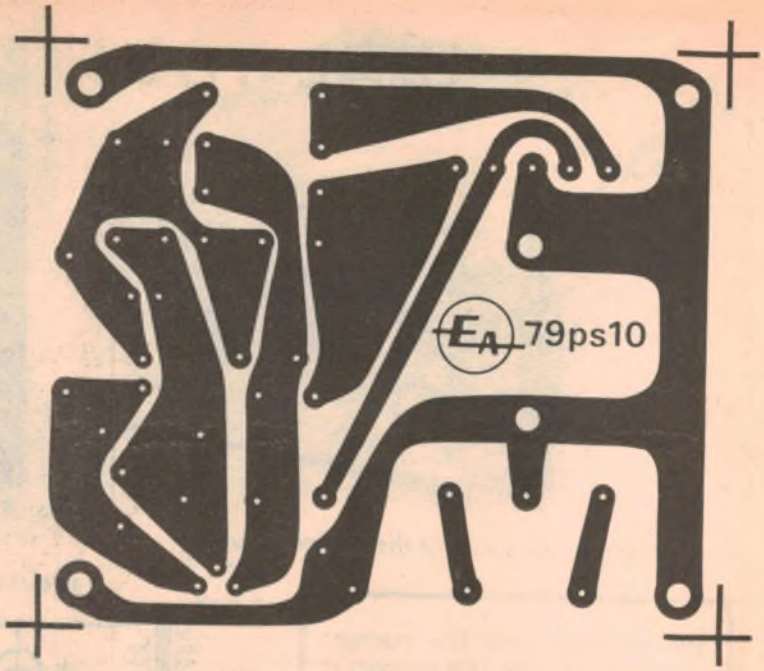
In view of the fact that the output is floating it is also desirable to use a transformer whose primary-secondary isolation and other parameters conform to the ASC126 safety specification. With this in mind I used a Ferguson type PL12/5VA transformer in the prototype, and would suggest that you use the same type.

Actually if you want to copy the physical construction of the prototype, you will more or less have to use the Ferguson unit because it is a PC-mounting type and we have designed the PC board to suit it!

The board measures 77 x 90mm, is coded 79PS10, and has been produced by our draftsman Bob Flynn. The pattern is reproduced in this article for the benefit of those who may wish to make their own board, although transparencies are being sent to the various board makers so that ready-made boards should be available shortly from the usual suppliers.

As you can see from the inside photograph and the PCB overlay diagram, the board wiring is quite straightforward and should present no problems. There are only a couple of points which should perhaps be noted.





The PCB pattern at upper right is shown actual size. In the wiring diagram above, note the unused holes.

One is that it is unwise to rely solely upon the melt-over plastic spigots and the connection pins to fasten the PL12/5VA transformer to the PC board, in a project like this where the unit is likely to be bumped around and occasionally dropped. Ferguson themselves recommend the use of a self-tapping of "PK" screw at each end, screwed into the blank centre hole between the connection pins. The screw size they suggest is a No. 5 by ⅜in (approximately 10mm long).

The other point is that you'll find a few unused holes on the PC board. These were included because I had planned to use the same board for a second power supply, a 9V unit to power movie cameras. However, there have proved to be a few problems with this, so for the moment it has been deferred. So just ignore the additional holes — or more precisely, make sure that you don't use them inadvertently.

Apart from these points the only things to watch are that you wire in the diodes, the electrolytic capacitors and the regulator IC the correct way around. Providing you do this, the supply should work correctly as soon as you power it up. Note that the regulator IC does not need any additional heatsinking, if you are using the supply with the Movie Mixer or equipment with a similarly low current drain.

Incidentally, to prevent accidental contact with the "live" PCB conductors associated with the transformer primary connections, while testing the board outside the case, I covered them with a strip of plastic insulating tape. You may care to do the same.

As you can see, the PC board for the prototype supply was housed in one of the small diecast aluminium cases. This produces a rugged unit, well able to stand the odd bump and drop. The case used measures 120 x 95 x 57mm, and is one of the well-known "Eddystone" range.

The board is mounted inside the case in the time-honoured way, using four 20mm-long ⅛in screws with multiple nuts to space the board about 10mm up from the bottom.

The mains cord is brought into the case at the transformer end, through a grommetted hole. It is then passed through a clamp, to prevent strain on the connections. The connections themselves are made via a three-way section of "B-B" connector strip, which is attached to the inside of the case by two 20mm x ⅛in screws and mating nuts. From the connector strip three short lengths of insulated wire connect to the adjacent PCB input points.

Note that the earth wire connects to the PCB along with the other two; this ensures that the outside copper track of the PCB is earthed even if the board is being tested outside the case. At the same time the case becomes reliably earthed when the board is mounted inside, via all four of the mounting screws.

I used a polarised two-pin socket for the 18V output from the supply, mounted on the opposite end of the case from the mains input. This allows the output cable to be separate from the supply — I tend to prefer this to having it "captive". On the other end of the cable I used one of the small coaxial-type power plugs, as used on many other "battery saver" DC supplies. This mates with a switching-type socket which has been added to the Movie Mixer.

The mixer socket is wired into circuit as shown in Fig. 2. This allows the mixer to be operated from its internal batteries as before, when the supply plug is withdrawn. Note that if you wire in the battery test facility mentioned earlier, this can be used to check the output from the power supply as well. It should read just a little short of the "+1dB" point on the meter scale, if all is well.

LIST OF PARTS

1 Diecast aluminium case, 120 x 95 x 57mm
1 PC board, 77 x 90mm, code 79PS10
1 PL12/5VA PC-type transformer
2 EM401, 1N4002 or similar diodes
1 LM342P-12 or 7812 regulator IC
2 1000uF 25VW PC-type electrolytic
2 100uF 25VW PC-type electrolytic
2 0.1uF LV plastic capacitors
1 0.22uF LV plastic capacitor
3 ¼-watt resistors: 390 ohms, 1k, 6.8k
Mains cord and plug, entry grommet, cord clamp, 3-section length of B-B mains connector strip, polarised 2-pin socket (panel mounting) and mating plug (cable type), output cable, plug and switching-type socket for mixer end. Nuts and bolts, solder, connecting wire, etc.

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may be used providing they are physically compatible.

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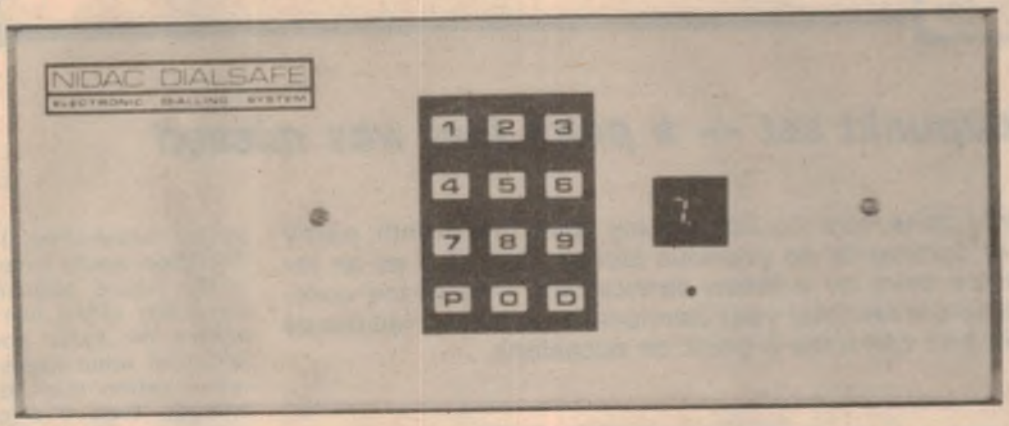

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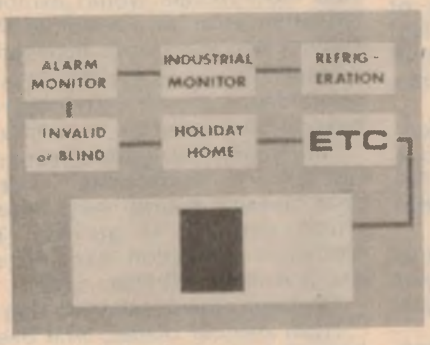

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Input Trigger Current 5mA@ 12v.D.C. Dialling Attempts: 3 maximum. Access Pause: 3.64 seconds.
Line Tone Frequency: 562.5 Hz. Interruption Rates: ½Hz, 1Hz, 2Hz. Keyboard Access Time: 30 seconds.
Battery: YUASA 6v. 1.2Ah or similar. Size: 280mm(L) 114mm(H) Weight: 1.3Kgm.

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The Serviceman

That Blaupunkt set — a point that was missed

Reader contributions form the basis of my notes this month, partly in the form of comments on previous stories, and also as an interesting service story by a fellow serviceman. One of the comments points up the fact that your Serviceman is just as fallible as anybody else, and can miss a point on occasions.

One of the letters is from a fellow serviceman, Mr K. L. of Dandenong, Victoria, who comments about my story on the Blaupunkt set in the June 1979 issue. In particular, he refers to my statement that the R-G-B amplifier board was so mounted as to make access to the components and wiring virtually impossible while it is in situ.

He points out that, assuming the set is the model he thinks it is, then it is possible to remove this board and re-insert it into the underside of the chassis, for complete accessibility while the set is running.

Well, you are right, K. L., at least as far as some of the Blaupunkt sets are concerned. And this set was one such. The truth is that this was a point I missed, though I was aware that some Australian sets, including some Kreisler models, incorporate this feature.

By way of explanation I can only point out that I have encountered very few Blaupunkt sets and, until this incident, I had acquired only a bare minimum of service literature. This has since been corrected and I discovered that this point is quite clearly made in the service manual.

And really, that is what practical service is all about; we learn by experience or, to be less euphemistic about it, we learn by our mistakes.

(I might perhaps point out that, according to K.L.'s business card, he specialises in German sets, so would undoubtedly have had a lot more experience with them than I have.)

K.L. also comments on the other story in the same notes, involving a heater/cathode short in the blue gun, my speculation that the problem might be solved by fitting an isolation transformer, and my reasons for eventually deciding against this.

He says: "We have experimented and found that an overwind on the line output transformer for the purpose of obtaining a heater supply is quite effective in overcoming the fault. With the electrical 'strain' between the heater and cathode removed by leaving the filament 'floating', the short circuit seldom seems to recur. If it does, it only smears the particular colour involved by a small amount, and may be acceptable to the customer as a means of staving off tube replacement until a more opportune time.

"We have used the same 'overwind' method to obtain a higher than normal supply voltage to overcome loss of emission. In three cases where we had intermittent heater operation at a rapid on/off rate (relatively speaking) this alternative supply has been tried.

"One tube operated for only a couple of hours before failing again, one has been going since about August last year, and the other is still going after similar treatment in April last year.

"I hope all this is of some interest to you and your readers. Have enjoyed the 'Serviceman' column since about 1947."

Well, thank you K.L. and I, too, hope that the comments may help someone else. In fact, I have "floated" the filament circuit on occasions, when circumstances justified it, but using a separate filament transformer. One typical situation was where the set was used in a small club, set well up on a wall where it was difficult for most people to approach close enough to note the resultant smear. Considering the cost saving, everyone was happy.

The point about many heater/cathode shorts vanishing once the voltage strain is removed is a good one, and not really surprising. However, such was not the case with the National set in the June issue. This fault was temperature sensitive, and would occur once the tube warmed up, voltage or no voltage.

As for the extra winding on the line output transformer, I feel that some discretion would have to be exercised in this regard, particularly concerning the ability of the line output stage to deliver the extra power. While the design of some stages may be conservative, others may be only just good enough. Even if a particular set-up seems to work, one would need to be sure that the line output transistor was not being pushed beyond its ratings.

To make matters more difficult, the filaments of individual guns are not normally accessible, so that all three guns must be fed from the new source. Typical power requirements would range from about 4W to 6W, or even a little higher with some older tubes.

It would also be handy to know how best to arrive at the correct supply voltage for the filaments, remembering that most meters would exhibit considerable error as a result of the frequency and waveforms involved.

Which is not to say that it is not a good idea; rather that each case would have to be treated on its merits.

And finally, that comment about having enjoyed "Serviceman" since 1947. That doesn't sound very impressive when you say it quickly, but a moment's calculation made me realise that it is nearly 33 years ago.

Do servicemen really live that long?

From another reader, who describes himself as ". . . just a dabbler", comes a story logically related to one I told in the July issue. The reader is Mr B.S. of Camira, Queensland.

It concerns a PYE model 22A-3A colour TV set purchased second hand from a Brisbane TV rental company. At the time it was given a three month's warranty but, within a few days, it suffered a severe drop in sound to a very low level, plus distortion.

Put in for service, it was returned to the owner the same day and ran faultlessly for several weeks. Then it failed again, was put in for service, and again returned apparently cured. Mr B.S. goes on:

"This time I asked for details of the fault for my own curiosity. The connections from the audio section to the volume control on the front panel is by a pair of co-axial leads, terminating in a

three contact female plug mating with three pins on the printed board. It was here that the problem originated, even minor movements of the cable causing the audio to vary. On this basis the serviceman had thoroughly cleaned the pins and bent them slightly to increase pressure on the plug contacts.

"All went well for about four months, then the same symptoms showed up again. This time I decided to tackle the job myself, and to dismantle the plug fully. This was easy, as the contacts can be withdrawn by depressing a small tongue through holes in the moulding.

"A long hard look under a glass showed that the central co-ax conductor was connected to the contact by crimping the sides of the metal over the wire. Apparently corrosion had set in, causing a high resistance joint between the wire and the contact.

"A swift touch with a soldering iron, taking care not to overheat the contact, and so draw the temper, and all was well again. There has been no sign of a recurrence so far. It is worth noting that the other two contacts had soldered joints, though whether from the production line, or a later visit to a serviceman, I cannot tell."

Mr B.S. then goes on to question the wisdom of crimped joints, pointing out that a minor design error of this kind can ruin the reputation of an otherwise good set. Finally, he implies that I will probably classify this as just another story about a dry joint.

On the contrary, B.S., I found it a most interesting story, particularly as it is such a close parallel to the one I told in the July issue. And I couldn't agree more with your comments about crimped joints and similar minor design points in general.

Something which some designers fail to appreciate is that failure of the most insignificant component in the set can be just as frustrating for the customer as a far more complex failure. As far as they are concerned the set has failed, they have missed their favourite program, and had to pay a service fee. To try to explain that it is ". . . only a little fault" will achieve little, if anything, it will probably only aggravate the annoyance.

And from another Queensland reader a quite different story, but one which highlights the idea that a serviceman should be prepared to broaden his outlook and tackle other than the conventional radio and TV devices.

The contributor is a professional serviceman, Mr F.S. of Townsville, and this is his story:

How's this for a number of faults on the one piece of equipment?

It all started out quite innocently (so, I believe, did the Martins and the Coys!) when I receive a call from a dealer in amusement machines.

These games consist of a TV monitor supplied with video generated by a "game board", which can hold as many as 120 TTL ICs. Power supplies, coin mechanisms, and operator controls complete the deal.

The game in question was entitled "Bazooka". Apparently, when working, a procession of tanks, trucks, transporters, and motor bikes proceeds across the screen and the operator attempts to annihilate these vehicles with a bazooka-like device mounted on the machine.

To add spice to the game, an ambulance and/or stretcher bearer also dash unpredictably across the screen, and shooting them results in the score being degraded.

This visual extravaganza is accompanied by tank, explosion, motor bike, shot, and ambulance noises.

On switch-on the machine displayed nothing. On firing the bazooka a line of dots ascended the screen to the accompanyment of a sound which can only be described as electronic flatulence! And, to make matters worse, the monitor displayed severe hum bars.

It appeared that the owner of the machine had purchased the games board and fitted it into another chassis. In so doing he had had to purchase and fit an additional power transformer.

Well, one has to start somewhere, so I pulled out the games board, which consisted of a mother board and three plug-in boards. The reason I started there is that I have found that printed board edge connectors can be highly unreliable.

While the board was out I remounted some large electrolytic capacitors, as they appeared to have been installed in a hurry and left hanging in space. While doing this I also noticed that one IC appeared to have something like "gravy" over it.

As these machines are patronised by particularly enterprising young customers, who are wont to include it in their staple diet of pies and pop, I wasn't particularly surprised. Using methylated spirit and a toothbrush I cleaned away the goo, only to discover a blob of solder between the IC and the board, where it could easily have been shorting out several pins.

A few moment's work with a spike removed the solder and an inspection with a jeweller's loupe failed to reveal anything else suspicious. I imagined that putting back the boards, plugging in, and making a few quick checks would serve to see me on my way.

No such luck! Granted, the assorted tanks, bikes, ambulances etc reappeared, but the only improvement in the sound was that, whenever the bazooka was fired and scored a hit, an explosion occurred. The hum bars were also still very evident.

I decided to tackle the sound problem next, rather than the hum bars, mainly because I did not relish the idea of removing the monitor — it was practically "un-removable", and definitely not repairable in situ. This was a wise decision, as it transpired.

Fortunately the owner had some documents which showed that there were two sound channels; one apparently providing the tank and explosion effects, the other the ambulance, motor bike, and bazooka shot effects.

Both channels used LM380 amplifiers, each driving a speaker. As it was the easiest thing to do, I swapped the two LM380s and this swapped the sound. I now had motorcycle, ambulance, and shot sounds.

The obvious cure was a new LM380, but I had only the 14-pin LM380s, instead of the 8-pin version used in this equipment. Fortunately, a wire-wrap socket and a little judicious pin bending solved that problem, and I had sound on both channels.

Why had the LM380 failed? I was inclined to put it down to old age or bad luck, until I idly moved one of the speaker leads — and promptly lost one channel. Fortunately, the LM380 survived and removing a plug and socket connection cured that one. It is incredible that so many problems can be traced to plugs and sockets.

That left only the hum bars. The most likely culprit was the power supply, which was a rather interesting installation. The board was designed to accept 9V AC each side of a centre tap, and 15V AC each side of the same centre tap, from a suitably designed, common centre tap transformer. Each pair of inputs worked into a conventional full-wave rectifier.

This machine used two transformers. One was a fairly robust, but rather ancient model, 9V centre tapped, and the other a more modern type with two independent 15V windings which had been series connected.

Just for the hell of it I pulled out the double-beam CRO and discovered that the series connection had been made out of phase. As a result the intended full-wave rectification was not occurring. Instead, each diode was functioning as a half-wave rectifier, in phase with its mate, or two half-wave rectifiers in parallel. No wonder the power supply had ripple in it.

Correcting this mistake reduced the hum hum bars significantly, but they were still very much in evidence. Then I noticed that the monitor had two earth wires; one the braid on the video input connection, the other a recently run wire back to the main earth point at the mains input. Disconnecting this wire cured the fault — no more hum bars. (I might add that this last effort called for a fair amount of deduction.)

I put the thing back together, checked the coin mechanism, and had the machine tested by an expert (the boss's nine year old son). As far as I know it is back in service — and I hope it stays that way!

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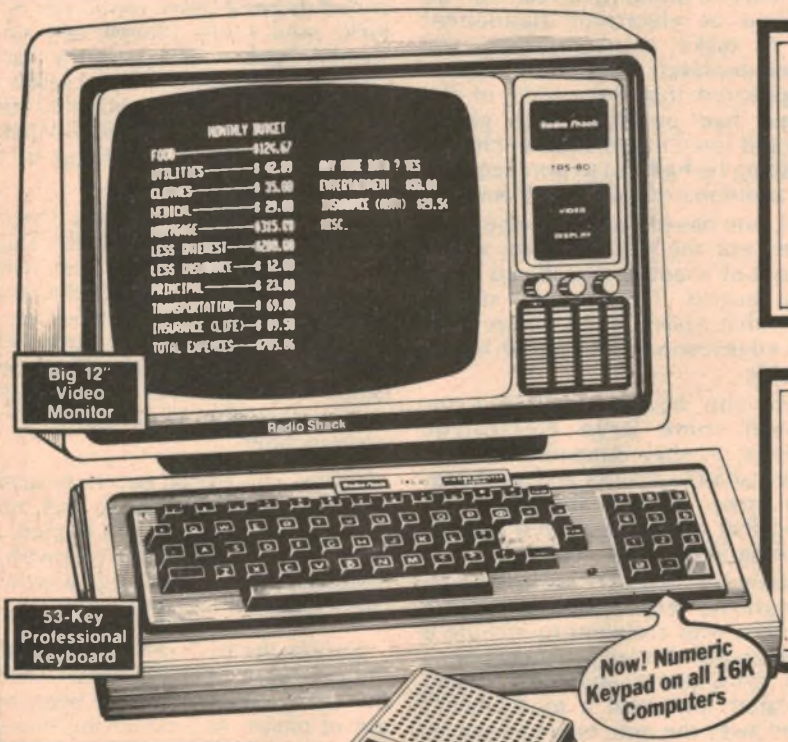

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A discussion of some of the design problems in

High Power Amplifiers

In the coming months, "Electronics Australia" will be publishing a high power amplifier design. This article provides some of the background to the design and details the stringent operating requirements for the output stages.

by LEO SIMPSON

Amongst users of audio amplifiers there is a great deal of attraction and mystique about very high power amplifiers. Apart from their potential to produce an awesome noise, some of the attraction stems from their large size and mass and last of all, their very steep prices.

Well, why is it that these amplifiers are so expensive? After all, it is true to state that amplifiers which produce up to about 60 watts into 8 ohms or around 100 watts into 4 ohms are relatively easy to design and manufacture. But it is also true that very few high power amplifier designs have been published in electronics magazines. So perhaps the design of these powerful beasts really is fraught with problems.

The best way to appreciate some of these problems is to consider the design of a high power amplifier. Let us aim for a figure of 100 watts into 8 ohms, and just see what is required. To do this, we start at the output stage and then work back, until we reach the input stages.

An amplifier which is intended to deliver 100 watts into 8 ohms must be capable of delivering an output voltage swing of 80 volts peak-to-peak, or to put it another way, +40 volts peak. This means that the peak currents into the 8 ohm load will be 5 amps.

On face values, these conditions do not present an insurmountable problem. For an output voltage swing of 80 volts we need to employ supply rails of +50 volts, or 100 volts overall. And if we draw the load line for a class B amplifier delivering this order of power into an 8 ohm load, we find that the peak dissipation in each output transistor is about 78 watts.

Selecting a pair of transistors which can withstand collector-emitter voltage up to 100 volts and peak dissipation of 78 watts is not too difficult, provided the heatsink has sufficient thermal capacity. But the job is nowhere near that easy. If it was, there would be a lot more high-power amplifiers being produced.

What makes it hard is the fact that nice, well behaved 8 ohm loads virtually only occur in the laboratory testing situation. In real life, the load is one or more loudspeakers with perhaps a crossover network. The result is a load which is highly complex and which is almost never purely resistive with a value of 8 ohms.

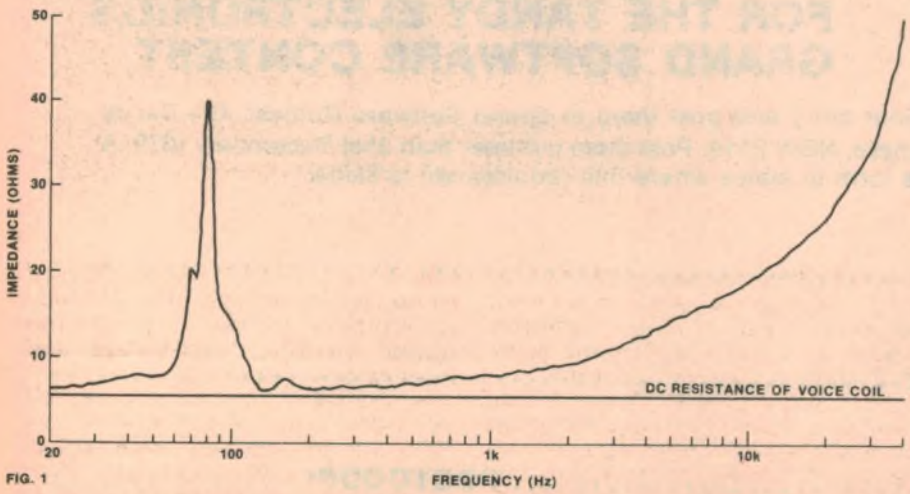


FIG. 1

This graph shows the impedance curve of a single loudspeaker in a closed box.

Fig. 1 shows the impedance curve of a typical loudspeaker mounted in a closed box. This shows a large peak at low frequencies, due to the mechanical resonance of the loudspeaker in the closed box and above the resonance, an impedance characteristic which dips to a value close to 8 ohms and then rises gradually in proportion to the frequency.

Fig. 2 shows an electrical approximation of the same loudspeaker which shows just how far removed a loudspeaker is from a simple 8 ohm resistor. But even there we are showing a relatively simple situation, because most loudspeaker systems, particularly those intended for high fidelity use, have more than one driver and a crossover network. The net result can still be approximated by an electrical network, but it makes the circuit in Fig. 2 look very simple.

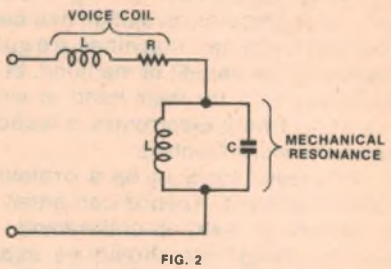


FIG. 2

The electrical analog for a loudspeaker.

Most loudspeaker designers try to ensure that the impedance of their loudspeaker systems is reasonably flat and does not dip below about 80% of the nominal value, ie, for nominal 8 ohm system the minimum is not less than about 6.4 ohms. And it is usual to find that the DC resistance of the voice coil is not less than about 5.5 ohms.

In practice, it is possible for the amplifier designer to simulate the behaviour of a loudspeaker sufficiently well by using a resistor of 5.5 ohms and a small series inductance of, say, half a millihenry. This can be used to examine the effect of typical complex loads on amplifiers.

In fact, it is not even necessary to do physical tests. Having decided on the simulated loudspeaker load, the

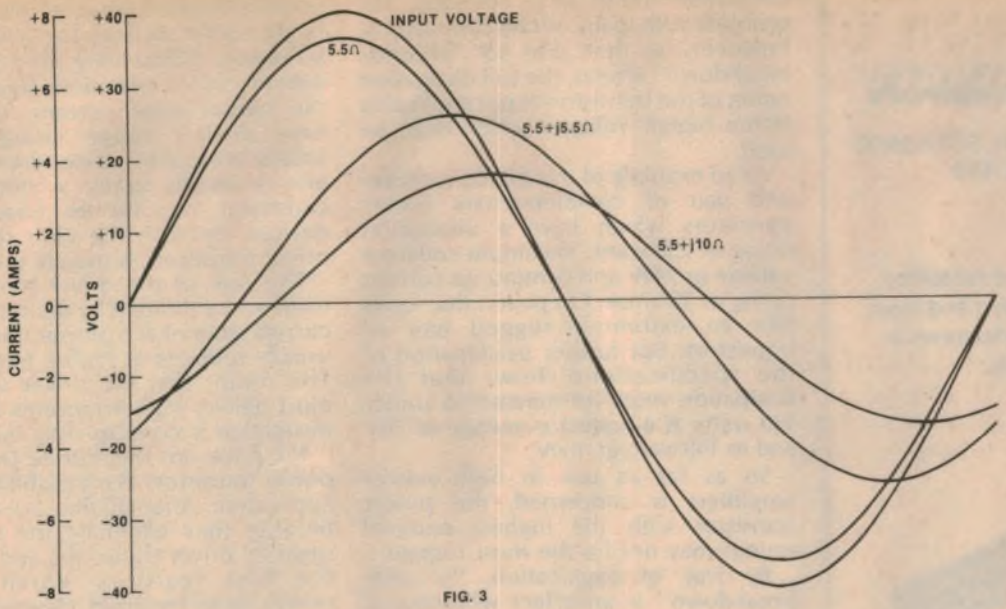


FIG. 3

These curves show the amplitude and phase difference for an input voltage of 28 volts RMS and the resulting currents into loads of 5.5 ohms, 5.5 + j5.5 ohms and 5.5 + j10 ohms. These inductive loads have phase lags of approximately 45 and 61 degrees.

designer is then able to plot load currents and voltages and then the load lines.

To demonstrate this, Fig. 3 shows the relationship between voltages and currents at the 100 watt level (ie, 28 volts RMS) for load impedances of 5.5 ohms, 5.5 + j5.5 and 5.5+ j10 ohms. The "j" figure is the reactance of the inductor at a particular frequency. This diagram shows not only the magnitude of the load currents, but also the phase difference between voltage and current.

It is this often large phase difference between the load voltage and current which makes an ordinary loudspeaker a far more stringent load than a simple resistor. Just how stringent can be seen in Fig. 4. This shows the load lines for an amplifier delivering 28 volts RMS to the above loads. The resistive load line (5.5 ohms) is essentially a straight line — it starts at the 50 volt mark on the voltage axis and slopes up to a point coinciding with 7.27 amps and 10 volts.

Each load line actually portrays the voltage and current conditions of the output transistors. Notice that, for the resistive load line, each output transistor swings between cut-off (ie, no current) with a collector-emitter voltage of 50V, and a point where the transistor has a C-E voltage of 10V and is conducting at 7.27 amps. The peak dissipation on this load line is about 108 watts, corresponding with 30 volts and 3.6 amps. That peak dissipation is certainly a lot higher than the 78 watts mentioned above, when operating into an 8 ohm load. Note that the power delivered to a 5.5 ohm load with 28 volts applied is over 140 watts.

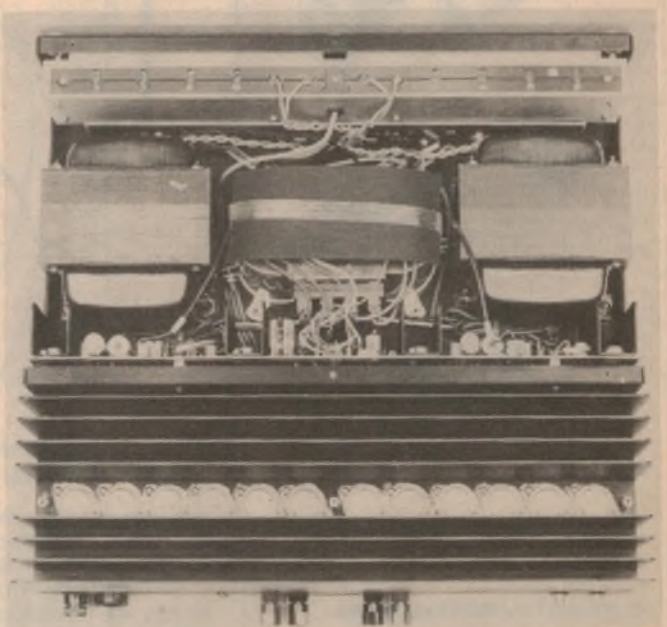
By contrast to the 5.5 ohm resistive load situation, the load lines for the reactive loads (5.5 + j5.5 and 5.5 + j10) are curved, and they sweep across into the high voltage area of the graph. This curvature of the load line means that the peak dissipation is very much higher than for a resistive load. For example, with the more reactive load, 5.5 + j5.5 ohms, the peak dissipation on the load line is about 184 watts! (45 volts multiplied by 4.1 amps.)

On the same graph we have drawn the hyperbola showing the power dissipation of a 150 watt transistor. If we continue to plot these curved load lines (representing all audible frequencies applied to the load) we shall find some that exceed the 150 watt dissipation. So we find that, at the very least, we need to specify a pair of output transistors which can each withstand peak dissipation in excess of 150 watts.

To cope with this stringent load condition the output transistors must be very rugged, substantially free from "second-breakdown" effects and may need protection circuitry. In addition, the output transistors should be reasonably linear in their current-gain characteristic and should have adequate bandwidth.

But the situation gets worse. What we have not allowed for, so far, is overdrive and short-circuited loads. If overdrive of the above loads is taken into account, the output transistors must each withstand peak dissipation in excess of 200 watts. High mains voltages make these figures even higher. Clearly, we must find some very rugged power transistors and probably include an effective means of protection against overdrive, over-voltage and short-circuits.

At this point some readers may still be wondering why there is any difficulty in selecting high power transistors for a 100 watt amplifier. After all, there are complementary pairs of power transistors readily available with



This rugged amplifier made by SAE is rated at 200 watts per channel into 8 ohm loads and has no less than six output transistors in each channel.

dissipation ratings up to 250 watts. The problem with many of these transistors, however, is that due to "second-breakdown" effects, the full dissipation rating of the transistors is not applicable at the higher voltages which must be used.

As an example of this effect, consider one pair of complementary power transistors which have a dissipation rating of 250 watts, maximum collector voltage or 140V and continuous current rating of 20 amps. On paper, that looks like an extremely rugged pair of transistors. But further examination of the specifications shows that the dissipation must be derated to under 150 watts at a collector voltage of 70V and to 100 watts at 100V.

So as far as use in high power amplifiers is concerned, the power transistor with the highest nominal ratings may not be the most rugged.

By way of explanation, "second-breakdown" is an effect whereby, at high voltage and high currents, the voltage distribution across the semiconductor chip causes current crowding and localised "hot spots" which can cause failure of the device.

Summarising what we have discussed so far, we have found that an amplifier which is rated to deliver 100 watts into 8 ohm loads must be able to cope with reactive loads which may have a resistive component which is considerably less than 8 ohms. The reactance will cause appreciable phase shift between load voltages and currents and this, in turn, will cause the peak dissipation in the output transistors to be considerably higher than if the load was simply resistive.

But if there are difficulties in selecting suitable output transistors, the problem is actually worse for the driver transistors. While they are required to deliver only a twentieth (typically) of the output stage current, they must have similar voltage ratings to the output transistors. Second-breakdown effects usually apply a more severe constraint than for the heavy power devices, because the chip for typical driver transistors is usually quite small.

The task of the driver transistors is made more difficult by the fact that the current-gain of the output transistors is usually reduced at higher frequencies. This means that the driver transistors must deliver higher currents and their dissipation is consequently increased.

We have not mentioned Darlington power transistors as a possibility for this application. After all, they are attractive because they eliminate the need for separate driver transistors and some of the bias resistors which would otherwise be required. However, at the time of writing, we know of no Darlington device which is rugged enough to guarantee reliable operation in a 100W/8 ohm amplifier.

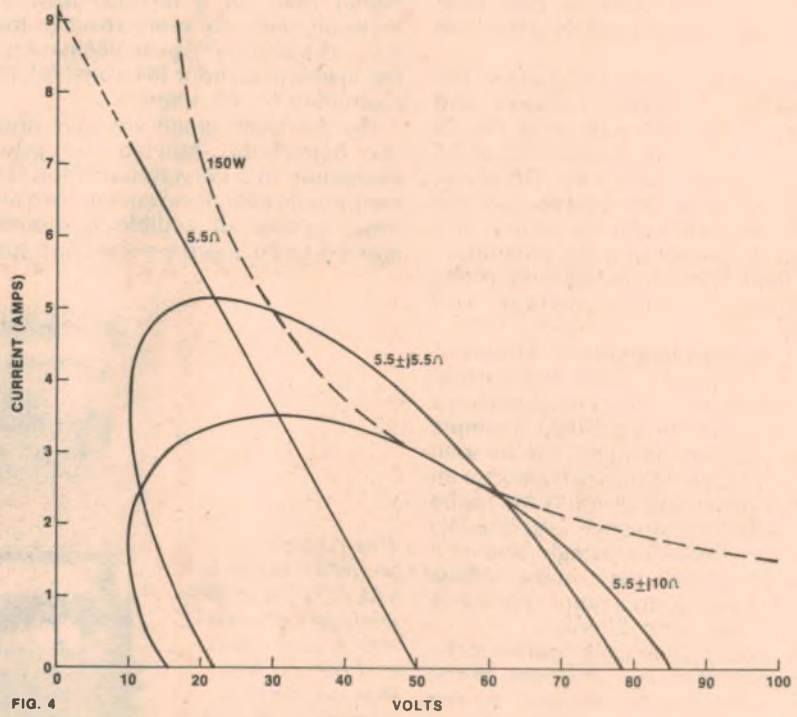


FIG. 4

The curved load lines for reactive loads produce peak dissipation figures. and to 100 watts at 100V.

Well the foregoing should explain some of the stringent requirements for a higher power amplifier. No wonder many higher power amplifiers use multiple power transistors in parallel and series configurations.

By comparison with the output and driver stages, the early stages of a higher power amplifier are relatively easy to design, but finding suitable transistors is still a problem.

In the coming months we shall be describing a power amplifier with a target rating of around 100 watts RMS into 8 ohms. Watch for it.

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Can you talk the same language as your home computer?

Understanding BASIC

Never tried to program a computer before? Don't worry, just about all of the new personal computers are programmed in Basic, a language that's surprisingly easy to understand and use. Here's an easy to read primer on Basic and how you use it.

by PETER A. STARK

Basic is probably the most popular and widely used computer language for small computer hobbyists, and with good reason — it is powerful, yet simple. I'm sure you're ready to learn more about what Basic is and what it can do.

Originally invented at Dartmouth College in the USA early in the 1960s, it was intended to bring the computer to the average Dartmouth student in a way that had never been tried before. The traditional approach was to place a large computer centre in the corner of the campus and then force students to go to the centre to run their computer programs.

Dartmouth tried the exact opposite. It placed computer terminals throughout the campus, even in dormitories, within easy reach of every student. It then tempted students to use them, not only by having the terminals easy to get to but also by having a simple computer language to program the computer with. That was the beginning of Basic!

Unlike earlier languages such as Fortran or Cobol, which were intended for large programs, Basic was intended for the small user. A Fortran and Cobol user had to prepare his programs on punched cards away from the computer. Only when he had the entire set of cards ready, would he go into the computer room and enter the cards into the computer. His problem would be run on the computer, his results printed or punched back into cards, and then he would be encouraged to leave to make room for the next user. In other words, these languages kept the user away from the computer as much as possible.

Basic, on the other hand, was designed for use with terminals, such as teletypewriters, which were connected to the computer and actually using the computer for extended periods of time. A student could sit down at a terminal and play a game against the computer for hours on end.

To make this entire idea practical in the days of million-dollar computers required the use of *time-sharing*, where dozens or perhaps even hundreds of terminals were connected to the computer at the same time. Since the computer is so fast, it easily could take care of many students using the computer at the same time, with each student having the impression he was the only user.

But now, the entire approach has changed. For just a few hundred dollars, you can buy a small computer which can run Basic programs. Since it is no longer necessary to time-share, the computer system can be quite simple and cheap, and yet still be powerful enough to run sizable programs, although only one at a time.

To see just what Basic is and what we can do with it, let's sit down at a computer terminal and type in some commands, seeing what the computer does. These examples were run on a Southwest Technical products MP-6800 home computer, but would be much the same with any small home or "personal" computer system.

The first thing we notice is that the terminal has a keyboard similar to a typewriter, except some symbols are in new places and some keys have symbols not found on a typewriter.

For instance, above the comma is the symbol <, and above the period is the symbol >. Of special importance is a key labelled CR or RETURN, which means carriage return. This key means you are finished with a line and want to return the carriage, the part that prints on the paper, to the left, ready for the next line. Every line you enter into the computer must be followed by a CR to tell the computer you are finished it.

Some computers have a key called ENTER, which works very much like the CR key. The Tandy TRS-80 uses an ENTER key, for example.

Let's sit down at the terminal and start by pressing CR (or ENTER). The computer responds with

READY

Like this Apple-II machine, most personal computers are programmed in easy to learn BASIC language. (Courtesy Computerland).

A typical personal computer keyboard. As you can see, it is very similar to that of a typewriter. (Courtesy Dick Smith Electronics).

In our case we get the message

```
READY
#
```

which tells us the computer is ready, and waiting for a command. Let's enter a simple program telling the computer to print something:

```
10 PRINT 2+3
```

A one-line program like this is about as simple as you can get. Don't forget the CR or ENTER at the end. This simple program tells the computer to add 2 and 3 and print the result.

Notice the number 10 in front. Every instruction of a Basic program must have a *line number* before it, and this is line number 10. The 10 does not necessarily mean that this is the tenth line of a program; it just means that we have decided to give this line the number 10. We could have just as well numbered it 1 or 500. The point behind line numbers is that every line of a program has a different line number, so at some later time we can go back and remove or change lines at will, referring to them by line numbers.

Once we have typed in a program such as this one, we can do two things with it — get a listing of it on the printer to check that we have typed it correctly, or run it. To get a listing, we type the word

```
LIST
```

and, as soon as we hit the CR, the computer responds with

```
0010 PRINT 2+3
READY
#
```

With minor changes, the computer simply types the program as we have entered it.

Notice that, up until now, we have not seen the actual answer of 5, which the computer is supposed to print. We merely have entered the program and checked it. To actually perform it and get our answer, we type

```
RUN
```

and the computer prints

```
5
READY
#
```

Notice that there is a difference between *lines of a program*, which *always* get a line number, and *commands* to the computer telling it what to do with the program, which *never* get a line number. The commands we use most often are LIST and RUN, but each computer system has a number of other commands such as:

- NEW or CLEAR — Erase the program
- SAVE — Save the program on tape or other storage for later use
- LOAD — Load a program previously saved back into the computer

Let's erase the simple program we wrote and enter a new one:

```
NEW
READY
# 10 LET I = 3
# 20 LET J=I + 17
# 30 PRINT I, J
#
```

With one exception, every program instruction starts with a short word such as LET or PRINT right after the line number. The one exception is that with many computers, the word LET may be omitted. Notice that each line has a line number. We could have numbered the lines 1, 2, 3 but this is a bad habit to get into. Very often we find, after trying to run the program, we made a mistake and have to add a few lines. With lines numbered 10, 20, 30, and so on, it's easy to slip in extra lines such as line 15 or 18. Even though we may enter them at a later time, giving them a line number between 10 and 20 will automatically tell the computer that we want them placed in that order.

In the above program, lines 10 and 20 mean just what they say. Line 10 says to let a number I be equal to 3. We have to learn the difference between *constants*, which are constant and never change, and *variables* which can vary and change. In this line, the number 3 is a constant while I is a variable. We could, for example, insert another line into the program as follows:

```
22 LET I=5
```

I thus changes — it was equal to 3 at line 10, but becomes equal to 5 at line 22. We could now get a listing of the program as follows:

```
LIST
0010 LET I=3
0020 LET J=I+17
0022 LET I=5
0030 PRINT I, J
READY
#
```

Notice how the computer automatically put line 22 in the right place, between 20 and 30.

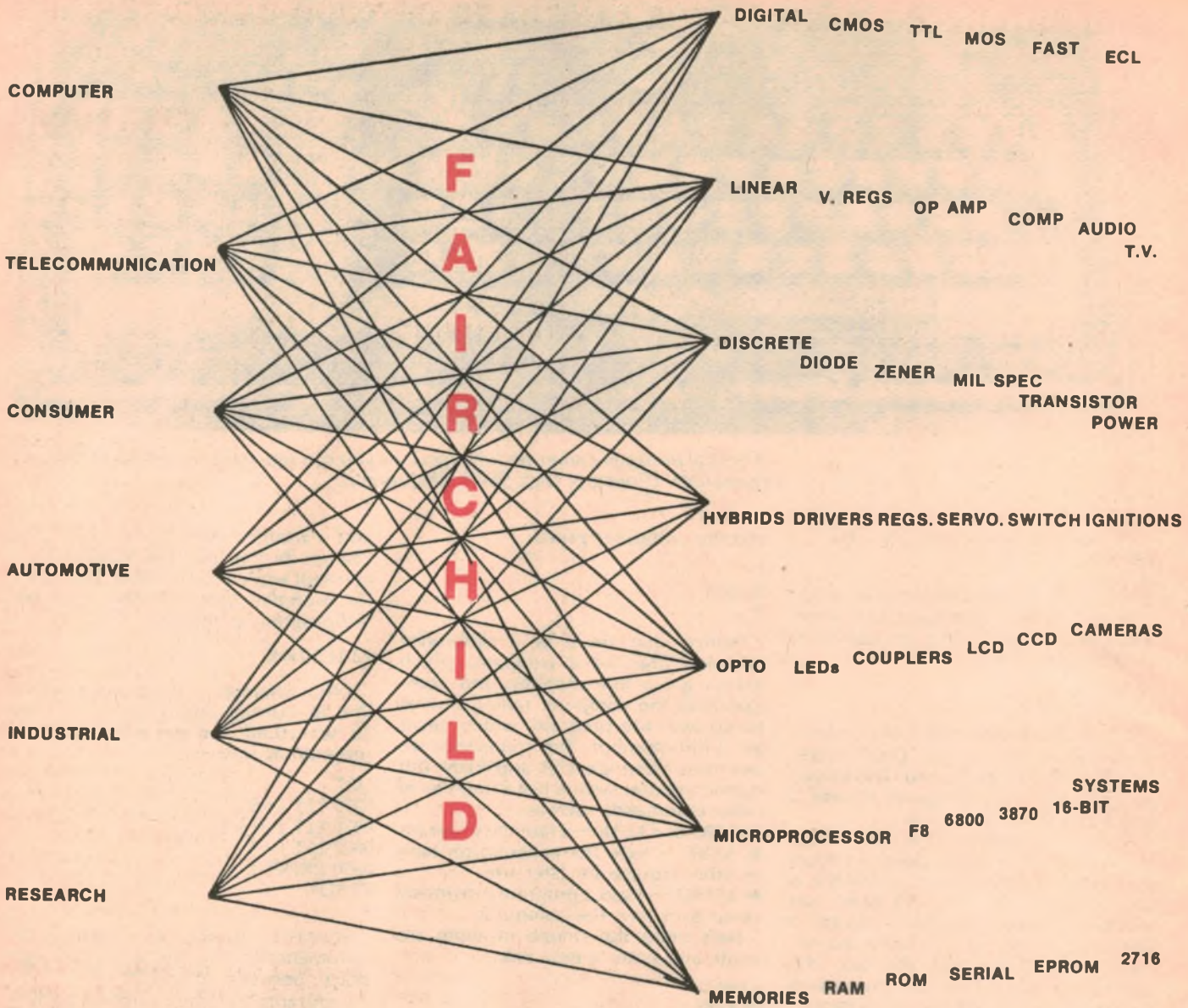
Constants are plain numbers such as 3, 5, 17, or -12.597. There is a way of expressing very large or very small constants by using powers of 10, but that need not concern us at this point. By their very nature, they obviously never change.

Variables, on the other hand, are represented by letters such as I or J. In fact, any of the letters A through Z can be used for variables. Since this only would allow 26 different variables, Basic also allows variables to be represented by a letter followed by a number from 0 through 9. This is very convenient for calculations on electrical circuits, since the values of resistors can be represented by the variables R1, R2, and so on.

Let's take the above program and run it.

```
RUN
5    20
READY
#
```

To understand what has happened, we have to examine the above program line by line. Line 10 told the computer



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to let the variable I equal 3. Line 20 says to add I (which is 3) to 17, and let J be the answer. Thus J becomes equal to 20. Then, line 22 says to let I equal 5. From this point on, I is 5, not 3, so that line 30 prints 5 for I and 20 for J.

As you can see, the computer performs these instructions in the order of their line numbers, not in the order we typed them in. This is another important use of line numbers — they specify the order in which the computer will perform its instructions.

The opposite of a PRINT statement is an INPUT. For an INPUT, the computer stops, prints a ? prompting character, and then waits for you to type in something. Let's write a short program to allow you to type in a number, have the computer multiply it by 3, and print out the answer. First erase the old program:

```
NEW
READY
#
```

Now enter a new program:

```
#10 INPUT N
#20 S = 3* N
#30 PRINT S
```

Line 10 allows you to type in a number, which becomes the variable N. Line 20 multiplies it by 3 to produce another variable, S; notice how a star * is used to mean *times*. Finally, line 30 prints out the product S. If we now type:

```
# RUN
```

the computer prompts with

```
?
```

and if we supply a number, such as

```
1.2
```

the computer comes back with

```
3.6
READY
#
```

This would not be much fun if we could only enter and print numbers, but Basic also allows us to use letters and words. For example, let's add the line:

```
# 5 PRINT "TYPE IN A NUMBER AND I
                WILL MULTIPLY IT BY 3"
```

and change line 30 to read

```
# 30 PRINT "THE ANSWER IS", S
```

If we list it, we get the printout

```
# LIST
0005 PRINT "TYPE IN A NUMBER AND I
WILL MULTIPLY IT BY 3"
0010 INPUT N
0020 S = 3* N
0030 PRINT "THE ANSWER IS", S
```

Now try running it:

```
# RUN
TYPE IN A NUMBER AND I WILL
MULTIPLY IT BY 3
? 7
THE ANSWER IS 21
READY
#
```

As you can see, enclosing a message in quotes (") and placing it in the PRINT statement makes the computer print it exactly as it stands.

Another type of variable is the *string variable*. It is generally signified by a letter A through Z, followed by the $ sign. Its function is to hold a string of letters or other characters from the keyboard, but allow them to be changed, like variables, throughout a program. To illustrate, let's try a new program:

```
# NEW
READY
# 10 PRINT "WHAT IS YOUR NAME?"
# 20 INPUT N$
# 30 PRINT N$, "IS A NICE NAME"
```

Line 20 lets us input a string of letters, while line 30 prints them out again. watch what happens when we run the program:

```
# RUN
WHAT IS YOUR NAME?
? PETE
PETE      IS A NICE NAME
READY
```

After inputing the name PETE, the computer printed it out again, followed by the words IS A NICE NAME. There is a large space after PETE which is put in by the computer because Basic normally prints its output spread out across the page to be in nice columns if numbers are being printed. in this case it makes the output look messy, but that is easy to get around if we use a semicolon (;) in line 30 instead of a comma. This is one of the fine points in Basic, which are of little interest to the beginner but are very useful to the expert.

Next month we will take this sample program a little further, and use it to show how you can get your computer to do things a controlled number of times. We'll also have a look at the ways it can be told to make decisions.

Programming your computer in BASIC is easier than you thought!

(Continued next month)

Reprinted from the March 1979 issue of "CQ" magazine, by kind permission of the author and Cowan Publishing Corporation.

Using the PIPLA/PIPBUG2 ROM in your 2650 system

After some delay, Signetics has released the 2656/CP1002 ROM device containing its "PIPLA" line assembler program, together with an improved version of the PIPBUG monitor. Here are details on how the device can be used with our 2650 Mini Computer system.

by JAMIESON ROWE

If you built up our popular 2650 Mini Computer system, you'll probably be aware that there was provision for a mysterious 40-pin IC, on the expansion board described in the November 1978 issue. This was explained at the time as simply "a possible future addition", and until now we haven't been able to clarify the situation any further.

Actually I did give a clue to the identity of the mysterious device in the April 1979 issue, in the article describing a simple line assembler program for 2650 systems. As you may recall, I mentioned that the assembler was based on PIPLA, a program developed by Signetics in the USA to go into a "special ROM device" along with a modified and enhanced version of PIPBUG.

But now the full story can be told. The mysterious device in question is the CP1002, a custom-programmed version of Signetics' 2656 "system memory interface" (SMI) device, and it is finally available.

I first learned of the CP1002 back in April 1978, during a visit to the Signetics facility in California. In fact during the visit, the Signetics people very kindly gave me a pre-production sample of the device, in the expectation that it would be going into production shortly.

Shortly after my return, David Edwards and I were planning the expansion board for the 2650 Mini Computer, and in view of the likely release of the CP1002 we decided to allow space for it on the board. However after this was done we were advised by Philips that Signetics had struck unexpected trouble with the device, and its release would be delayed. By this stage it was too late to modify the PCB pattern, so we were forced to gloss over the matter.

Apparently Signetics struck more trouble than they expected, because as the months wore on the CP1002 still failed to appear. This was one of the reasons that I finally decided to describe a modified version of the PIPLA line assembler, in the April 1979 issue.

Well, the problems must finally have been solved, as the CP1002 is here at last. So without further ado let's see what it contains, and how you can hook it into your 2650 Mini Computer.

As mentioned above, the CP1002 is actually a custom-programmed version of the Signetics 2656 SMI device. This is a mask programmed N-channel MOS LSI device, in a 40-pin package, and containing 2K bytes of ROM, a 128-byte static RAM, a clock oscillator, an 8-bit latch and 8 multi-purpose pins which may be programmed to serve as either I/O lines or memory block chip enable outputs.

In the case of the CP1002 version, the 2K ROM contains two useful programs. One is PIPBUG2, a modified and enhanced version of the familiar monitor program used in most small 2650 systems; the other is PIPLA, a small line assembler.

PIPBUG2 is similar to the original PIPBUG, but it offers some additional features. One is that it will operate at either 110 or 300 baud, as far as communication with the terminal is concerned. It is automatically synchronised to whichever of these rates is required, simply by sending in a "U" from the terminal keyboard after the CPU has been reset.

Another feature offered by PIPBUG2 is that it is capable of dumping a program in the binary format needed to program PROMs on a Data I/O PROM programmer. And there is a third feature: the ability to perform hexadecimal addition.

The only drawback of PIPBUG2 is that Signetics have made it quite different from the original PIPBUG in terms of subroutine calling addresses, etc. So if you have a swag of programs which make use of the subroutines in original PIPBUG, you'll have to modify them for use with PIPBUG2. It isn't just a matter of changing the subroutine calls, either — some of the subroutines use different registers, and different parameters.

As for PIPLA, the line assembler, this is very similar to the line assembler I described in the April 1979 issue. The only differences are as follows:

1. PIPLA gives no initial identifying message.
2. PIPLA assumes an initial origin at 0C00, rather than 0440.
3. PIPLA has no facility to accept the DATA directive.
4. PIPLA does not strip the address of non-branching absolute address instruction to 13 bits, so that can make errors when assembling programs for pages other than page 0.

Of course a final difference is that PIPLA is meant to go with PIPBUG2. It uses subroutines from the latter, and thus is dependant upon it.

What it boils down to is this. The CP1002 provides you with PIPBUG2 and PIPLA, resident in ROM so that they're always ready to go. And together the two programs are a big improvement over the original PIPBUG, which you can consider them as replacing. But whether you'll want to replace your existing PIPBUG ROM with the CP1002 will probably depend upon how many programs you have that use the original PIPBUG subroutines. If you've got quite a lot, you may not find the idea too attractive.

For those who do want to use the CP1002, it can be connected into the 2650 Mini Computer quite simply. The details are shown in the diagrams. As you can see, the main thing is to add a 40-pin DIL socket to the previously unused space on the expansion board (78UP9). Most of the necessary connections are made by the PCB pattern, already. All you have to do to get the ROM section of the device in operation is to run a wire from pin 22 of the 2650, to supply the WRP signal to the CP1002's pin 17.

The CP1002 has its own internal memory block decoding, so that it automatically assumes the address range 000-87F. The ROM occupies the addresses 000-7FF, while the 128-byte RAM occupies 800-87F.

What this means is that to prevent bus conflict, no other memory devices can occupy the same memory range. As you won't need the original PIPBUG ROM any more, this will free the bottom 1K (address range 000-3FF). However you'll probably have to shift some of the RAMs out of the range from 400-7FF and 800-BFF, to higher blocks. Depending upon your system and the amount of RAM you have, this may be simply a matter of changing links at the output of the 74LS138 decoder on the CPU board.

As you can see, the CP1002 also provides for a crystal clock oscillator for the 2650 CPU. So if you haven't provided your 2650 with a crystal clock as yet, this can now be done by adding a 4.000MHz crystal, three resistors and a capacitor as shown. Space is already provided for these components, alongside the CP1002 socket on the expansion board.

The output of the clock oscillator appears at pin 10 of the CP1002, and is at 1MHz ready to connect directly to the clock input of the 2650 chip (pin 38). Needless to say you will have to remove the existing 74LS123 clock oscillator chip, to prevent it loading down the new clock signal. If you have used a socket for the 74LS123 this will simply be a matter of unplugging the IC from its socket. Otherwise you may have to unsolder the IC and remove it that way, although some may elect to simply cut the PCB trace connecting its output pin 5 to pin 38 of the 2650.

In the CP1002 version of the 2656, the eight "multi-purpose" pins are programmed as memory block select and extended I/O address enable outputs. Although these are unlikely to be of much use in the 2650 Mini Computer system, Table 1 shows the significance of eight signals. Note that four of them are memory chip enables for 256-byte blocks, while the other four are enable signals for extended I/O addresses.

TABLE 1: 2656/CP1002 SMI enable outputs

PIN	LABEL	FUNCTION	ADDRESS	M/$\overline{IO}$
34	X0	I/O enable	FF	0
35	X1	Mem. select	0C00-0CFF	1
36	X2	Mem. select	0D00-0DFF	1
37	X3	Mem. select	0E00-0EFF	1
9	X4	Mem. select	0F00-0FFF or 1F00-1FFF	1
8	X5	I/O enable	00-03	0
7	X6	I/O enable	04-07	0
6	X7	I/O enable	FF	0

When you have wired in the CP1002 and checked it out, you'll be ready to turn on the system and try it out. As with the original PIPBUG, PIPBUG2 starts at address 0000 and thus comes up immediately due to the power-up reset. But in this case it doesn't print its prompt asterisk (*) immediately; instead it waits for you to key in a "U" from the terminal, in either 110 or 300 baud. This tells it which of the two rates you want, and it then locks onto that rate and sends out the prompt character to show that it's ready for business.

The commands for PIPBUG2 are the same as for its predecessor, except for the two extras. The format for the hex addition command is

H sp AAAA sp BBBB cr

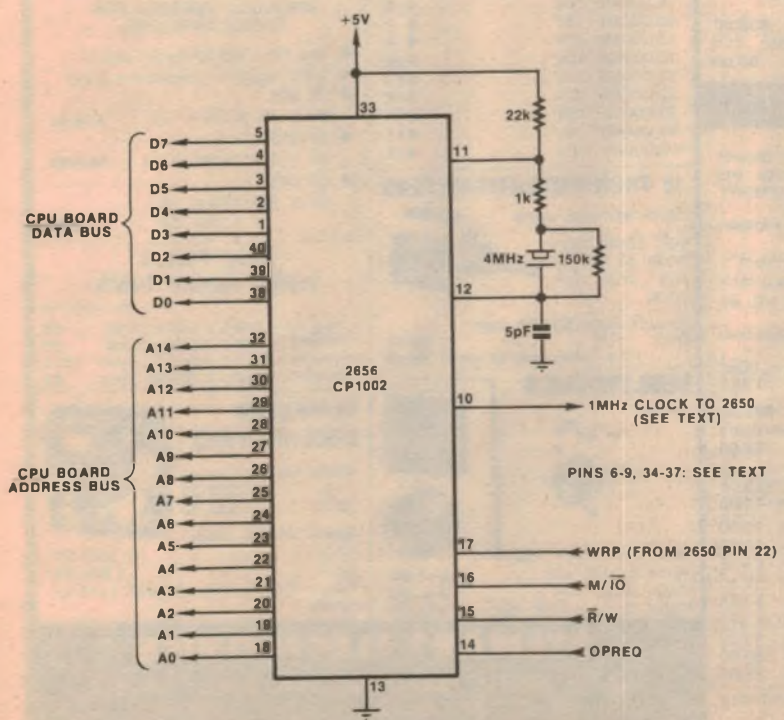
where H is the command character, AAAA is one of the hex numbers to be added, BBBB is the second number, sp is a space and cr is a carriage return. Leading zeroes are not necessary when keying in the numbers.

Note that you can use this command to perform a hex subtraction by using it to tell you the 2's complement of the subtrahend first, then adding that to the diminuend. To get the 2's complement you first work out the 1's complement yourself, simply by complementing all bits individually. Then use the H command to add 1 to this figure, which will give you the 2's complement. Finally you then use the H command again to add this to the second number.

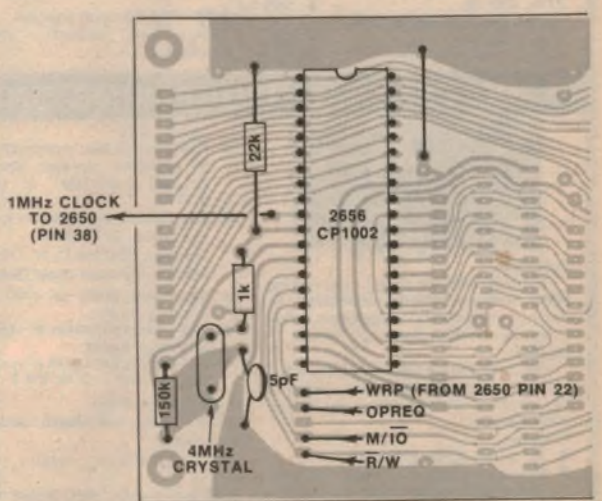
The format for the PROM programming dump command is

P sp A sp BBBB sp CCCC cr

where P is the command character, A is a parameter specifying the bits of each byte to be dumped, BBBB is the starting address in memory of the data to be dumped, and CCCC is the number of following words (i.e., one less than the word capacity of the PROM to be



2656-CP1002 PIPBUG 2/PIPLA ROM CONNECTIONS



ABOVE: The wiring required on the 2650 Mini Computer expansion board, in order to use the CP1002. The address, data and supply connections are provided already by the PCB.

LEFT: The schematic connections for the CP1002 ROM. No chip enable signal is required, as it contains its own address decoding. The crystal oscillator is optional.

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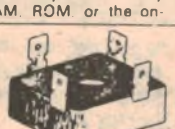

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CP1002 "PIPLA" ROM

loaded). As before sp means a space, and cr means a carriage return.

The parameter A is used to specify the dumping format. There are three formats allowed; you can either dump all 8 bits of each memory byte, only the least significant 4 bits of each, or only the most significant 4 bits. The three modes correspond to the following values for parameter A:

0 — all 8 bits dumped
1 — only the least significant 4 bits
2 — only the most significant 4 bits

If options 1 or 2 are specified, the four bits of data are right justified and the upper four bits are dumped as zeroes.

The remaining command functions provided by PIPBUG2 are virtually identical to those of the original PIPBUG. Hence there is the "A" command to examine and alter memory, the "L" command to load from cassette or paper tape, the "D" command to dump to cassette or paper tape, the "S" command to see and set the registers, the "B" command to set a breakpoint, the "C" command to clear a breakpoint and the "G" command to transfer command to a user program. These are all used in exactly the same manner as those of the original PIPBUG.

As with the first version of PIPBUG, there are a number of utility subroutines in PIPBUG2 which may be called by user programs. The most useful of these are described in Table 2. Note that as mentioned earlier, some of these sub-routines are significantly different from those in the original PIPBUG when it comes to use of registers, etc.

The PIPLA line assembler starts at hex 0400. As mentioned earlier it gives no initial identifying message and assumes a starting origin of 0C00 for the program to be assembled. So when you call it, the response is simply

0C00.

Apart from this, its operation is very similar to that of the modified assembler I described in the April 1979 issue. You can change the origin as desired with an ORG directive, store a string of ASCII characters with an ASCI directive, and return to PIPBUG2 with an END directive. The only directive not available is the DATA directive.

There is only one other point to remember. The input buffer used by PIPLA is only 24 characters long, compared with the buffer of about 60 characters used by the modified assembler. So you cannot have a long string in an ASCI directive, nor can you fit in comments after the operand field of an instruction line. But you can still have normal comment lines (identified by an asterisk as the first character), as long as they are shorter than 24 characters.

TABLE 2: User-accessible subroutines in PIPBUG2

LABEL	FUNCTION	CALL BY
CHIN	Inputs a character to R0 from the serial terminal	ZBSR *0009 (BB 89)
COUT	Outputs a character from R0 to the serial terminal	ZBSR *0007 (BB 87)
BIN	Reads two hex chars from the terminal, forms byte in R1	ZBSR *000D (BB 8D)
BOUT	Prints the byte in R1 as a two-digit hex number (Data in R0 is destroyed)	ZBSR *000B (BB 8B)
LKUP	Converts a hex char in R0 into a 4-bit number (returned in R0 also)	ZBSR 0026 (BB 26)
GNUM	Fetches a 4-digit number from the input buffer, stores in R1 and R2	ZBSR *000F (BB 8F)
STRT	Stores R1, R2 into 80D, 80E	ZBSR 0021 (BB 21)
INCRT	Increments contents of 80D, 80E	ZBSR 0017 (BB 17)
CRLF	Sends CR, LF to terminal	BSTA, UN 01A9 (3F 01 A9)
CHNG	Converts the byte in R0 into two hex chars returned in R1, R2	BSTA, UN 028D (3F 02 8D)
FORM	Outputs 3 spaces to terminal	BSTA, UN 0360 (3F 03 60)
GAP	Output 50 spaces to terminal	BSTA, UN 0364 (3F 03 64)

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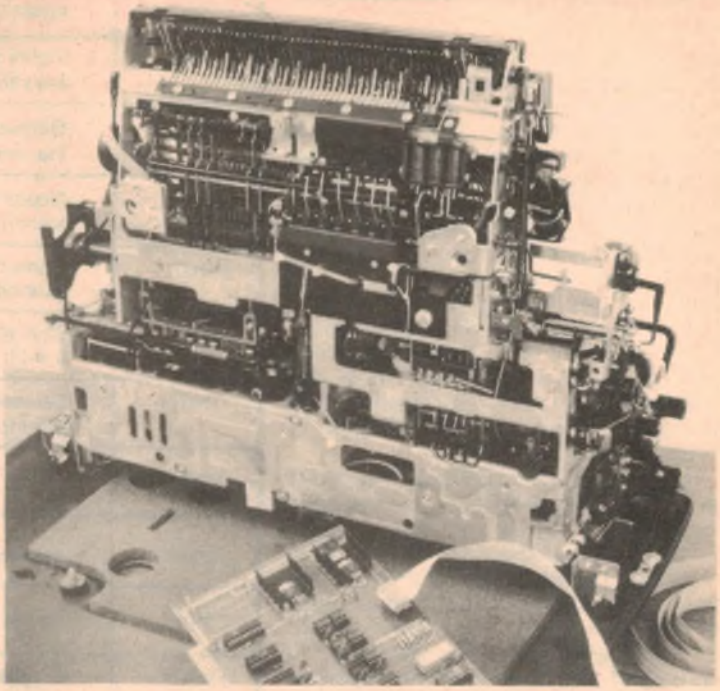

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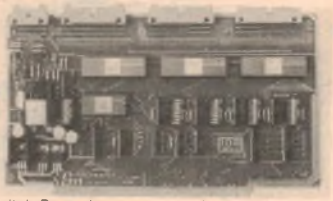

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Microcomputer News & Products

Itoh line printer

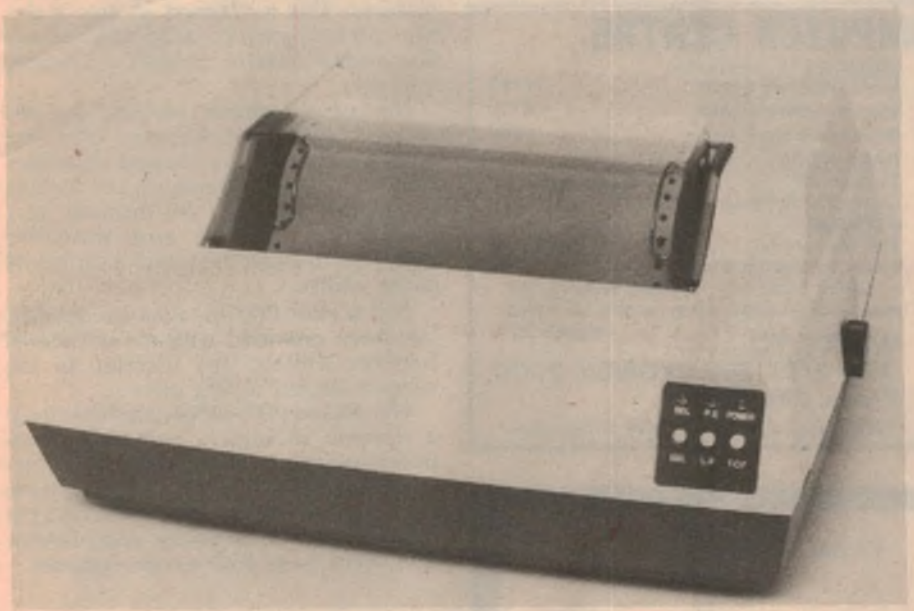
Ampec Engineering advise that they are now able to supply the Itoh model 8300 dot-matrix serial impact printer, in both parallel-input and RS-232C interface versions. The printer is bidirectional, and has a printing speed of 125 characters per second. The standard versions print both upper and lower case on a 5 x 7 matrix, but 7 x 9 matrix is available as an option. This gives improved character readability.

The printer uses tractor feed with perforated fan-fold paper, and can accept paper from 4.5 to 9.5 inches wide. The paper entry can be from either the underside or the rear of the machine. The printer includes an 80-character line buffer, for maximum throughput.

The model 8300 is microprocessor controlled and provides a number of "intelligent" functions such as vertical tabulation, switching between normal/double width characters in response to control characters, and the ability to generate an internal character string for testing. The internal electronics has also allowed the mechanics of the printer to be simplified, for improved reliability.

Interface circuits for using the 8300 with popular microcomputers such as the Tandy TRS-80, Apple II and Commodore PET will be available shortly.

Further information on the Itoh model 8300 line printer is available from Ampec Engineering, 1 Wellington Street, Balmain, NSW 2039. Telephone (02) 818 1166.



The Itoh model 8300, an 80-column bidirectional matrix printer. An internal microprocessor provides high reliability.

CHIPOS manual

Michael Bauer, the designer of our very popular "Dream 6800" tuitional microcomputer project, has advised that he is able to supply readers with a software manual for the project. The manual provides a listing of the CHIPOS interpreter, complete with comments, together with other useful data and a DREAMBUG debug routine which should be of particular interest to machine-code programmers.

The manual is available for $5.00 by sending a cheque or postal note to Dreamware, PO Box 343, Belmont, Victoria 3216.

Sorting in PASCAL

A versatile sort/merge program designed for use in microcomputer systems which use the UCSD Pascal language is available from Oblong Software Products. Called PSORT, the program has the following features: Fixed or variable length for both fields and records; the ability to specify that a record is to be included or excluded from a sort or merge; up to 10 user-redefinable sort keys; merges of up to 10 pre-sorted files; support for multiple disks for input, output and work files; use of either text files or files of strings; the ability to read sort control parameters from either the console or a parameter file; and the ability to be

Microcomputer News & Products

called as a procedure from a user program.

PSORT is supplied on a single-density floppy disk (205mm), complete with user manual providing the full Pascal source code, for $100. The user manual is available separately for $10, this figure being refundable upon purchase of PSORT.

Further information is available from Oblong Software Products, 19 Cedarleigh Road, Kenmore, Qld 4069. Telephone (07) 378 2415.

Anadex printer

Bell & Howell Australia, distributors of the Anadex DP-8000 line printer, have announced that the printer has now been provided with additional features. This is claimed to give it the best performance to price ratio of any 80-column matrix printer currently available.

The new features include an improved print mechanism offering higher stability, an enlarged character buffer of 1K (with the option of further expansion to 2K), an integral test diagnostics facility and movable sprockets to allow the use of a variety of paper widths.

Bell & Howell stress that the DP-8000 has been provided with the additional features without any increase in the recommended selling price.

The Anadex DP-8000 is available from a number of outlets including Computerland stores, Dick Smith Electronics stores and EAI. It is also available from Bell & Howell's own distributor network, which provides comprehensive spare parts and service support.

More on clubs

Further to the listing of clubs given in the August and September issues, the following information has been received:

SOUTH AUSTRALIAN MICROPROCESSOR GROUP: The meetings of this group take place on the second Friday of the month, not the third as listed.

SORCERER USERS' GROUP: An organisation of Sorcerer users has recently been formed in Sydney. Mail address of the group is PO Box 43, Peakhurst, NSW 2210. Meetings are held at the WIA hall, 14 Atcheson Street Crows Nest, at 7.30pm on the first Friday of the month in odd months, and the second Friday of the month on even months. Further details from group secretary Mr Ian Craddy.

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- 16k Bytes organised in 2 x 8k Blocks individually selected to any 8k Boundary

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each 16k adds $125.00
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- Clock speed, 2MHZ Standard, 4MHZ Option
- I/O Z80 P10 2 x 8 bit programmable parallel I/O.
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- Onboard 2100 baud Tarbell Cassette Interface (Software Controlled) with cassette recorder remote motor control. Cassette supplied with CPU Kit contains set up procedures for cassette interface as well as software to allow the cassette interface to read and dump 300 baud CUTS (Kansas City) format.
- Keyboard input direct onto card in parallel ASCII.
- Monitor performs all functions to drive ET1640 VDU as on ASCII terminal. Entry points for cursor control etc
- The spare socket onboard is to allow the National MM57109 to be fitted which works in conjunction with the CPU to give a full floating point RPN arithmetic unit.
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PRICE KIT $199.50 2MHZ
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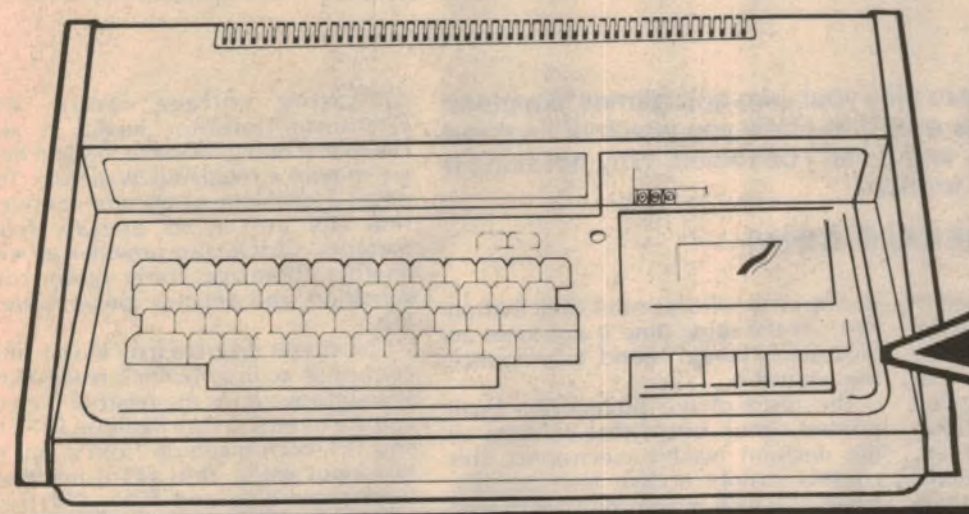
THE DICK SMITH SYSTEM 80 is fresh from the design laboratory and features latest "STATE OF THE ART" techniques.



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DSE605

Build our

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Here's a gadget you can use to play your own quiz games like those on TV. It "bleeps" and lights a LED to show you which of its three buttons was pressed first — and it can't be fooled. Why not build it up and have fun with your friends?

by GERALD COHN

You can use the gadget described in this article to play one of the quiz-type games like the familiar "Jeopardy" or "It's Academic" on TV. Or you can simply use it to compare the reaction times of you and your friends. Either way, you can use it to have a lot of fun.

It provides three player pushbuttons. After the circuit has been reset, it will indicate which of the three buttons is pressed first, by means of a corresponding light-emitting diode (LED). It then latches itself so that the other two buttons are made insensitive — leaving no doubt as to who pressed their button first! At the same time it produces an electronic "bleep" sound, to announce the winner.

The heart of the project is a small printed circuit board that contains all the decision making electronics. This consists mainly of five low-cost ICs, three of which are of the CMOS type (complementary Metal Oxide Semiconductor), and the other two of the more conventional bipolar type.

We decided to use CMOS type ICs because of the flexibility of their operating voltage range. TTL (Transistor-Transistor Logic) is also capable of doing the same job, but here we require a regulated 5V supply. This poses a problem when one considers that the unit is to operate from batteries. CMOS also provides us with another advantage: lower power consumption, and hence a longer battery life.

A front panel LED comes on to indicate which of the three buttons has been pressed first. Plastic film cannisters were used to house the player buttons.

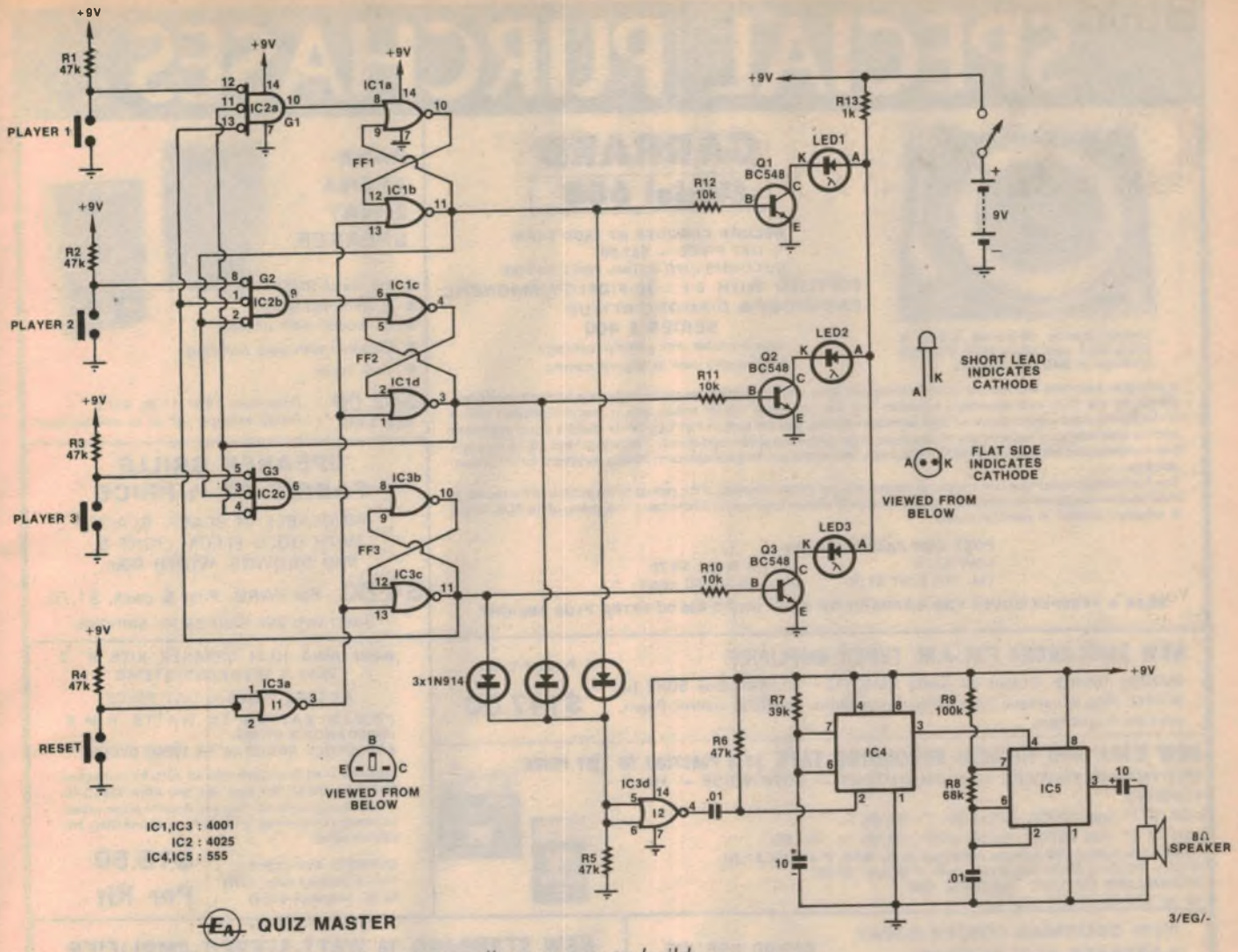
The circuit diagram may look a little confusing at first, but it's really fairly straightforward. At the heart of the circuit are three R-S type flipflops, FF1, FF2 and FF3, each made up from a pair of two-input gates. Thus FF1 is made up from gates IC1a and IC1b, FF2 from IC1c and IC1d, and FF3 from IC3b and IC3c. Each flipflop is associated with one of the three player pushbuttons.

The pushbuttons are not connected directly to the flipflop inputs, but via the three-input gates IC2a, IC2b and IC2c. These gates are shown on the circuit as AND gates responding to negative logic on their inputs, as this is the way they are being used here. (If you are unfamiliar with the idea of logic convention, I suggest you look at the EA handbook "An Introduction to Digital Electronics".)

If you trace through the circuit, you will see that the second and third inputs of each gate are actually connected to the outputs of the two flipflops which correspond to the "other" players. The idea behind this is quite simple: when any of the three flipflops is triggered into the set state, it disables the gates leading to the other two flipflops — and thus prevents them from being triggered. This is how we get the "lockout" action, to ensure that there is only one winner.

The second inputs of each of the three flipflops are tied together, and connected to the output of gate IC3a. This is wired as an inverter, and driven in turn by a fourth pushbutton labelled "RESET". So by pressing this button we are able to force all three flipflops into their reset state, ready for a new game.

Attached to the output of each flipflop is an indicator circuit, consisting of an NPN transistor driving an LED. Thus transistor Q1 and LED1 form the indicator for FF1, Q2 and LED2 the



The circuit may look complicated, but it's really very easy to build.

indicator for FF2, and Q3 and LED3 that for FF3.

Also attached to the outputs of the three flipflops are three 1N914 silicon diodes, which together with resistor R5 from a simple OR gate. These feed gate IC3d, wired as an inverter, which in turn drives the "bleeper" circuitry based on IC4 and IC5. These are both 555 timer devices, with IC4 connected as a monostable which determines the length of the "bleep", and IC5 as an astable which generates the bleep itself. As you can see the output of IC5 drives a small loudspeaker.

Confused? Well, let's go through the operation step by step. First of all, the reset button is pressed. This resets all three of the flipflops, so that their outputs are at the "low" logic level. This means that Q1, Q2 and Q3 are all cut off, and their LEDs receive no current. Also none of the three 1N914 diodes can conduct, so IC3d, IC4 and IC5 are all inactive.

Because the three flipflop outputs are all low, the input gates IC2a, IC2b and IC2c each have two inputs low. The only input of each one that is not low is the one connecting to its pushbutton; and in each case there is a 47k resistor (R1-R3) pulling that input high. So all three gates remain inactive — until one of the three buttons is pressed.

As soon as one of the buttons is pressed, things suddenly change. The first thing that happens is that the button which is pressed pulls the third input of its associated gate low, so that all three inputs are finally low. This makes the gate concerned switch its output from the low level to the high level, and as a result it triggers the corresponding flipflop into the "set" state.

The output of this flipflop thus goes high, turning on its corresponding LED via the driver transistor. And at the same time one of the three 1N914 diodes conducts, taking the inputs of IC3d high and causing this element to trigger the "bleeper" circuit. So the winner's LED lights, and the win is announced with a loud bleep.

What also happens is that in going to the high logic level, the output of the winner's flipflop pulls up one input of the input gates for each of the other two players. So about one microsecond after the first button is pressed, the other two buttons are effectively disconnected from their flipflops — or "locked out".

At this stage you're probably still a little vague as to the operation of the bleeper circuitry, around IC4 and IC5. Unfortunately this would take quite a deal of explanation to describe in detail, so we can't take it much further than we have done above. The main thing to note is that IC4 produces a pulse about half a second long, which is then used to turn on IC5 for that time. IC5 operates as an astable or oscillator, producing a square wave of about 600 Hertz. This is fed to the loudspeaker to produce the "bleep". Now that we have discussed the operation of the circuit, let's take a look at the construction of the project.

Most of the components are mounted on a printed circuit board (PCB), which measures 74 x 80mm and is coded 79QM9. The PCB pattern is reproduced here actual size, for the benefit of those who may wish to make their own. However patterns are being sent to the various board makers, so

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that you should be able to buy ready-made boards shortly.

Before you rush in to start placing components on the PCB and begin soldering, I suggest that you first check the PCB to make sure that it has been properly etched. Some of the things that you should look for when checking the board are continuity of the tracks, (some of them are rather narrow) and/or incomplete etching. You can use the PCB pattern reproduction as a reference against which to check the board.

If you are happy that the board is OK, you can start assembling the unit. The best place to start would be with the wire links. All the links on the board are made using tinned copper wire, and if you don't have this as such, you will find that telephone-type wire with the insulation removed is ideal for this.

The resistors and capacitors are mounted onto the board after the links have been soldered. Take care when inserting the two tantalum capacitors to ensure that they are correctly placed, since they are polarised components.

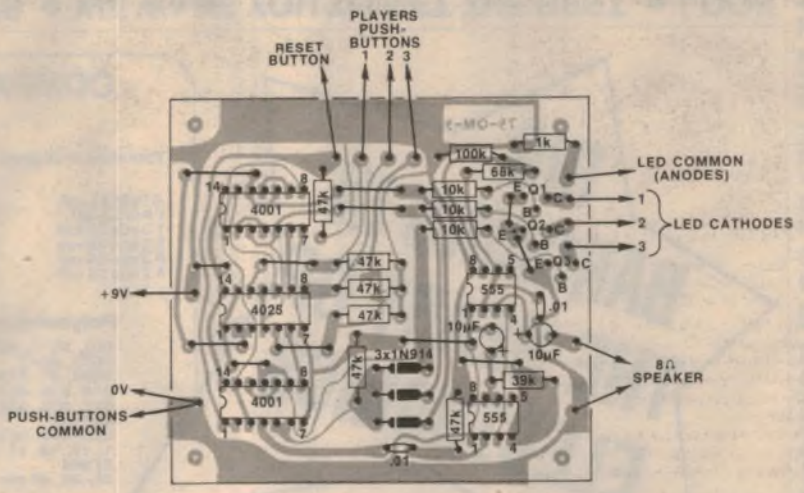
The PC pins used for wiring terminations are the next to be mounted on the PCB; followed up by the sockets for the CMOS devices (IC1, 2 and 3). I suggest that sockets are used for the CMOS IC's, since these devices are easily damaged by static discharges, particularly during soldering. A point to note is that CMOS devices must be handled with care if they are not to be damaged. When you pick the IC's up, try not to handle them by the leads; rather pick them up by the ends of the plastic body.

The 555 timer chips can by soldered directly to the printed circuit board, although care must still be taken to ensure that the devices are not subjected to excessive heating. After the 555s come the three diodes and the three transistors. These should be soldered to the PCB using heatsink clips or a pair of long nosed pliers, to protect them from heat while soldering.

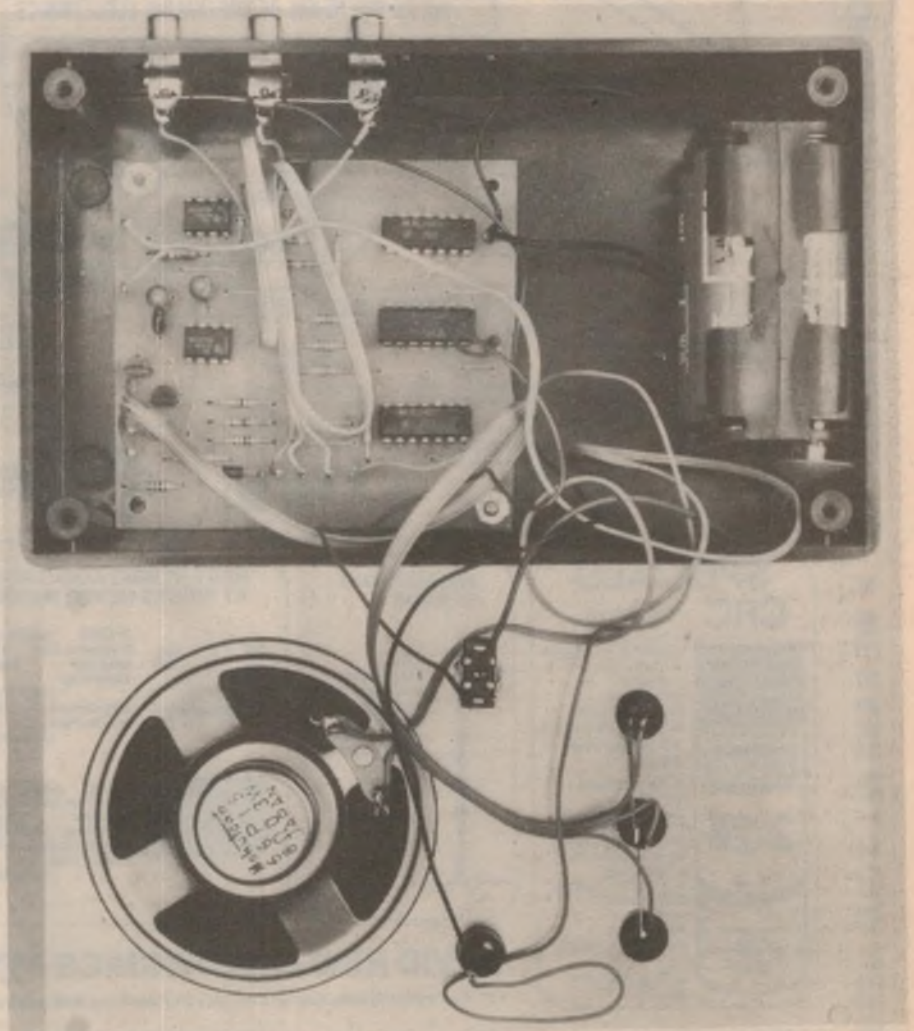
The PCB assembly should now be complete, and you can turn your attention to the box that houses all the electronics. We used one of the plastic "Zippy" boxes for our prototype, the dimensions of which are 150 x 90 x 50mm deep. The box is listed in the Dick Smith catalogue as part No. H-2751, but should also be available from other suppliers. It comes supplied complete with an aluminium lid and fixing screws.

The front panel of the box was "dressed" up with a photo etched aluminium panel that was made with "Scotchcal". The artwork for the panel has been reproduced here full size for those who may wish to use it as a guide to making their own. You can, on the other hand, use the artwork as a drilling template, and obtain a "Dyline" transparency of the same from us at EA for a nominal cost of $2.00. Yet again you may be able to buy a ready-made Scotchcal panel, from suppliers such as Radio Despatch Service.

The holes for the speaker are 3mm in diameter, while the other holes, i.e. those for the switch, the reset button,



Above is the component overlay diagram. The three CMOS ICs (at left) should be mounted last. Below is a view inside the completed prototype, showing the layout of components on the front panel and inside the plastic case.



and the three LEDs are 6.5mm in diameter. Another three holes are required in the side of the case for the three sockets into which the players' buttons are connected. We found this to be the best way since it adds a little to the versatility of the unit. The position of the three connectors is not critical, and the photograph should give you some idea of how we placed them.

The pushbuttons for the players were mounted into small plastic film cannisters. The type that we used for the prototype was obtained when we purchased some 35mm Kodak film. The film cannisters were found to be ideal here because they fit quite snugly into the hand, with the thumb being used to activate the button. We fitted the buttons with a five metre length of twin flex, and found this to be suitable for most situations, although they can be made longer or shorter as required.

The speaker was mounted onto the front panel using contact adhesive, and this proved to be quite adequate. When using the adhesive, refer to the directions first, as this type of adhesive has to be used in a special manner if it is to do the job properly.

The printed circuit board is mounted under the speaker, so due allowance must be made for the depth of the speaker. The battery holder is mounted on the other side of the box, right up against the side, and this allows plenty of clearance for the LEDs. The printed circuit board is held in place using some screws with multiple nuts as spacers.

We used RCA-type audio connectors for the player buttons, and these were of the panel mounting type. The solder lugs that are supplied with the sockets were bent over and commoned up with a length of tinned copper wire.

The wiring to the components not mounted on the PCB is a simple task, but one that is best done in a systematic order. The easiest way would be as follows:

- Wire the pushbutton inputs to the sockets (taking note of the order), and take the common to the negative terminal on the board.
- Mount the LEDs onto the front panel and connect them to the LED outputs on the PCB. The anodes of the LEDs are taken to the LED common terminal on the PCB.

The last of the wiring involves hooking up the speaker, the power switch and the battery clip. You may find it desirable to extend the length of the positive lead on the battery clip to allow the lid of the box to come well clear of the rest of the unit if you ever have to open it up.

When you have completed all the wiring, go back and do a check on the complete assembly, making sure that things such as the ICs are in the proper places, and the right way around. The other things that are important are the transistors and the polarised capacitors. If you are happy that all is in order, continue with the testing of the unit.

Testing of the unit is simple and should not take more than about 10 minutes. Start by closing the power switch, noting that there are no LEDs on and that there is no sound coming from the speaker. Should a LED be lit up,

We estimate that the current cost of parts for this project is approximately

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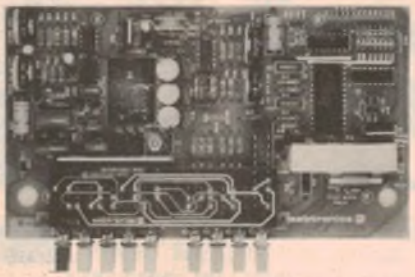

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DC Volts: 100μV to 1000V in 5 ranges
AC Volts: 100μV to 1000V in 5 ranges
DC Current: 0.1μA to 10 A in 6 ranges
AC Current: 0.1μA to 10 A in 6 ranges
Resistance: 0.1Ω to 20 MΩ in 6 ranges
Diode Test Current: 0.1μA, 10μA, 1mA
ACV Frequency Response: 40Hz to 40kHz
Input Impedance: 10 MΩ on ACV and DCV
Overload Protection: 1200 VDC or RMS on all voltage ranges except 250 VDC or RMS on 200mV and 2V AC ranges. Fuse protected on ohms and mA ranges.
Power Requirement: 4.5 to 6.5 VDC (4 "C" cells) optional NiCd batteries or AC adapter/charger
Display: 0.36" (9.2mm) Digits reading to ±1999
Size: 8"W x 6.5"D x 3"H (203 x 165 x 76 mm)
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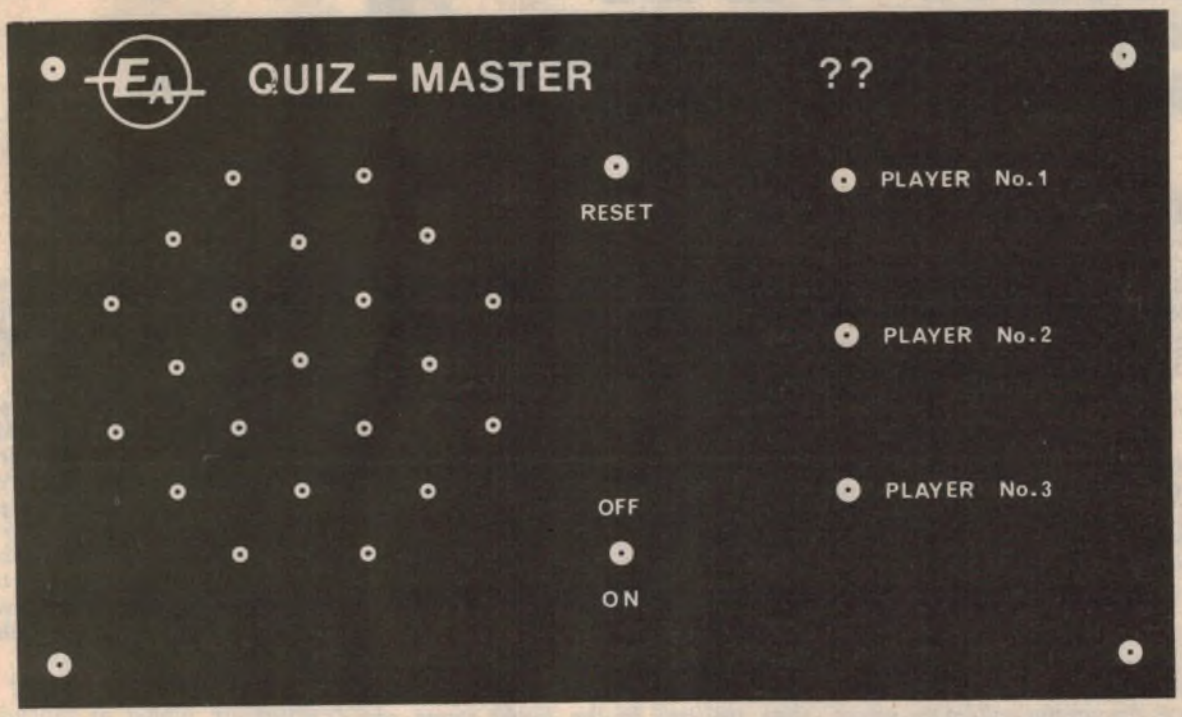


Here are actual size reproductions of the front panel artwork and the PC pattern.

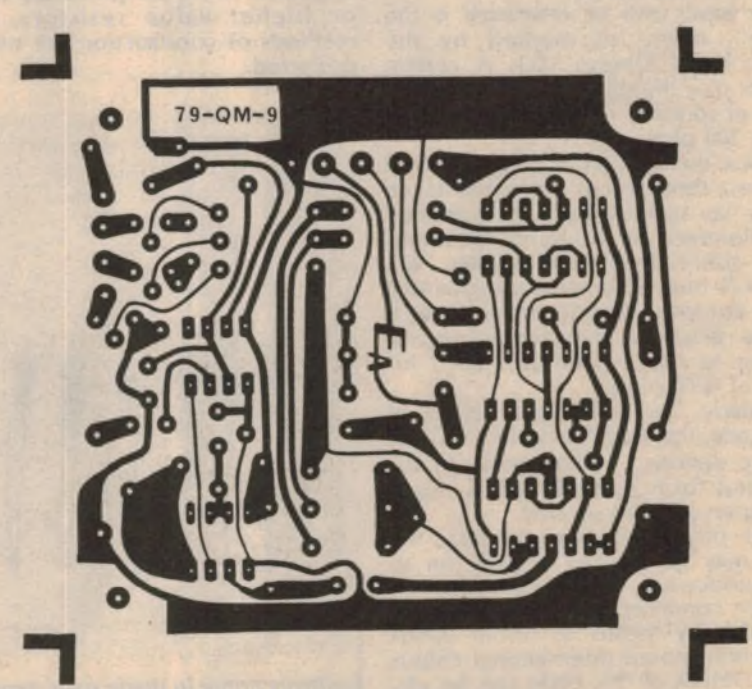
PARTS LIST

SEMICONDUCTORS
2 4001 CMOS ICs.
1 4025 CMOS IC
2 555 timer ICs
3 BC548 NPN transistors
3 1N914 diodes
3 red LEDs

RESISTORS
6 47k ¼W 5%
1 1k ¼W 5%
3 10k ¼W 5%
1 39k ¼W 5%
1 68k ¼W 5%
1 100k ¼W 5%

CAPACITORS
2 .01uF LV polyester
2 10uF 25V tantalum
1 1000uF 16V electrolytic
1 printed circuit board code 79QM9
4 momentary contact pushbuttons
3 RCA panel mount audio connector sockets
3 RCA plugs
1 single pole miniature toggle switch
1 miniature eight ohm loudspeaker
1 plastic "zippy box" 150 x 90 x 50mm

MISCELLANEOUS
Battery clip and holder, wire, solder, screws, nuts, bezels for LEDs, glue etc.



press the reset button and see that the LED goes out.

Now, press the button for the first player. You should see the LED for player No. 1 light up, and you should also be able to hear a tone coming from the speaker, the duration of which should be approximately half a second. Pressing the buttons for players two and three should not have any effect on the unit. Now, press the reset button and the LED should go out. Repeat the same procedure this time with button No. 2, and then finally with button No. 3.

If all the functions appear to work properly, then chances are that nothing is wrong, leaving only one thing to be done: to close up the box. You could also perhaps give yourself a small pat on the back, for another project successfully finished!

Know Your Components

Resistance and Resistors

Resistors are among the commonest, and often the cheapest, components used in electronic equipment. Without getting involved in obscure theory, here are a few basic facts about resistors, which might assist newcomers to the hobby.

As the term implies, the basic role of a resistor is to "resist" the flow of current through an electrical circuit; not to prevent current flow altogether, but to resist, or impede, or limit current flow to a degree required by the circuit design.

The degree to which a resistor may do this is signified by its "resistance". Fairly obviously, the higher the value of resistance, the greater will be the effect or limitation on current flow through the circuit concerned.

The basic unit of resistance is the "ohm", often represented by the Greek letter Omega (Ω). A certain resistor may therefore be said to have a value of so many ohms; eg, 1 ohm, 10 ohms, 100 ohms, etc.

Where the number of ohms involved rises to a thousand or more, resistance values can conveniently be expressed in "kilohms", or thousands of ohms, often abbreviated to the letter "k". Thus 4.7k means the same thing as 4700 ohms. European practice is to put the k in the place of the decimal point, leading to the expression "4k7", instead of 4700 ohms.

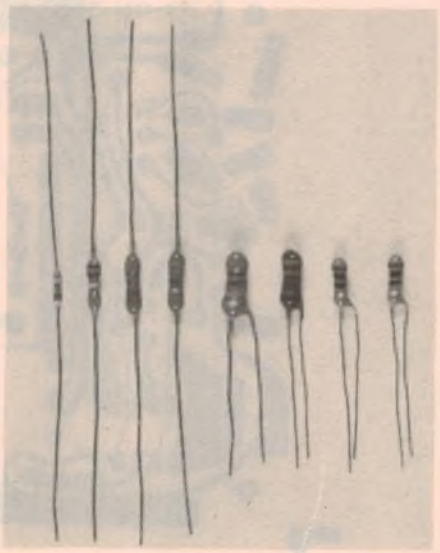
Similarly, for still larger values of resistance, the term "megohm" can be used to denote 1 million ohms. In abbreviated form 4,700,000 ohms might be written as 4.7M or 4M7.

With physically large resistors, the value may be printed directly on to their surface but, with small resistors, it is more common practice to indicate the value by means of colour bands conforming to an international colour code. Details of this code can be obtained from various electronics textbooks, including our own publication "Basic Electronics".

Resistors have a central body, which accommodates the resistance element, with a tinned copper lead at each end so that it can readily be soldered into a circuit. The body is normally encapsulated, or coated with lacquer or vitreous enamel to provide some degree of protection and insulation, and to limit the ingress of moisture.

In so-called "wire-wound" resistors, the current has to pass through a coil of resistance wire, wound on the central body between the two pigtails. The finer and longer the wire in the coil, and the higher the natural resistance of the particular metal or alloy involved, the higher will be the overall resistance of the component.

In practice, wire wound construction lends itself best to more bulky, heavy duty resistors in the lower range of values — say, from a few ohms to a few thousand ohms. For physically smaller, or higher value resistors, other methods of construction are normally preferred.



Resistors come in many sizes, types and styles. These are miniature carbon film types.

For example, in a conventional (and traditional) "carbon resistor, the body between the pigtails is a rod moulded from a mix of finely divided carbon particles and a non-conducting binder. The actual resistance is largely dependant on the ratio of carbon to insulator in the mix. Carbon resistors are cheap, and can be made to a wide variety of sizes and resistance values. However, they are difficult to mass produce to target figures and may change value due to heat, moisture and ageing. For this reason, they are not favoured nowadays.

In "carbon film" resistors, a carbon mix is deposited on the surface of a glass or ceramic rod. By then grinding a spiral in the deposit, to increase the effective length of the carbon path, the resistance can be adjusted to the required value. In general, carbon film resistors can be manufactured to within smaller tolerances and they will hold that value better than the moulded carbon types mentioned earlier.

"Metal film" or "metal oxide" resistors are similar in concept to the carbon film type but use a metallic rather than a carbon based material as the conductor. They are generally more accurate, more stable — and more expensive!

To rationalise production and application, resistors are normally manufactured to values which look odd at first glance. In fact, the so-called "preferred" range has been worked out mathematically to meet the anticipated needs of circuit designer, with the minimum number of different values.

Resistor values most commonly encountered in electronic circuitry are based on the series 1.0, 1.2, 1.5, 1.8, 2.2, 2.7, 3.3, 3.9, 4.7, 5.6, 6.8 and 8.2. Resistors are commonly sold marked in those numbers of ohms. in the next decade, the values run: 10, 12, 15, 18, 22, 27, 33, 39, 47, 68 and 82 ohms. So on through the decades to at least 10 megohms.

It is normal practice to design circuits around values from the abovementioned range. It is also usual to specify that the resistors shall have a maximum tolerance of 5% or 10% — ie, the actual resistance will not differ from the marked value by more than plus or minus 5% (or 10%, if specified). If the circuit design requires closer tolerances or in-between values, these can usually be obtained at extra cost.

As well as being manufactured to specified tolerances, resistors also have a specified maximum power dissipation which is rated in watts or fractions of a watt, depending on their design and size. This rating should not be exceeded otherwise the life of the resistor will be seriously shortened.

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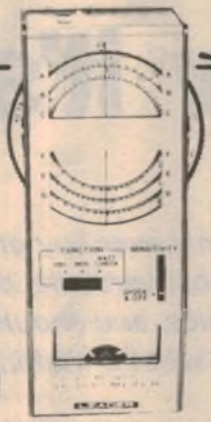

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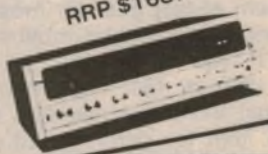

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PRACTICAL ELECTRONICS

The multimeter and how it's used

Many electronics hobbyists only ever buy one item of test equipment — a multimeter. This is the most versatile, cost-effective piece of test gear ever devised for electronics, and should be considered as an essential item. So let's find out what a multimeter is, and see how it is used.

by GREG SWAIN

Many people think that to get involved in electronics you have to buy a lot of expensive test gear. That, fortunately is not true. There's just one essential item of test gear for most hobbyists, and that's a good multimeter.

Even if you never buy or make another item of test equipment, you really must have a multimeter. It's an essential item for carrying out all the basic checks required in building and, if necessary, troubleshooting electronic equipment.

These various checks include making continuity tests, checking resistor values, and performing voltage measurements. You can check the voltage of a power supply rail, for example, to make sure that its value is correct. And, of course, if an assembled project does not work properly, a multimeter will prove invaluable in tracking down the cause of the trouble.

What's a multimeter?

Let's back up a little and find out what a multimeter is.

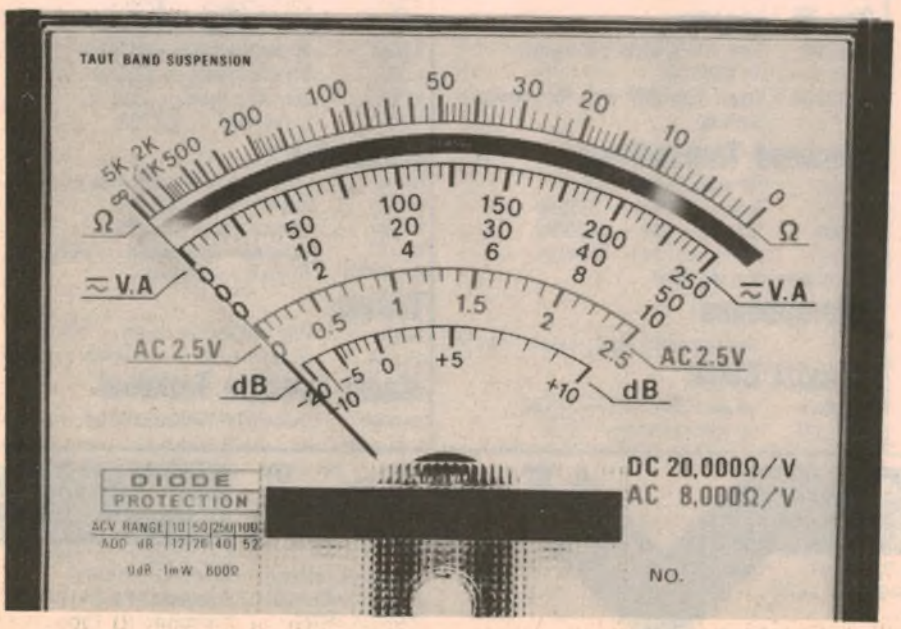
A multimeter is a multi-purpose test instrument that can measure AC and DC voltages, direct current (at least) and electrical resistance, in several overlapping ranges. For this reason, it is often also called a volt-ohm-milliammeter, or VOM for short.

In its most common form, a multimeter consists of a sensitive moving-coil meter movement fitted to a moulded plastic case. The face of the meter is covered with several different voltage, current and resistance scales, arranged in a series of concentric arcs and suitably calibrated. These are sometimes printed in different colours to make it easier to tell which scale is which.

Situated below the meter is a multi-position switch, together with various minor controls and a number of input terminals into which the test leads are plugged. The purpose of the multi-position switch is to allow the user to select the operating mode and the measurement range he or she requires. A typical multimeter has between 15 and 30 different ranges to choose from.

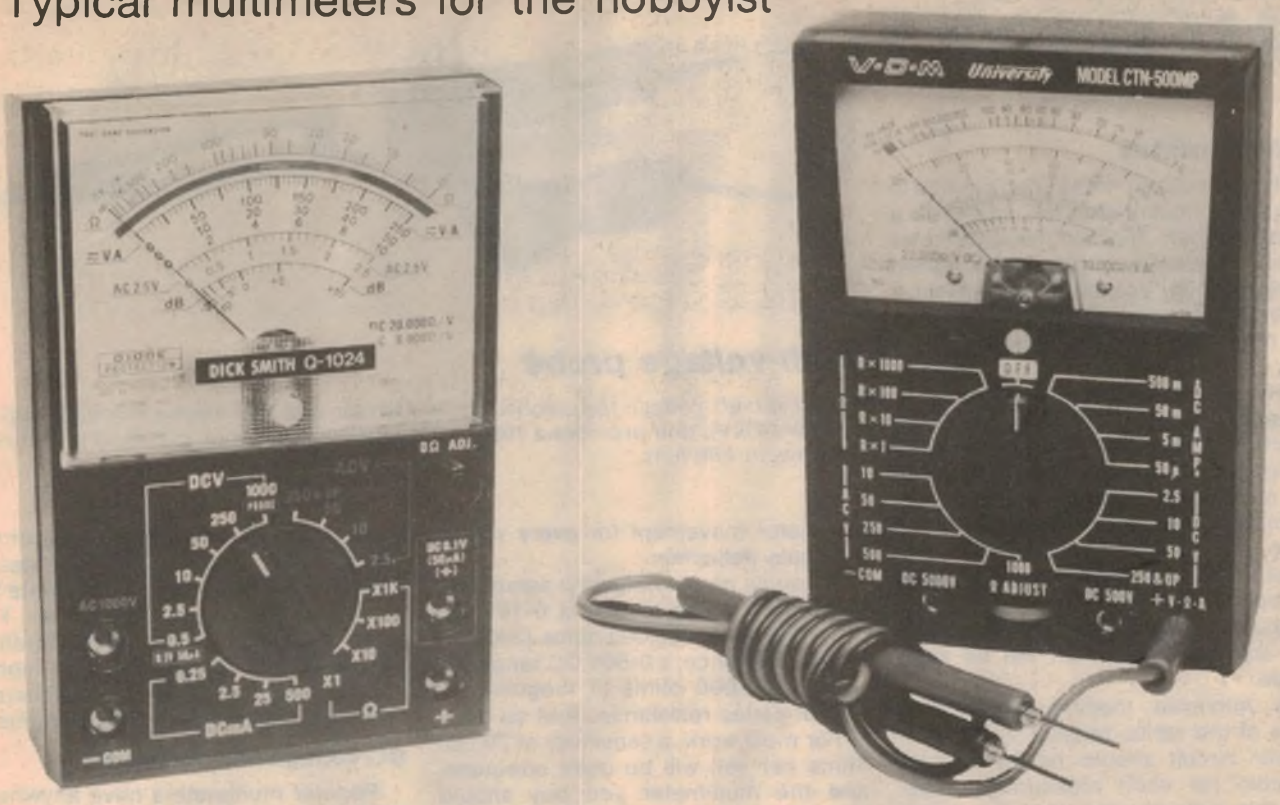
OK, so how does a meter that indicates current flow also indicate AC and DC voltages and measure resistance?

The answer is that inside the multimeter are some cleverly contrived circuits that convert voltage and resistance values into tiny electrical currents that the meter can measure. When you select a specific voltage, current or resistance range by means



This close-up view clearly shows the scale markings on a typical multimeter. The mirror strip is provided to eliminate parallax errors when reading the meter.

Typical multimeters for the hobbyist



Featuring almost identical specifications, the Dick Smith Q-1024 (left) and the University Model CTN-500MP are ideal multimeters for the hobbyist. Both offer 20,000 ohms per volt sensitivity on the DC voltage ranges, are supplied complete with batteries and test leads, and cost less than $30.

The Dick Smith Q-1024 has 21 measuring ranges as follows: DC voltage 0.1, 0.5, 2.5, 10, 250 and 1000V; AC voltage 2.5, 10, 50, 250 and 1000V; direct current 50uA, 0.25mA, 2.5mA, 25mA and 500mA; resistance (ohms) R x 1, R x 10, R x 100 and R x 1000.

The University Model CTN-500MP has 19 measuring ranges and an "OFF" position which applies damping to the meter movement when the unit is not being used. The ranges are: DC voltage 2.5, 10, 50, 250, 500 and 5000V; AC voltage 10, 50, 250, 500 and 1000V; direct current 50uA, 5mA, 50mA and 500mA; resistance R x 1, R x 10, R x 100, R x 1000.

The Dick Smith Q-1024 is available from Dick Smith Electronics, PO Box 747, Crows Nest 2065; the University Model CTN-500MP from Radio Despatch Service, 869 George St, Sydney 2000.

of the multi-position switch, you actually connect a specific circuit between the multimeter's test leads and the meter movement.

The circuits themselves are surprisingly simple, and consist mainly of various fixed-value resistor networks. These resistor circuits are connected both directly across the meter terminals and in series with the meter to allow the various measurements to be made. A rectifier circuit, made up from a pair of diodes, is also included to allow AC voltage measurements.

The input terminals

The input terminals of a multimeter are usually recessed "banana" sockets. These accept the banana plugs connected to the ends of the test leads, and allow the test leads to be easily connected to the multimeter. The banana sockets are recessed into plastic moulding for a good reason — to stop you from inadvertently receiving a shock when measuring high voltages.

Typical multimeters have between three and five terminals on the front panel, but only two are used for most measurements. One is usually marked "—COM", and accepts the black test lead. The second is usually marked "+V. Ω .A" (or "+INPUT"), and accepts the red test lead.

The remaining input terminals are high voltage and/or high current input terminals. They are always clearly marked with the voltage (or current) range they measure, and should be used whenever measurements are likely to exceed the ranges normally selected by the multi-position switch.

Note that for voltages up to about 500V, the red test lead supplied with the multimeter can be used. Voltages above this figure generally require the use of a special high voltage test probe.

You will seldom, if ever, use the high voltage input terminals — at least not for hobby work. The average hobbyist, in fact, rarely encounters DC voltages above 50V!

Ohms adjust control

All multimeters have an "Ohms Adjust" (or "Ohms Calibrate") control. Its purpose is to compensate for slight variations in the output voltage of the multimeter's internal batteries, and is used only when making resistance measurements.

The Ohms Adjust control is actually a variable resistor in series with the meter movement, and must be adjusted so that the meter reads full scale when the test leads are short-circuited together. It should be used to set the meter for full scale deflection whenever you switch to a resistance range for the first time, and each time you switch to a different resistance range.

In case you're wondering, the multimeter's internal batteries supply power to the meter movement only for resistance measurements. When voltage or current measurements are made, power is supplied to the meter movement by the circuit being measured.

High-voltage probe

A typical high voltage test probe. This particular unit can measure voltages up to 45,000V (45kV), and provides a 1000 to 1 attenuation of input signals to give direct readings in kilovolts.

Meter sensitivity

The DC voltage-measuring circuits in all normal multimeters are based on a simple series resistor/microammeter circuit. When you switch to a different voltage range, you effectively select a different value series resistor to change the meter's full-scale voltage calibration.

When a multimeter is used to measure voltage, its very presence effects the operation of the circuit it is trying to measure. The degree to which the multimeter "loads" (draws power from) the circuit depends mainly on the value of the series resistor in the meter circuit. If loading becomes significant, the operating conditions of the circuit being measured will be greatly altered and any readings taken will be inaccurate.

To minimise loading effects, the value of the series resistor in the multimeter circuit should be as high as possible for each measuring range, and this calls for the use of a highly sensitive meter movement. Most popular multimeters employ a microammeter with a full-scale sensitivity of 50 microamperes (50uA); ie, a current of 50uA must be passed through the meter movement to deflect the pointer full-scale.

The sensitivity of the multimeter itself generally will be specified in terms of an ohms-per-volt value. Assuming the use of a 50uA meter movement, the multimeter will have a sensitivity of 20,000 ohms per volt for its DC voltage ranges. This means that there are 20,000 ohms of resistance in series with the meter movement for every volt of full-scale deflection.

A couple of examples will serve to illustrate what this means: a 0-10V DC range will have 200,000 ohms (200k) of series resistance; a 0-50V DC range will have 1,000,000 ohms (1 megohm, or 1M) of series resistance. And so on.

For most work, a sensitivity of 20,000 ohms per volt will be quite adequate, and the multimeter you buy should have this sort of specification (or better). Don't buy a very cheap multimeter with a 0-1mA meter movement. It will load down the circuits it measures much more than a 20,000 ohms per volt instrument, and will be quite unsuitable for work on modern electronic circuits.

The sensitivity for the AC voltage ranges is also specified in terms of ohms per volt. This is always less than the sensitivity for the DC voltage ranges, a typical figure being 5000 ohms per volt.

A somewhat different situation applies to digital multimeters. These usually have a constant input resistance of around 10 megohms (10,000,000 ohms) for all DC ranges, a figure which is more than adequate for most measurement situations. The main drawback of digital multimeters has to do with their somewhat higher cost when compared to multimeters with conventional meter movements.

DC voltage measurements

Popular multimeters have anywhere from four to eight overlapping DC voltage ranges. A typical unit, the University Model CTN-500MP, has six ranges for example: 0-2.5V; 0-10V; 0-50V; 0-250V; and 0-500V. The high voltage input terminals must be used for measurements on the last two ranges.

Why so many different ranges? The answer is that you will have an appropriate measuring scale at your disposal for any of the widely ranging voltages found in electronic equipment. It's obvious that you can't use a low voltage range to measure a high DC voltage — the meter will "slam" full scale, and could even be damaged, if you try. On the other hand, you shouldn't use a high voltage range to measure a low DC voltage — you will not be able to read the scale accurately enough.

Added to this is the problem of the meter's inherent accuracy. The voltage and current ranges of most popular multimeters are only accurate to within ±1% or ±2% of the meter's full scale reading. If we select the 0-to-250V range, for example, the voltage measurement will only be accurate to ±5V (assuming a meter accuracy of ±2%).

So you can see that it doesn't make much sense to try to measure a 1.5V

The Fluke 8022A from John Fluke Manufacturing Company Inc., USA, features a 3½-digit LCD readout, has 24 ranges, and measures DC volts, AC volts, DC and AC current, and resistance. Enquiries to Elmeasco Instruments Pty Ltd, PO Box 30, Concord, NSW 2137.

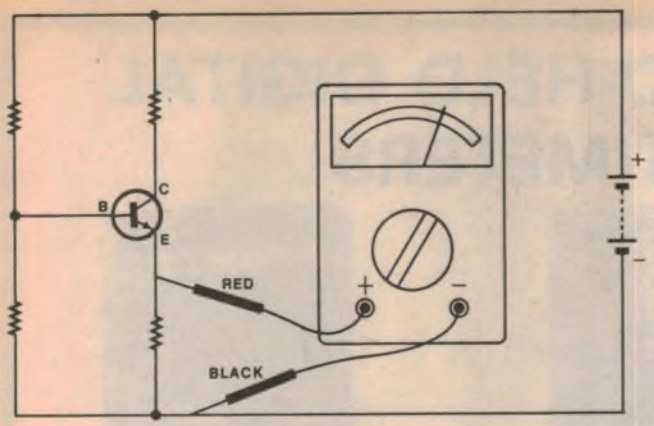


FIG. 1

How a multimeter is used to measure voltage. The red test lead connects to the more positive side of the circuit.

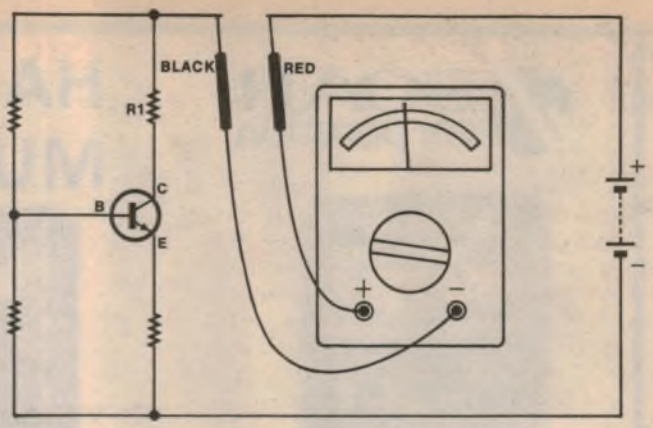


FIG. 2

Current measurements are made by breaking the circuit and connecting the multimeter in series across the break.

battery on the 0-to-250V range — the meter's allowable accuracy would be greater than the voltage you are trying to measure!

The best range for voltage measurement is the one which comes closest to giving a full scale reading, without the meter going off scale (or overloading). The correct technique is to first set the range switch to a voltage range which is known to be higher than the voltage to be measured. The test leads are then connected to the circuit under test, and the best range selected by switching down.

If you have no idea of the value of the voltage you are trying to measure, then initially the highest voltage range should be selected.

What if you inadvertently overload the meter by selecting a voltage range that's too low? Well, most meter movements will withstand a momentary 10-times overload — any more than that and you could damage the meter and/or other components in the multimeter.

To explain further, let's say that the multimeter is switched to the 0-to-2.5V range. A voltage of 25V applied to the test leads will not damage the multimeter, provided the overload is removed immediately.

The same comments regarding meter overload apply to the direct current and AC voltage ranges (but not to the resistance ranges). Note, too, that some multimeters include protective diodes across the meter which limit the maximum overload that can be applied to the meter movement. However, this does not prevent the diodes themselves and/or other components from being damaged in cases of gross overload — it merely serves to protect the meter.

Taking a voltage measurement is easy. To measure the voltage between any two points, you simply select the correct voltage range and connect the test leads to those points. The voltage reading is then read directly off the appropriate meter scale.

There's just one proviso — the test leads must be connected to the circuit the right way round. The rule is that the red test lead is always connected to the more positive side of the circuit. If the leads are connected the wrong way round, the meter will attempt to read backwards (this will not damage the meter).

Fig. 1 shows how a multimeter is used in a typical voltage measurement situation — in this case, to measure the voltage between the emitter of a transistor and the negative supply rail. As you can see, all you have to do is connect the test leads directly to the circuit. The red test lead (+) is connected to the emitter, since this is more positive than the negative supply rail.

The power supply voltage for the same circuit is measured in a similar fashion. The only difference is that the red test lead now has to be connected to the positive supply rail. The black test lead is connected to the negative supply rail as before.

What if you wanted to measure the voltage between the collector and emitter of the transistor in Fig. 1? It's quite simple — just connect the multimeter's test leads directly to the transistor leads. The red test lead would be connected to the collector, while the black test lead would go to the emitter.

Other common DC voltage measurements include: measuring voltages across resistors and capacitors, checking transistor base to emitter voltages, checking battery voltages, and checking voltages on an assembled electronic project against those marked on the circuit diagram.

Note that unless otherwise stated, all voltages marked on an electronic circuit are taken with respect to chassis, or the negative supply rail. These voltages are often included on circuit diagrams to guide construction and as an aid to troubleshooting.

AC voltage measurements

AC voltages are measured in much the same way as DC voltages — that is, by connecting the test leads directly to the circuit under test and switching down to the appropriate range. But there's one important difference: it doesn't matter which way round the test leads are connected!

Most popular multimeters have four or five AC voltage ranges, and can measure up to 1000V AC. It may be as well to point out here that a multimeter actually measures a special kind of "average" AC voltage called the RMS (root-mean-square) voltage, rather than the peak AC voltage. In a nutshell,

The Soar ME-523 deigital multimeter is sold by Radio Despatch Service. Like the Fluke 8022A it features a 3½-digit liquid crystal display and has automatic zero adjustment and polarity indication.

SOAR corporation

HAND-HELD DIGITAL MULTIMETERS

Specifications

General Specifications
Display: Liquid crystal display
Maximum indication: 1999 or — 1999
Measuring mode: DC V, AC V, DC mA, AC mA, and OHMS.
Measuring range: 5-range change-over in each mode.
Polarity: Automatic, negative polarity indication.
Zero adjustment: Automatic
Overrange indication: the top of digit position of (1) or (—1) is displayed.

Specifications

General Specifications
Display: Liquid Crystal Display
Maximum indication: 1999 or — 1999
Measuring mode: DC V, AC V, DC mA, AC mA, OHMS.
Measuring range: 5- ange change-over in each mode.
Polarity: Automa ic, negative polarity indication.
Zero adjustment: Automatic
Overrange indication: The top of digit of (1) or (-1) is displayed.

Specifications

Display: 7 segment LED
Maximum indication: 1999 or — 1999
Measuring mode: DC V, AC V, DC mA, AC mA and ohms
Measuring range: 5 ranges of resistance mode and 4 ranges in the other modes.
Polarity: Automatic, negative polarityindication.
Zero adjustment: Automatic
Overrange indication: the top of digit of (1) or (—1) is displayed.

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6.	Number of columns	80 column
7.	Character spacing	10 CPI (Enlarged character printing is available)
8.	Line spacing	6 LPI
9.	Paper width	Width from 4.5 inch to 9.5 inch (including sprocket margin)
10.	Number of Copies	Original+3 copies nominal (max. total thickness 0.013 inch)
11.	Paper feed method	Pin feed
12.	Ribbon	13mm width, purple color
13.	Operating temperature	10°C — 35°C (50°F — 95°F)
14.	Operating humidity	10% — 80% (Non condensed)
15.	Power input	115VAC ± 10%/60HZ 220 or 240 VAC ± 10%/50Hz available
16.	Power Consumption	Printing 100W Non printing 7W
17.	Dimension	approx. 449 (W) x 375(D) x 185(H) mm
18.	Weight	approx. 10Kg

—The above specifications may be changed without prior notice —

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Above: a selection of clip-on test probes. They can be clipped directly to the circuit under test, leaving the hands free for other tasks.

Right: the Kamoden 360-TRCX features an input impedance of 100,000 ohms per volt and offers bipolar transistor and capacitor testing. The unit pictured came from Radio Despatch Service; Dick Smith Electronics sell an equivalent model.

the RMS voltage is the numerical value of AC voltage that is as effective in doing work (eg, lighting a light bulb) as the corresponding value DC voltage.

Virtually all AC voltages, including mains voltages, are specified by their RMS value. So when we talk about the mains wiring in our homes as being 240V AC, we really mean 240V RMS.

The AC voltage ranges are most frequently used to measure transformer secondary voltages. Mains voltages may also be checked, but this (and any other high voltage measurement) calls for extreme caution to avoid the possibility of an electric shock.

Current measurements

The majority of direct currents flowing inside electronic equipment range from a few tenths of a milliampere (thousandths of an ampere) to 500 milliamperes (500mA). This means that a four- or five-range instrument capable of measuring up to 500mA is sufficient for most practical electronic work. The University Model CTN-500MP mentioned previously has four current ranges: 0-50uA; 0-5mA; 0-50mA; and 0-500mA.

A few multimeters (generally the more expensive ones) include a 0-10A scale as well. You'll rarely use this range unless you service automotive gear.

Unlike voltage (and resistance measurements), current measurements require a slight modification to the circuit under test. Basically, to measure the current drawn by a circuit, the power supply rail to the circuit must be broken and the multimeter connected in series across the break.

Fig. 2 shows the basic idea. As with DC voltage measurements, a multimeter is polarity conscious when measuring direct currents. The test leads must be connected the right way round, with the red test lead going to the more positive side of the circuit. As before, the best range is the one that comes closest to giving a full-scale reading, without overloading the meter movement.

Of course, current measurements aren't just limited to the situation shown in Fig. 2. We might, for example, only want to measure the current drawn by a certain circuit stage. A typical situation is where the current drawn by the output stage of an audio amplifier must be monitored in order to make circuit adjustments.

Referring back to Fig. 2, let's say that you want to measure the collector current drawn by the transistor. This simply involves breaking the circuit between the collector of the transistor and resistor R1. The multimeter is then connected across the break, with the red test lead going to the resistor.

Alternatively, you could connect the multimeter between the other end of resistor R1 and the positive supply rail. The reading will be exactly the same as in the previous case.

Resistance measurements

Most multimeters have four or five resistance ranges, each scaled by a factor of 10. A typical unit has four resistance ranges: R x 1, R x 10, R x 100, and R x 1000. The numbers 1, 10, 100 and 1000 are the range multipliers. This means that every marking on the resistance scale is effectively multiplied by 10 when the range switch is set to R x 10; by 100 when set to R x 100; and by 1000 when set to R x 1000.

If you look at the resistance scale on a multimeter, you will notice that it is not linear; the high resistance marks are crammed tightly together near the bottom end of the scale, while the low resistance calibrations are spread out near the top end of the scale. Both ends of this scale should be avoided when taking resistance measurements.

It's no good trying to measure high value resistors with the range switch set to a low resistance range, for example. The readings at the bottom end of the scale are just too closely crowded together for an accurate reading to be taken. At the other extreme, it's no

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good trying to measure low value resistors with the range switch set to a high resistance range. In this situation, the meter will swing almost full scale and will be quite insensitive to large variations in resistor value.

What you have to try to do, in setting the range switch, is to get the meter to read towards the centre region of the scale. It is only in this region that you will be able to accurately measure resistor values. Of course, if you are measuring very high value or very low value resistors, then you may have no option but to take readings from the ends of the scale.

Fig. 3 shows how a multimeter is used to measure the value of a resistor.

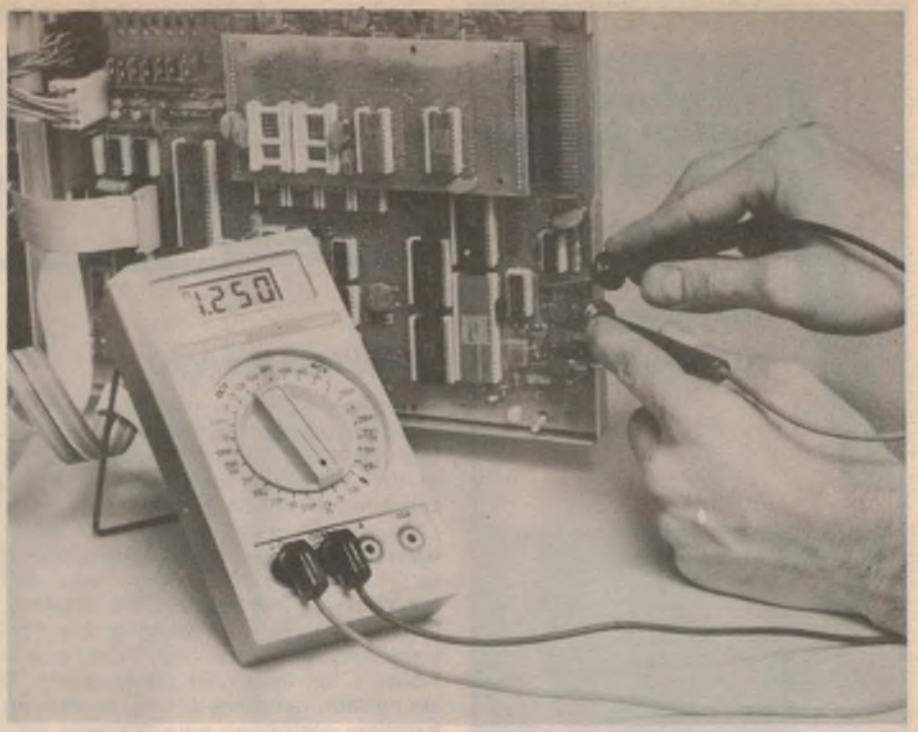
The first step is to set the multi-position switch to the appropriate resistance range, short the test leads, and zero the meter using the Ohms Adjust control, as described previously. The multimeter's test leads are then connected to the resistor, and the indicated value read off the ohms scale of the meter. Multiplying this value by the range multiplier gives the value of the resistor in ohms.

That's really not as complicated as it sounds! Let's say, for example, that the resistor we are measuring has a value of 1000 ohms (or 1k). The best range to select in this case is the "R x 10" range, meaning that we have to multiply the reading on the meter scale by 10. The meter will read "100" and 10 x 100 equals, 1000 ohms — the value of our resistor.

The best advice is buy a handful of resistors, work out their values from their colour codes, and check them with your multimeter. You'll soon get the hang of things.

Resistance measurements are not just confined to measuring resistor values, though. You can also use your multimeter to check other components — checking capacitors for short circuits, for example — and to check the resistance between any two points of an assembled circuit. Make sure that no power is applied to the circuit when making these checks, otherwise your readings will be hopelessly inaccurate.

Another thing to remember here is that it is not possible to check accurately the value of a resistor that has been soldered into circuit. The reading will be considerably affected by the presence of other components, both active and passive, shunting the component to be measured. The only way round this problem is to disconnect one lead of the resistor from the circuit. Its value can then be measured in the normal way.



The Beckman Model 3020 3½-digit LCD multimeter features 0.1% accuracy on DC voltage ranges, a 10A current range, and a diode test function. It is fully overload protected up to 1500V DC and 1000V AC. Enquiries to Warburton Franki Pty Ltd, 199 Parramatta Rd, Auburn 2144.

Continuity checks

Switching to one of the low ohms ranges — R x 1 or R x 10 — enables you to use your multimeter as a continuity checker. In fact, you will probably use your multimeter as a continuity checker more often than for any other job.

When you test for continuity, you are simply checking to see whether or not two points are directly connected together by a copper track, a length of hook-up wire, or by some other very low resistance path. If the two points are directly connected, then the meter will read full scale, or zero ohms, the same as when you short the two test leads together. If the two points are open circuit (ie, not connected), then the meter will read infinity.

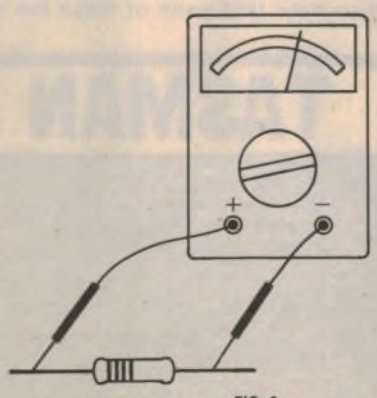


FIG. 3

How to measure resistance. Just connect the test probes across the circuit to be measured and select the best range.

Here are just some of the useful tests that can be performed:

- making sure that a transformer frame is properly connected to earth (chassis);
- tracing wires in a multi-core cable;
- checking wires, cables and copper tracks for breaks;
- checking newly installed mains wiring for inadvertent shorts;
- identifying connector terminals;
- checking that circuits are properly earthed;
- checking switch action; and
- general troubleshooting.

Buying a multimeter

Most multimeters cost somewhere between $20 and $80, although a digital multimeter can cost well over $100. The average hobbyist spends somewhere between $25 and $35 on a multimeter, and a model chosen from this price range will be quite adequate for most hobby work. Specifications for two models chosen from this price range, the University Model CTN-500MP and the Dick Smith Q-1024, are given on the second page of this chapter.

So that's the multimeter — a versatile test instrument that is a voltmeter, an ammeter, and an ohmmeter all rolled into one. Buy one as early as you can and learn how to use it; your money will be well spent.

Letters to the editor

Beryllium danger

I wish to draw your attention to an article that appeared in the radio amateur journal "QST" July 1978, which warns of the extremely toxic nature of the substance Beryllium Oxide.

As well as those applications mentioned in the article, beryllium oxide is to be found in commonly used RF power transistors (e.g. 2N5590, 2N6084, B40-12 etc). Some mounting kits for transistors also use beryllium oxide washers for improved conductivity. I am certain that there are many persons handling such items who are quite unaware of the dangers involved. Unfortunately the use of beryllium oxide (BeO) seems to be widespread.

Recently I came across an item in the 1979 Dick Smith catalog. This warned that one of their products, Heat Transfer Compound, happened to contain BeO. If this is in fact so, and if other brands of heatsink compound also contain BeO, it would appear that a very real health hazard exists to any persons involved with the maintenance or construction of electronic equipment. As you are no doubt aware, heatsink compound being in the form of a grease, is a rather messy substance to use, and even if care is taken it is difficult to keep from coming into physical contact with it. This could result in traces of it being taken internally, with possible disastrous consequences.

Up till now, I have seen four different brands of heatsink compound available on the market — one contains BeO, the others may or may not, but it is significant to note that none of these has so much as a word of warning labelled on it. I find this type of situation deplorable, especially when one considers that other products on the market, far less toxic than BeO, have warning labels on them.

I hope that you will be able to pass this information on to your readers so that they will be aware of the dangers in handling beryllium oxide. I would suggest that any project you may publish which makes use of this substance in any form also contain a suitable warning.

E. J. Smeda VK3YNM
Eltham, Victoria.

CDI problems

With reference to the problem encountered by G.O. of North Mackay, Queensland, when using a CDI unit with a V8 motor, I would like to put forward the following points.

(1) Provided spark plug leads are adequately spaced to prevent crossfiring, CDI systems generally offer the same advantages to V8 motors that they offer to six cylinder motors.

(2) The symptoms G.O. describes have been caused in my experience by either of two problems. Firstly, the 1000uF electrolytic filter capacitor in the inverter circuit breaks down because it is unable to handle the current spikes generated whilst the inverter is running. Secondly, the "dump" capacitors fitted must be of the correct type, preferrably Metalised Polycarbonate. Polyester capacitors such as "greencaps" have in my experience been unsuccessful.

As I have repaired many of these kits,

some with these faults, the information above should be of some assistance.

G. Crapp
Service Manager,
Dick Smith Electronics
Artarmon, NSW.

Cigarette advert

I was shocked to see a cigarette commercial in the August 1979 issue of what I know to be an electronics magazine of no small repute, Electronics Australia.

To my knowledge this is the first time an "alien" advertisement has been included. I have all copies from Vol 1 No. 1 of Radio and Hobbies — over 40 years, I think it must be something of a record. I have built many of the projects, and they've usually worked too! The latest is the 40+40 Amplifier and speakers.

I fear I am a lone voice crying in the wilderness in these days of "why bother?" but I sincerely trust you will at least consider devoting the magazine solely to electronics and its related components.

The offending advertisement is attached hereto — I don't want it. If necessary I would be prepared to pay more for the magazine if it would mean "NO" to such advertisements.

I trust you will at least read the above before consigning it to the waste paper basket. At least I cared enough to write!

Chas Fletcher
Toongabbie West, NSW.

Program mod

Here is a small modification to your Line Assembler program which may be of interest. It causes the line input routine to print a backspace instead of the incorrect character in response to the rubout key being pressed. This is more useful (and neater) if you are using a VDU rather than a printer.

```
1ADB A7 01 SUBI,R3 01
1ADD 1A 6E BCTR,N LINE
1ADF 04 08 LODI, R0 08 (BACKSPACE)
```

The rest remains the same. Location 1AD8 could be changed to H'08 in order to use the backspace key for error correction.

I also have a minor complaint about the program, and that is the use of the ZBSR instruction when calling "PIPBUG" subroutines, in particular "COUT" (ZBSR *20). This makes it very difficult to use a different subroutine. (e.g. to operate a VDU at 1200 baud). Apart from this, I find the program most useful, and have spent many hours using it.

Ian Crawford, VK5ZDB
Smithfield Plains, SA.

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REVIEWS OF RECENT

Records & Tapes

CLASSICAL ● POPULAR ● SPECIAL INTEREST

Mozart Quartets: "worthy of . . . attention"

MOZART: Six String Quartets dedicated to Haydn: K387, in G; K421 in D minor; K428 in E flat; K458 in B flat ("The Hunt"); K464 in A; K465 in C ("Dissonance"). Quartetto Italiano.

Philips 6998 (three Stereo discs, boxed). (P.F.)

The Italian Quartet is an ensemble of remarkable staying power. Their first recordings were made in the late forties; the four fine musicians constituting the group were drawn together in 1945, and when I heard them in Venice last year they sounded as fresh and excited by their repertoire as ever. They have played Mozart quartets for many years — the first to be heard here, monophonic LP's, were released by Columbia about 1961; several of the quartets have been recorded by them more than once, always beautifully and with excellent taste.

The six quartets in this set were written between 1782 and 1785, when Mozart humbly proferred them to Haydn; they are, generally, well enough known to require no commentary. What they do require, now as always, is thoughtful performances and careful listening. The performances recorded by Philips and now re-issued in this attractive form date from 1967, when they were rivalled by similarly distinguished readings by the Amadeus and Juilliard Quartets, which have since been deleted. More than a decade later, there are fine performances by the Guarneri and the Melos Quartets which are very highly thought of and it may well be that both the RCA and the DG sets are superior technically — my own mind is not made up about this.

What I am quite certain about, on the other hand, is the musical quality of these performances. Tempi are a trifle faster, generally, than those adopted by the Italians in the earlier efforts, but the music moves correctly, at breathing pace and the utmost care has been taken to allow the composer's voice to be heard, untrammeled by any "interpretation" which, all too often, is just a polite name for a performer's convenience. The performances and the recorded sound are very beautiful indeed and worthy of every collector's attention. (P.F.)

☆ ☆ ☆

BACH: The Four Suites for Orchestra. English Chamber Orchestra, conductor Raymond Leppard. Philips 6768 028 (two Stereo discs, boxed).

Presumably, individual recordings featuring these performances have been available before now, but I never saw or heard them. In addition to the ECO, there is a long and impressive list of soloists, including oboists Peter Greame, Edward Selwyn and Neill Black, flautist Richard Adeney, several trumpeters led by John Wilbraham; Mr Leppard plays the harpsichord in Suites 1 & 2, Leslie Pearson in Nos. 3 & 4. One disc contains Suites 1 & 4, the other Nos. 2 (which is in B minor, not B flat as stated in the English-language notes) and No. 3.

Bach's orchestral Suites — basically a slow overture, followed by a series of courtly dances — are not nearly as familiar to concert-goers as one might assume. In fact, No. 3 in D major, scored rather magnificently for three trumpets, drums, oboes, strings and continuo is probably the only one of the set which appears regularly in the repertoire. It includes the famous "Air" which is quite richly performed on this occasion. A rather rich sound is, as it happens, one of this set's distinguishing characteristics.

To be frank, I am not persuaded that these performances are ideal ones; for one thing, the four suites are made to sound very much alike and I know them to be otherwise. Also, there is a certain lifelessness which does not serve Bach's cause at all. In many ways, it seems as though an excess of scholarship and attention to period-style has resulted in a performance which is just as stilted (and perhaps unauthentic?) as the ones by monster orchestras which we used to bemoan. I think the recordings made by Harnoncourt are more likely to give lasting pleasure to most listeners; all the same, it must be noted that the playing of all concerned is quite exemplary and I have no fault to find with the Philips sound. In the end, this will be a question of personal taste and every collector must decide for himself. (P.F.)

☆ ☆ ☆

DVORAK: Piano Concerto in G minor, op.33. Rudolf Firkusny, piano; The Cleveland Orchestra, conducted by George Szell.

TCHAIKOVSKY: Variations on a Rococo Theme for cello and orchestra, op.33. Leonard Rose, cello; New York Philarmonic, conducted by George Szell. CBS Odyssey Mono disc ODA 5129.

This is a rather curious release — to begin with, monophonic issues are extremely rare nowadays except for much sought-after items of historical significance. It so happens that both these works have been available, played by these same soloists, on wholly satisfactory stereophonic discs and one of these a CBS one — the plot thickens! In fact, Firkusny has recorded the Dvorak concerto twice previously (once accompanied by conductor Somogyi and once by Susskind).

Critics, generally, have held a low opinion of Dvorak's piano concerto and Alec Robertson, in his biography of the composer, almost discards the work completely. As it happens, Firkusnv plays are revised version, prepared by one of his former teachers, Professor Kurz; this is much more pianistic than Dvorak's original score and I've always found it quite enjoyable in Firkusny's readings. There's nothing wrong with this latest one, the sound is pretty good, the orchestra likewise and the performance is not in any way much different from others I've heard.

The Tchaikovsky work has the same opus number and the same conductor as the Dvorak; there the similarity ends.

Reviews in this section are by Paul Frolich (P.F.), Neville Williams (W.N.W.), Jamieson Rowe (J.R.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.), Greg Swain (G.S.), and Danny Hooper (D.H.).

Leonard Rose recorded a beautiful performance of this piece with the Philadelphia Orchestra, which was issued here about 1967. It is, in my view, very superior to this latest one — assuming that it is, in fact, a later one. Szell is much more deliberate in his tempi than Ormandy and I must say that I find the New Yorkers' sound, despite its clarity, inferior to that of the Philadelphia players.

The greatest difference is in Mr Rose's playing, though; there was a delicious freshness, even cheekiness in his playing which, this time, is replaced by sonority, slowness and something that may be boredom. Other than the bargain price, there's little to recommend this disc. (P.F.)

☆ ☆ ☆

SCHUMANN: Complete Music for Cello & Piano. Friedrich-Jurgen & Eckart Sellheim. CBS stereo disc SBR 235946.

Record manufacturers really can be infuriating. Here we have a fine recording made by artists completely unknown to us, and of music that is little-known. The record jacket includes two prints of the identical photo showing two smiling men, probably in their early thirties, but that is all they tell you.

Some digging by me did establish that they are brothers, probably live in East Germany and that they regularly work together; also, that this is their third recording. I hasten to add that they play splendidly, that the recording is exceedingly well produced and that I

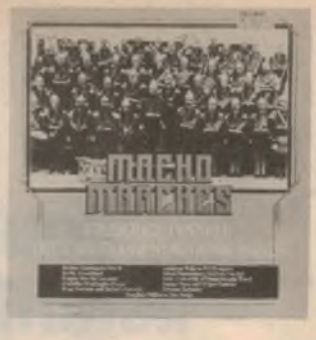
Now to the music: there are the "Fantasie-Stucke", op.73, the "Adagio & Allegro in A flat major", op.70, and the "Funf Stucke im Volkston", op.102. All these works were written in Dresden, in 1849, during one of the happiest periods in Schumann's troubled life. The first two were written for horn and clarinet respectively, with the composer's direction that violin or cello might be substituted; opus 102 is the only work specifically written for cello and it is both the least known of these fine examples of "domestic" music and the most rewarding on the disc.

The five pieces in "folksy" style are of considerable technical difficulty and very interesting, to listener and performers alike. They are written with genuine attention to the cello's range and potential and worth knowing. Opus 70 & 73, on the other hand, really do sound best in their wind versions and offer inadequate scope to as fine a cellist as F. J. Sellheim.

It is good indeed to have new performers brought to notice; one hopes that such services, abroad, are simultaneously being rendered to Australian artists of note and that manufacturers will, both there and here, return to the practice of giving a little information about the performers instead of merely listing their names with those of art directors, recording supervisors and producers! (P.F.)

For audiophiles —

DIRECT CUT & DIGITAL



ORCHESTRATIONS ASTROMATIC. Tokyo Philharmonic Orchestra conducted by Tadaaki Otaka. Direct cut stereo, RCA RDCE-6. (From M.R. Acoustics, PO Box 165, Annerley, Qld 4103).

An extra centre page in this quite elaborate double-fold jacket is given over to some revealing notes by Producer Hiroshi Isaka. He talks about the problems of organising a direct cut of a full symphony orchestra; of having to anticipate every detail of the dynamics to facilitate manual over-ride of groove spacing and to avoid cutter overload; of having to repeat and repeat entire sides and of seeing solo instrumentalists grow too weary to do their best on the final take.

If ever there was a hard way of recording, Hiroshi Isaka has spelt it out in these notes.

But, be that as it may, the recording was completed finally and is available here on the RCA label.

Side 1 is a medley arrangement for symphony orchestra, obviously inspired by memorable movies: Also Sparach Zarathustra (Introduction, R. Strauss) — Tara's Theme From "Gone With The Wind" — Concierto de Aranjuez (Second Movement, Rogrigo) — Title and Princess Leia's Themes from "Star Wars" (John Williams).

On side 2 are three distinct tracks: Light Cavalry Overture (F.V. Suppe) — Thais, Meditation (J. Massenet) — Die Meistersinger, Prelude (W. R. Wagner).

Technically, the recording is very quiet and the instrumental solos and lighter passages are crystal clear. On full orchestra, the definition is okay but not extraordinary — possibly due to the use of 20 or more microphones and the utter finality of the mix that is committed to the vinyl at the actual performance.

Good, but not one of those discs that brings you forward in your chair. (W.N.W.)

☆ ☆ ☆

MACHO MARCHES. The Cleveland Symphonic Winds, conducted by Frederick Fennell. Telarc digital stereo DG-10043. (From P.C. Stereo, PO Box 272, Mt Gravatt, Qld 4122).

The Cleveland Symphonic Winds, drawn largely from the Cleveland orchestra, are making quite a name for themselves. Here they perform 11 marches selected for their variety in source and style:

Commando (Barber); Florentiner (Fucik); March Lorraine (Ganne); Washington Grays (Grafulla); Barnum and Bailey's Favourite (King); Belgian Paratroopers (Leemams); Anchors Aweigh (Miles-Zimmerman); University of Pennsylvania (Seitz); Stars and Stripes Forever (Sousa); Radetzky (Strauss); Sea Songs (Vaughn Williams).

All that brass, punctuated by the poundings of the big drum adds up to a lot of band sound, but it is relieved by the variations in the style of the music and by the highly professional quality of the playing. However, there's no law which says that you have to play straight through both sides, as tends to happen when one is reviewing.

Technically the sound is of the highest standard, unmarred by background noise, very clean, and with the grooves opening up automatically to accommodate the full weight of the drum. A good one. (W.N.W.)

☆ ☆ ☆

FREDERICA VON STADE sings works by Dowland, Purcell, Liszt, Debussy, Canteloube & Hall; Martin Katz, piano. CBS Stereo disc SBR 235963.

Miss von Stade has a very lovely voice. Since she is practically unkown to Australians, some information about this fine young singer from the US (even that she comes from the US is an unconfirmed rumour) might usefully have been included with this lavishly packaged disc. There are full texts, in three languages, of the works presented but, alas, not a word about the singer or her equally talented accompanist.

There is a photo of Miss von Stade,

which suggests that she is still quite young; her voice, a rich mezzo, certainly gives me the impression of still being built up. If I am less than wholeheartedly delighted with this recital this is due to uncertainty about the singer's musical discernment. There are two songs by Dowland, a simplified version of Purcell's "Blessed Virgin's Expostulation" and three Liszt songs on one side — all are beautifully sung throughout, but with little stylish change to differentiate between them.

On the second side are Debussy's enchanting "Chansons de Bilitis" and John Canteloube's folk-song arrangements "Chants de France", capped by a rather trite little song by Carol Hall, presumably a composer-friend of the singer's. All the way, there are quite lovely sounds from a well-managed voice, but I cannot build up any idea of the singer's personality or artistic standing, try as I may.

The quality of the recording is excellent and everything is done with good taste; perhaps the fault lies in me that I cannot respond to some utter subtlety and fastidiousness? I do know that Miss von Stade is very highly thought of and can only suggest that you listen for yourselves. (P.F.)

☆ ☆ ☆

GUILLAUME DUFAY: Mass "Ave Regina Coelorum". The Clemencic Consort. Harmonia Mundi/World Record Club Stereo disc 05884.

Dufay, of whose Christian name there are at least three authorised spellings, was a Burgundian composer of the early Renaissance. Born about 1400, he spent most of his mature years in Cambrai, now a city in Northern France, in earlier centuries, Cabrai was considered to be part of the Netherlands and Dufay died there in 1474. In his time, he had travelled widely, been a member of the Papal Choir in Rome and elsewhere and was regarded as the greatest composer of his time. There was, then, hardly any indigenous music-making in Italy, where the Flemish composers and singers held sway.

Although Dufay wrote some secular music — nearly seventy of his chansons are known — his greatest work was liturgic and he was the holder of high church offices in Cambrai, Bruges and Mons. The Mass on this record is one of several he wrote and it will come as a surprise to listeners who are reluctant to approach the music of the Middle Ages (and of the Avant Garde!) because its beauty is such as to make it fairly easy to comprehend. This is not, of course, music easily related to the sounds of the 19th or even 17th century; nonetheless, its perfection is self-evident and hearing it can add enormously to one's fund of musical appreciation and enjoyment.

Rene Clemencic is a Viennese authority on early instruments, of which he has built a remarkable collection, and on early music; the performers directed by him on this occasion are three counter-tenors, a tenor and a bass-baritone; a bass bombarde and an alto bombarde (early forms of oboes), a tromba (a type of trumpet), two sackbuts (early trimbones), a bowed hurdy-gurdy, lute, positiv organ and percussion. I have no reason to doubt that everybody's performances are

first-rate and thoroughly authentic; to my ear, the most excitement is provided by the percussion, particularly the very sonorous kettle-drums which, alone, would have made this an acoustic experience worth writing about! (P.F.)

☆ ☆ ☆

HANDEL. CONCERTOS FOR LUTE AND HARP. Lute and Harp Concerto in B Flat Major, Op. 4, No. 6. Harp Concerto in F Major, Op. 4, No 5. Concerto Grosso in C Major ("Alexander's Feast"). Desmond Dupre, Lute, and Osian Ellis, Harp accompanied by The Philomusica of London Conducted by Granville Jones. World Record Club stereo WRC S/4219.

The first two concertos on this record are reconstructions from an incomplete score. As such, I am sure that Handel would have approved. The result is exquisitely entertaining with the two solo instruments accompanied by muted and pizzicato strings, treble recorders and continuo played on an 18th century chamber organ.

On side two, the Concerto Grosso in C Major is equally enjoyable with distinguished playing by the Philomusica of London. Violin solos are by Carl Pini and Neville Marriner, cello Joy Hall and harpsichord continuo Thurston Dart.

Recording quality is very good, although tape hiss does intrude a little at times. Thoroughly recommended. (L.D.S.)

☆ ☆ ☆

CORNET CARILLON. The G.U.S. (Footwear) Band. World Record Club WRC 04224.

This record serves to demonstrate the fact that the English factory brass band tradition is far from dead. With the dean of brass band conductors, Stanley Boddington, in control the band romps through a medley of familiar tunes including a couple used as TV themes:

Post Horn Galop — Cornet Carillon — Euphonium Concerto — When The Saints Go Marching In — Rock Of Ages — Entry Of The Gladiaators — The Adagio From

DIRECT CUT — WITH A DIFFERENCE!

DUTCH TILDERS DIRECT. Eureka stereo E111. Distributed by RCA Records Pty Ltd. $6.99.

If you buy this direct-cut disc in the expectation of obtaining a very clean recording with wide dynamic range you could be disappointed. For a start, the material recorded by country and western signer Dutch Tilders does not have a particularly wide range. No, it seems to me that Eureka records have used the facilities at the EMI Studio 301 to gain maximum impact for Tilders' voice and guitar. To that end, they have used "close miking" and gain levels have been ridden to the limit, and more, than the recording lathe can handle. As a result, there is audible distortion on both the guitars used by Tilders (acoustic on side one and electric on side two) as well as on his voice.

As far as I was concerned, the distortion on the recording tempered my reactions to Dutch Tilders. Even so, if you are a fan of his, I can say that this is probably his best record yet. His unaffected style is growing in popularity and apparently has been well received overseas.

Track titles are as follows: Simple Rag — Glory Of Love — Rainy Day — Song In G — Stoned Again — Frankie And Johnny — Take A Trip With Me — Dutchman's Boogie — Corina, Corina — My Heart's In Sorrow. (L.D.S.)

'Spartacus' — English Folk Songs Medley — Perils Of Pendaragon —Chit-Chit Polka — I Heard The Voice Of Jesus.

The sleeve notes give a full rundown on the Band personnel and a biographical note on the conductor and the composer of the Euphonium Concerto. (NJM).

THE MAGIC ORGAN, Good Time Show. HARLEQUIN L 25315 Festival release.

If you can imagine a dozen old time favourites played on an electronic organ with synthesized rhythm backing, you would have a fair idea of what to expect from this disc.

— Hallelujah Chorus.

My earlier reference to Liberace was deliberate. If you like his concert style, less the patter, of course, then you'll enjoy Dino at least as much. The sound quality is excellent. (W.N.W.)

New Devotional Records

BOB. Stereo, Galilee GA-2002. (Distributed by Rhema Artists, 6th Floor, 210 Pitt St, Sydney, 2000).

"Bob" is Bob Wolfgramm, who is responsible for most of the lyrics on this album, most of the music and all of the vocals. Members of the band and backing vocalists are acknowledged on the jacket notes, which also indicate that the recording was made in EMI's new Sydney studio 301.

The lyrics, set out in full on an inner sleeve, reflect traditional Gospel values but certainly not in traditional Gospel terminology. The titles: Good Samaritans — Refugee — Man's A Tree — Thomas' Song — Emmaus — Look A Yonder — Carried Away — Born To Die — You Are The Harmony — It Was News To Me — Bring Back The Good News.

If your tastes in music, Gospel or otherwise, run from M.O.R. to conservative, you can forget about this one forthwith. If you're a rock Gospel aficiado, you may be as keen about it as those who worked on it. If you're somewhere in between, best you listen to a few tracks in sequence in judge whether or not you hanker for the remainder.

The recording quality is okay, as you would expect. (W.N.W.)

☆ ☆ ☆

RISE AGAIN. DINO. Stereo, Light LS-5752. (From Word Records Australia, 18-26 Canterbury Rd, Heathmont, Vic, 3135).

If memory serves me correctly, my last encounter with Dino (no other name is mentioned) was as a predominantly solo pianist with an outstanding ability to embellish and transform Gospel tunes into an entertaining cocktail, piano sound.

In this album, the same ability is evident but he has on call the backing of an orchestral and choral group. As one would expect, the arrangements vary from track to track, but with some of the flourishes strongly reminiscent of Liberace & Co. In this context, the titles don't mean a great deal but here they are anyway:

Easter Song — Rise And Be Healed — He's Alive — Oh How He Loves You And Me — Born Again — Rise Again — Joyful, Joyful, We Adore Thee — Lord Of My Life (Chopin's Etude in E Major)

For information on World Record Club albums, contact the club at 605 Camberwell Road, Hartwell, Victoria, 3124. Tel. 29 3636.

The twelve titles are: Top Of The World — Paper Roses — Cielito Lindo — Cold Cold Heart — China Town — Big Bird Strut — When The Saints Go Marching In — Last Date — Steppin' Out — Blue Hawaii — Little Brown Jug — Lover's Waltz.

One thing you won't need and that is lots of bass boost, unless you have a rattle free house; mine isn't! The quality is good, with no noticeable surface noise, making a pleasant record for light listening. (NJM).

☆ ☆ ☆

NO. 1 IN HEAVEN. Sparks. Virgin Records L 36857. Festival release.

This is Sparks' 5th album, but it is their first to be recorded without the conventional "rock band" format. It was recorded at the famous Musicland Studios in Munich, Germany, assisted by Giorgio Moroder.

Giorgio Moroder has revolutionised modern music by commercially mating disco rhythms with futuristic electronics. On "No. 1 In Heaven", he has assisted Sparks in their songwriting and played numerous synthesised instruments.

The six tracks on the album are: Tryouts For The Human Race — Academy Award Performance — La Dolce Vita — Beat The Clock — My Other Voice — The No. 1 Song In Heaven.

Sparks have never been more listenable. (D.H.)

Oops! We apologise for showing the 625RD in last month's advert.

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	162 Pacific Highway,	GORE HILL.	Phone 439 5311		656 Bridge Road,	RICHMOND.	Phone 428 1614
	30 Grose Street,	PARRAMATTA.	Phone 683 1133	QLD	166 Logan Road,	BURANDA.	Phone 391 6233
	263 Keira Street,	WOLLONGONG	Phone 28 3800	SA	203 Wright Street,	ADELAIDE.	Phone 212 1962
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AMATEUR RADIO

by Pierce Healy, VK2APQ

Scouts, Guides and amateurs in 22nd Jamboree on the Air

J-O-T-A, the event in which amateur radio combines with world Scouting and Guide organisations to exchange greetings and goodwill messages, takes place over the weekend October 20-21, 1979. This is the 22nd year in which amateurs have provided international communication as a community service.

Thoughts of international goodwill will be uppermost in the minds of thousands of young people throughout the world, during this weekend. Each year J-O-T-A introduces the younger generation to the practical side of international communication through amateur radio. The exchange of greetings and expressions of good fellowship serves as an educational experience between those of different cultures and national loyalties.

Activities will commence at 0001 EST 20th October and conclude at 2359 EST 21st October. J-O-T-A is not a contest but a friendly get together where acquaintances made in previous years are renewed or new ones made. It also gives Scouts and Guides the opportunity to exchange thoughts and ideas on subjects of common interest, and learn about activities and customs in different areas of the world. In some cases discussions between local or interstate groups fulfill a useful means of establishing friendships and exchanging details of awards or achievements.

Over the years J-O-T-A has introduced many young people to amateur radio and awakened a dormant interest in radio and electronics which has led to a career in those fields. Many thus exposed have themselves become amateurs and extended their Scouting group's activities to include amateur radio classes.

The basic rules for J-O-T-A are:—

1. Observe national licensing regulations.
2. Use only authorised frequencies and modes of transmissions.
3. Advise branch organisers of intention to participate.
4. Ensure that a report of your station activities is sent promptly to the branch organiser for inclusion in official report.

All amateurs are invited to participate, either by inviting groups of local Scouts or Guides to visit your station at suitable times, or by operating portable from a Scout hall or camp. Contact your local Scout or Guide group or branch organisers.

Further information may be obtained from:— National organiser — Commissioner Noel Lynch, 15 Noeline Street, Dorrington. Qld. 4060.

Branch organisers: Qld — Scout — Les Weller, 110 Cardiff Street, Darra 4077. Phone (07) 375 5213. Guide — Mrs G. Fletcher, 25 Station Road, Sunnybank. Phone (07) 345 4297. NSW:— Scout — Eric Van de Weyer, 101 Francis Street, Bondi, 2026. Phone (02) 30 1224. Guide — Mrs Valda Lambert, 76 Ula Crescent, Baulkham Hills, 2153. Phone (02) 29 3373. Vic: — Scout — Max Dawkins, 74 Springvale Road, Nunawading, 3131. Phone (03) 878 7721. Guide — Mrs Joy Kellett, 54 Maxianne Way, Mt Waverley. Phone (03) 232 7414. Tas:— Scout — Colin Walker, 41 South Street, Bellerive, 7018. Phone (002) 44 1759. Guide — Miss Sue Wyatt, c/- Teachers Hostel, Frederick Street, Cygnet, 7112. SA: — Scout — Geoff Taylor, 16 Fairmont Street, Black Forest, 5035. Phone (08) 293 5615. Guide — Mrs E. Thomas, Flat 2, 15 Brook Street, Torrens Park, 5062. Phone (08) 71 3068. WA:— Scout — Peter Hughes, 58 Preston Street, Como, 6152. Phone (092) 367 1740. Guide — Mrs June Retallack, 224 The Strand, Bedford Park, 6052.

Donation to WARC 79: Dick Smith Electronics Pty Ltd recently donated $500 to the WIA WARC 79 fund. Photo shows their Richmond (Vic) store manager "Mac" McCallum (right) receiving a receipt from WIA president, David Wardlaw. (See story page 112.)

REMEMBRANCE DAY CONTEST

The 1979 WIA Remembrance Day Contest, on the 11th - 12th August, was officially opened by a recorded address by Mr Dick Butler, Deputy Secretary-General of the International Telecommunication Union in Geneva, Switzerland.

Mr Butler was introduced by Ted Robinson, F8RU, past president of the International Amateur Radio Club 4U1ITU.

Mr Butler, officially opening the contest, said;

"In the year 1979, I am delighted that I, as Deputy Secretary-General of ITU, have been invited to open your Remembrance Day Contest and to remember, with you, those who have served before us, offering their skills and services without hesitation and indeed their lives in time of national need. In thanking my colleague Ted Robinson, for the introduction, I should add that he comes from Belgium, a country well known to many Australians who served abroad.

"Amateur radio has had formal recognition in the ITU statutes for a little over 50 years, of the Union's 114 years of existence. Initially, as part of what was known as the 'private experimental station' but nevertheless operated by 'a person interested in

AMATEUR RADIO

radio technique solely with a personal aim and without pecuniary interest'. How wise that international encouragement and recognition proved to be, when radio was in its infancy.

"It encouraged personal initiative and interests, as well as self help. The growth of amateur radio has proved to be of basic importance to community service, without cost, in times of stress and emergency. Think of the local firefighting unit in the early days. The regulatory provisions established a major potential for fostering goodwill between people with the same pursuits in other countries — yet never to meet except through the friendly dialogues on the air.

"The radio frequency possibilities and spectrum operating conditions for the amateur service, which was elevated from recognised station use to a 'Service' at the ITU Atlantic City Conference in 1947, received even more formal recognition as a 'Radio Communication Service', being permitted to operate in space, following the World Administrative Radio Conference for Space Telecommunications in 1971. The practical possibilities for amateur enthusiasts was enlarged immensley as the world community moved to the adaptation and use of satellite telecommunications.

"But let us not overlook the conventional radio communications which continue to satisfy our personal needs and contribute to our knowledge of scientific and technical propagation conditions.

"In Geneva, September 1979, there will be another focal point for the amateur community. The reason — the World Administrative Radio Conference 1979 — for which our colleagues — your colleagues (and they are much more numerous now) are preparing all over the world.

"I have been privileged to be associated with some of these preparations: in the Region I meeting in Hungary of the IARU, then in all of the ITU forums, the CCIR and the preparatory seminars. In all of these activities, the amateur interests have been in the forefront. Such preparations lead one to be optimistic in the search for negotiation of rational solutions which will respond adequately to the competing needs for radio frequency spectrum of all users, including the amateurs.

"So, happy hunting and good luck. Do not be too worried by the WARC. You have admirable representatives in your delegation.

"Thank you for listening. It is an honour for me personally to declare open your 31st Remembrance Day Contest."

DUKE OF EDINBURGH'S AWARD SCHEME

The Governor General of Australia, Sir Zelman Cowan, accompanied by Lady Cowan, visited the State Award Conference of the Duke of Edinburgh's Award Scheme held at the Namaroo conference centre, Lane Cove, NSW on Saturday 7th July, 1979.

Over 100 young people from all over the state demonstrated the many facets of the scheme's activities, including those associated with community service requirements, expedition, and physical skills.

A number of hobbies were also on display. One was an amateur radio station operated by James Woodhill, VK2YKH/NYW, a Duke of Edinburgh's Award candidate and a student at Hurlstone Agricultural High School, Glenfield, NSW. Jim was supported by Brian Wade VK2AXI and other members from the Hurlstone Amateur Radio Club, whose members are candidates for bronze, silver or gold Duke of Edinburgh's Awards.

The station operated throughout the day on the 80, 15 and 10 metre bands, also VHF simplex and repeater channels.

Amateur service publicity material made available by Tim Mills, VK2ZTM, secretary of the NSW division WIA, was used to support the display.

WIA WARC 79 FUND

For their generous donations towards WIA representation at WARC 79, the following amateur equipment suppliers are entitled to use the WIA emblem and the words "WARC amateur Supporter" in their advertising displays:— Dick Smith Electronics; Vicom International; Bail Electronics; Chirnside Electronics; Scalar Industries; Elmeasco Instruments.

Many substantial donations have also been received from individual amateurs and radio clubs. A notable one being as anonymous donation of almost $900 in the memory of the work that the late John Moyle did in 1959 for the amateur service at a similar WARC.

WIA NEWS

The 1979 Australian Amateur Radio Call Book, produced by the WIA, was published in August and may be obtained through divisional offices and major book sellers. The cover price is $2.95 a copy.

NSW Divisional Education Service: The latest publication from this source is the "500 Questions and Answers for the AOCP" booklet. This is available at $2.50 post paid from The Education Service, PO Box 109, Toongabbie, NSW 2146. Also available from the same source is the "1000 Questions for Novice Candidates", price $3.00 post paid.

The latest Westlakes Radio Club publication, the "Ham Exam Cram Book", may be obtained from WRC,

AMATEUR RADIO

PO Box 1, Teralba, NSW 2284. Cost $3.00 includes priority paid post.

An interesting and informative quarterly publication is the Youth Radio Scheme's "Zero Beat", edited by Ken Hargreaves, VK2AKH. It covers YRS club notes from various states, as well as technical subjects and hints for the beginner. The annual subscription is $3.00 post paid for four issues — September, December, March and June. The address, The Editor, Zero Beat Publications, 52 Marlin Avenue, Floraville, NSW 2280.

RADIO CLUB DIRECTORY

Details must be received by October 15. Send to address given at bottom of page.

IARU NEWS

An Association of Radio Sport has been formed in the People's Republic of China. Officers of the society were elected in Peking during March, 1979.

There is also news of the formation of the Bangladesh Amateur Radio League.

The Amateur Radio Club of Tonga was elected as the 105th member of the International Amateur Radio Union. Two other societies, the Cayman Radio Society and the Fiji Association of Radio Amateurs, have applied for IARU membership.

VHF RECORDS

A new world record has been claimed for 144MHz. On the 13th February, 1979, at 1810GMT Dave Larsen, ZS6DN in Pretoria, South Africa made a CW contact with Costas Fimerelis, SV1DH in Athens, Greece on 144.130MHz. Reports were readibility 5, strength 2. No tone reports were exchanged as signals were distorted and accompanied by a "rushing" sound. The distance was 7100km.

Three days later, 16th February, at 1800GMT ZS6DN made two way contact with SV1AB, 10km north of SV1DH. The contact lasted 10 minutes and the reports were as before.

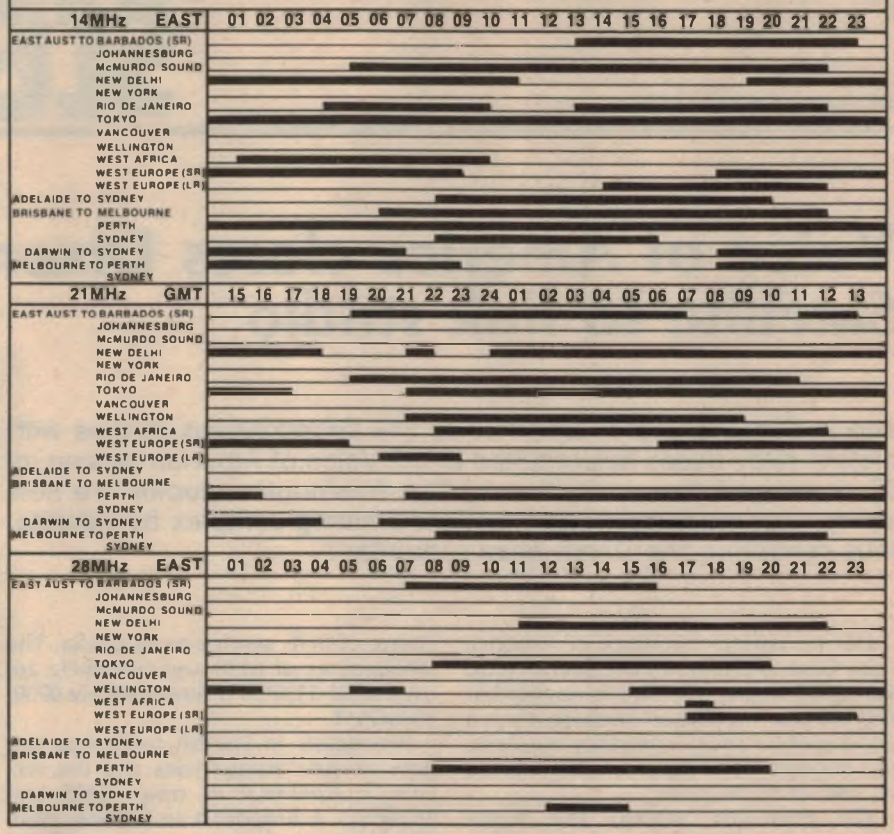
On 5th March there was an opening between South Africa and Greece on 144MHz which lasted from 1750GMT to 1845GMT. During that period ZS6DN was in contact with SV1AB and SV1DH they were later joined by Jack Anderson, ZS6LN in Pietersburg. The four-way contact lasted almost an hour.

WB6NMT in California has had E-M-E contacts on 50, 144, 220 and 432MHz. All contacts were with normal home based stations (as distinct from those using large professional dish antennas). WB6NMT's antenna installation includes eight ten element yagis on 144MHz, and an array of eight tandem reflector type yagis for 432MHz.

(Acknowledgement 4-2-70, Rad. Com. May 1979)

IONOSPHERIC PREDICTIONS FOR OCTOBER

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 10.79



Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent to Pierce Healy at 69 Taylor Street, Bankstown 2200.

SHORTWAVE SCENE

by Arthur Cushen, MBE

Voice of America closes Dixon base: Satellite to link studio

The increasing use of satellites to link broadcasting studios with distant relay bases has resulted in the Voice of America closing its Dixon relay station in California. The Washington studios are now linked with the huge Philippines transmitting complex by satellite, thus rendering the Dixon base redundant.

Having visited the Voice of America relay base at Dixon, in the Sacramento Valley of California, one is aware that the site was not chosen because it was a good spot for short-wave transmissions, but because the 800 acres was available in 1943 at a low price.

On this site stands the huge transmitter hall offices and a vast field of antennae masts which carried programs beamed to Asia and the Pacific area. Four sets of towers were beamed on New Zealand and Australia, a reminder that in 1943 the South Pacific was the focal point of war. The aerial systems were later re-designed and only the rhombic array was left to cover the South Pacific.

Altogether fourteen arrays stand on this vast complex of buildings and installations, while inside the building programs from Washington were received by satellite. Some ten years ago new 250kW transmitters were installed. With the closing of Dixon, the Delano site in California will provide listeners in Australia with Voice of America broadcasts from the West Coast, backed up by coverage from the Philippines.

The transmitting facilities at Dixon which were closed consisted of three transmitters of 250kW, one 200kW, two 100kW, and two of 50kW.

NEW HCJB CHANNELS

The present schedule of HCJB with English gospel broadcasts, shows no change for its service to Australia. The frequencies of 6130 and 11900kHz are used 0600-1130GMT and 9745kHz 0700-1030GMT.

Broadcasts in English to Europe are now on new frequencies and the service at 0700-0830 is now 11835 and 1524kHz. A broadcast to Europe 1900-2000GMT is on 15225 replacing 15420, and 17890 replacing 17765 and 21480kHz. A further broadcast 2130-2200 is on 15225, 17890 and 21480kHz, and this includes DX Party Line on the Monday, Thursday and Saturday broadcasts.

The broadcast in English 2030-2120GMT is also on 17695 from Bonaire, as well as 21640kHz. As well the transmission is carried on the Madagascar relay on 11730 and 15220kHz.

BBC CUTS

The British government has asked the BBC External Services to cut £4 million from its previous income of £37.2 million, received as a grant from the government to pay for external broadcasting. Following debate in the House of Lords it is obvious that there is strong opposition to the announcement.

Several plans have been announced by which a savings could be made. One of these is the ending of the BBC Service in Arabic which was the first broadcast by the BBC in a foreign language and their most extensive. Another plan proposes the withdrawal of the eight language services to western and southern Europe, and the closing of the monitoring station at Caversham Park. Another suggested "package" is: stopping all broadcasts to the Indian subcontinent and Iran, stopping all foreign language services to South-east Asia and the Far East, and closing the Far Eastern relay station at Singapore.

As far as Australian listeners go, the proposed cuts, to take effect next year, would not reduce the World Service coverage from the United Kingdom, but the closing of the Singapore relay station would make reception difficult. During the winter months when direct reception from London is often not possible, the relay base at Singapore is able to re-broadcast the World Service.

VOICE OF ASIA

The Voice of Asia broadcasts from Taiwan and is heard on 5980kHz with English at 1100GMT. The facilities are those of the Voice of Free China, Taipei and relay the medium-wave program on 621kHz.

Transmission begins with English at 1100 followed by language lessons at 1110GMT on a Saturday. Peter Bunn, Melbourne, reporting on "DX Time" on Radio Australia, states that after English concludes at 1200 there are broadcasts in Indonesian till 1300, Chinese till 1500 and Thai till 1600GMT when the broadcast ends. This schedule is from Monday to Saturday, while the program on Sunday includes English 1100-1110 and Chinese 1110-1200GMT. The address is the Voice of Asia, PO Box 880, Kaohsiung, Taiwan.

VATICAN TESTS

The continuing interference to short-wave frequencies means that stations are always looking for new channels in order to provide their listeners with the best possible signal, free from interference. Over the past few weeks the Vatican Radio has been testing in the 25-metre band, looking for a better frequency for Australian reception during the English transmission 2210-2225GMT.

A new frequency of 11745kHz was initially used to replace 11705kHz, which suffered interference from Radio Sweden. However, the transmissions on 11745kHz suffered interference from

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT. Add 8 hours for WAST, 10 hours for EAST and 12 hours for NZT.

SHORTWAVE SCENE

Radio Moscow, which broadcasts in Portuguese to Brazil on the same channel. The latest frequency to be tested is 11830kHz and this seems to be the most satisfactory for this area. 9615 and 15120kHz are also being used, but Peter Walsh in Melbourne and Alvin Aslat of Adelaide both report that 15120kHz is not providing as good a signal as predicted.

RADIO UGANDA HEARD

Broadcasts from Radio Uganda at Kampala have been heard over the past few weeks with their usual transmission to the United States, Canada and New Zealand. The broadcast is between 0300-0400GMT on 15325kHz. The quality between the studio and the transmitter has suffered due to the recent war in the country and this has resulted in difficulties in understanding some of the programs being presented.

Furthermore, Radio Moscow has returned to this channel and causes interference to the broadcasts from Uganda. The station is asking for reception reports when they close and these should be sent to the External Service of Radio Uganda, PO Box 2038, Kampala.

FREQUENCY CHANGING

In order to avoid interference, it is often necessary for short-wave stations to change frequency. This recently was the case with Radio Nederland which found its Bonaire frequency of 17810kHz suffering from considerable interference. Radio Nederland did not wish to move out of the 16-metre band, and so the Lopik transmitter in Holland, which was using 17695kHz, was moved to the new frequency of 17605kHz and operates on that channel from 1430-2230GMT. The move was made so that Bonaire, which was on 17810kHz, could use 17695kHz, and this is the frequency used for a broadcast to Africa in French 1830-1925GMT.

FALKLAND ISLAND RADIO

One of the most difficult areas of the world to receive is the Falkland Islands. This is because they operate on a very low frequency, and on a schedule which does not generally permit reception in Australia and New Zealand. This interesting station uses the power of 5kW on midium-wave 536kHz 1400-1615 Monday to Saturday, and on 536 and 2370kHz 2230-0200 Monday to Saturday and 2200-0100GMT Sunday.

A letter from John Macaskill, Port Stanley, Falkland Islands, states that Radio Australia is received on a regular basis, and that Radio New Zealand was recently tuned in for the first time when 6105kHz was heard after many weeks of listening.

RADIO KAMPUCHEA

A new government Radio station in Kampuchea, formerly Cambodia, has been heard with its external service, with the best reception at 1200GMT on 9695kHz. English has been observed at this time, and this is followed by French and Thai, each transmission being for 15 minutes. The frequency of 11938 carries the same broadcast.

The BBC Monitoring Service reports that the domestic program of Radio Kampuchea is carried on 6090 and 7008kHz, while the frequency of 9695kHz also carries this service when not being used for external broadcasting. The studio is located in Phnom-Penh.

NEW FREQUENCIES

CANADA: Radio Canada International is using the new frequency of 9560kHz for the transmissions during our afternoons, and this is valid up to November 4. This frequency replaces 9655 and is used with an English broadcast 0300-0327 and 0400-0427GMT, with the same program being carried on 5960, 9535 and 11845kHz. The frequency of 9615kHz carries English 0200-0227GMT and is later used for a broadcast in Russian 0315-0345GMT.

NORWAY: Radio Norway at Oslo is using the 11-metre band for the first time for several months and is broadcasting on 25730kHz 1100-1230GMT. This transmission has English for the last half hour on Sunday and is also carried on 21730kHz. The earlier broadcast 0700-0830GMT is now on 11850, 15135, and 21655kHz.

USA: From November 4 station KGEI, San Francisco, will be broadcasting to Latin America 2130-0400GMT on 15280kHz, 0400-1400 on 9615, and 1400-1600 on 15355kHz, with English 2130-2200. Broadcasts to the Far East are on 5980kHz 1000-1400, with Japanese 1000, Russian 1100, and CHinese 1300GMT.

RADIO KIEV

Broadcasts from Radio Kiev in the Ukraine are now heard on some new frequencies for the English transmissions. Broadcasts to Europe 2000-2030GMT are now on 6020, 9560 and 9665kHz. The service to North America includes two transmissions: 0030-0100 on 11735, 12060, 15180, 17845 and 17870kHz; and 0300-0330GMT on 9610, 9655, 11735, 12000, 15180, 17760and 17870kHz. The program includes a DX Club during the Thursday afternoon broadcast to North America, while letters from listeners are answered in the Sunday transmission.

The DX Club is similar to those operated by many international stations, with the main qualification that the listener must send in a specified number of reception reports over a given period to be eligible to take part in various Club activities.

(Continued on page 117)

SHORTWAVE SCENE

COLOMBIAN SIGNALS

A new frequency is now being used by Radio Super at Bogota which operates 24 hours a day. The station has appeared on 6070kHz and was received around 0830GMT. Programs are typical Spanish commercial presentation, with station announcements after each recording.

Another frequency change has been observed with Radio Melodia at Bogota, now operating on 6045kHz. This station broadcasts 24 hours a day and the new frequency is best around 0700GMT. This channel replaces 6140kHz.

Another signal from Colombia is La Voz del Llano, Villavicencio. This uses 6115kHz has been heard around 0715GMT by Tony Marr of Wellington, reporting in "New Zealand DX Times". The program consisted of Spanish music with plenty of station announcements and time checks.

VOA CHANGES

The Voice of America is now using the new frequency of 26000kHz for its broadcast from the Philippines to the South Pacific 2200-2400GMT.

This frequency replaces 15290kHz, which in the past has suffered interference from jamming and Radio Free, Europe.

Another recent change for VOA is that 15160kHz has replaced 15155kHz 1100-1600GMT. The reason for this frequency move was that 15155kHz suffered severe interference from the Moscow program, Peace and Progress.

LISTENING BRIEFS

EUROPE

CYPRUS: Radio Bayrak, Turkish Federated State of Cyprus, has been heard on 6140kHz closing at 2000GMT. The program generally consists of light music, with a full station announcement in Turkish before closing with the National Anthem. Signals have been spoilt at times by a morse transmission on the frequency.

MALTA: According to the BBC Monitoring Service, programs from the Libyan Radio are relayed over Radio Malta 07000800GMT in Arabic on 5960 and 7135kHz. The Radio Mediterranean transmission on5960kHz with English 1835-1850 is followed by station announcement in English, French and Arabic.

AMERICAS

VENEZUELA: Radio Nacional at Caracas is using 6170kHz with an extended schedule and has been heard around 0900GMT. The program consists of light popular music, with full station identification each 30 minutes, and more frequently when presenting short spoken features. Peter Bunn in Melbourne also reports reception, with signals being received from around 0730 until after 1030GMT.

ASIA

AFGHANISTAN: Radio Afghanistan at Kabul has altered its English language broadcast time to 1530-1600GMT. This is carried on 4775kHz, while the transmission 1900-1930, which is now on 15075kHz, has also been noted with fair reception.

INDIA: All India Radio has been noted with a five minute broadcast in English from 1135-1140GMT on 9705kHz. This frequency provides the best reception, but the same program is available on 6050, 7170, 9675, 11725, 11855, 15250 and 15275kHz.

New Products

Tono Theta-7000 CW/RTTY communications terminal

Designed specially for amateur radio operators, the Tono Theta-7000 "communications computer" will do just about everything for the amateur specialising in the RTTY mode. It will also function as an ASCII video terminal, and as if that's not enough, it can also be used for CW operation. It is an outstanding piece of equipment, available at what we believe to be a very reasonable price.

This very interesting piece of equipment may well be classified as "state of the art" in electronics technology, as applied to a terminal designed for use in amateur CW, RTTY and ASCII modes of transmission and reception. Although intended mainly for amateur use, the Tono Theta-7000 could also have a place in commercial communications systems, and as a data terminal.

The unit is housed in an attractive and well finished metal cabinet, with a slope of the operating face which allows easy access to all functions. The main body of the panel is occupied with what is fundamentally a standard typewriter keyboard, with a number of peripheral keys for additional functions. Above the keyboard is another section or group of controls, consisting of a number of slider switches, knobs, a push button and LED indicators to show the state of relevant functions.

Facilities for interconnecting the 7000 with other pieces of equipment are mainly via RCA sockets mounted on the rear panel. A small loudspeaker for monitoring purposes is mounted on the base of the cabinet.

Considering the number of functions which the 7000 can perform, the size is quite modest, thereby occupying a small space on an operating desk. The dimensions are 400mm wide x 300mm deep x 120mm high at the back, sloping to 57mm at the front. The weight is quoted as 4.5kg.

Equipment additional to the 7000 required for a two-way communications setup are a power supply for the 7000, a transmitter and receiver (or transceiver) and an ordinary domestic TV receiver capable of being tuned to either channel 3 or 4. Although not essential, a simple CRO makes tuning of signals easier.

The number of functions which the 7000 will perform is almost bewildering and space will only allow me to touch on what may be some of the more immediately important ones. So here is a brief run down on the specification list.

It can handle CW, RTTY and ASCII, with the alphabet, figures, symbols and some special characters. When receiving CW it can cope with speeds of from 15 to 220 characters per minute, following automatically. It will transmit CW at 17 to 176 characters per minute. RTTY speeds are 45.45 baud, 50 baud, 56.88 baud and 74.2 baud. With ASCII the rates are 110 baud and 300 baud.

An active filter type of demodulator of high stability is inbuilt, and provides for reception of RTTY shift widths of 170Hz, 425Hz and 850Hz. A Fine Tuning facility is also available, making accurate tuning easy. The complementary modulator is crystal controlled, giving accurate and stable transmission.

The keyboard is arranged so that when using RTTY, it is not necessary to change from letters to figures manually. This is done automatically.

A large display memory has a capacity of two pages of 32 characters x 16 lines and the pages may be changed by operating a key switch, so that one page may be used for receiving and the other for transmitting. A battery backed-up memory facility is also provided. In addition, a cassette tape recorder may also be used as a supplementary memory.

On transmission, a buffer memory with a capacity of 23 characters may be displayed on the bottom line of the TV screen. This is useful when the rate of keyboard operation at least temporarily exceeds the rate of transmission. As each stored character is transmitted, it disappears from the screen. Also, a "Rub-Out" function may be used to alter a wrong character while it is still in the buffer memory. A correcting code is also available to correct a wrong character after it has been transmitted.

I could go on, but the list already given should convey some idea of the versatility of the 7000. Checks which were made under operational conditions bore out the claims made for it.

Perhaps the most remarkable feat which the 7000 is able to perform is to receive CW (Morse code), decode it and display it on a TV screen as the letter, figure or character which it represents. Having set up the 7000 with a TV receiver and a communications receiver tuned to the 14MHz amateur

New desoldering tool

A new solder removal tool is now available on the Australian market, from Semiconductor Imports. Of Swiss manufacture, the tool offers a number of advantages.

Major advantages of the tool are its size and efficiency in the removal of solder from a circuit board. It measures a mere 150mm in length, and is 15mm in diameter, making it ideal for the serviceman to carry in his pocket. Another desirable feature is a plunger that pushes the removed solder out again, thus avoiding congestion of the nozzle.

The nozzle and the main barrel of the tool are also easily removed for routine maintenance. In fact this is required at regular intervals, depending upon the amount of work being done.

The quality of the tool is very high, and with average use should last several years. The fine tip of the tool is made from teflon and is particularly suited to the servicing of printed circuit boards containing integrated circuits.

All in all, a tool which should be of interest to the serviceman and the hobbyist alike, and represents excellent value at $9.90 each. Replaceable teflon nozzles are also available at $2.25 each.

The tool is available from Semiconductor Imports, PO Box 43, Groydon, 2132, or from Pre-Pak Electronics, 718 Parramatta Road, Croydon, NSW, 2132.

"Scotchcal" panels

Radio Despatch service advise that they are now able to make "Scotchcal" type labels for any "Electronics Australia" or similar project. The "Scotchcal" label has the advantage of providing a neat, professional looking finish, but is substantially cheaper than an etched label.

For the present, labels can be supplied on either blue or black material, with either a positive or negative image as requested by the customer. For popular, current projects, labels should be available ex-stock, but any label for which art work is available can be supplied within 24 hours.

Prices are based on the size of the label, at the rate of 2.5c per square centimetre, with a minimum charge of $2.50 for any label. Thus a label for a typical Zippy box measuring 15cm x 9cm would cost about $3.40. These prices include sales tax.

The labels will be supplied rough trimmed, undrilled, but sprayed with a protective coating of clear lacquer. This service will be available to their wide range of mail order customers, as well as personal shoppers.

Further information from Radio Despatch Service, 869 George St, Sydney, 2000.

Tono Theta-700 communications terminal

band, we tuned to a CW signal and were fascinated by watching the signal being printed out on the TV screen. The 7000 will only accept CW on an audio frequency of 830Hz, but this requirement can easily be met by adjusting the receiver tuning.

Similarly, we looked for some RTTY on 14MHz and "read" a local amateur in Sydney "talking" to a fellow RTTY enthusiast in France. This all sounds very easy but for a newcomer to the mysteries of RTTY, there are many traps to negotiate, such as setting the correct baud rate, the correct shift width, etc, not to mention correct tuning of the incoming signal. However, these are obstacles which experience will soon overcome.

Of all the LEDs on the front panel of the 7000, two of them designated "mark" and "space", are provided as indicators of correct tuning. They do the job as intended, but I am of the opinion that if a CRO is available, it makes tuning of RTTY signals much easier. Outputs are provided to allow the CRO to produce a standard "cross pattern", for this purpose.

One problem which was noted on receiving RTTY under very noisy conditions and with a weak signal, was that the readout flipped over from letters to figures, resulting in a meaningless readout under this condition. The situation could be corrected by pressing the "reset" button but this was rather drastic in that it cleared the screen! So far, I have not found the correct button to push, that is if there is one. If there isn't one, then hopefully the designers will see fit to add one on a later version.

A comprehensive instruction manual is provided. However, it is rather badly written, having suffered in the translation. While an experienced person in the field of RTTY would have little if any difficulty in understanding the text, the newcomer would not be so fortunate.

To sum up, this is an excellent piece of equipment and we have no hesitation in commending it to prospective buyers. At the price of $739.00, plus $5.00 extra for delivery anywhere in Australia, it seems to be particularly good value for money. The unit for review was supplied by Vicom International Pty Ltd, 68 Eastern Road, South Melbourne, Victoria 3205. Telephone (03) 699 6700. (I.L.P.)

New Products

Dicom RF Wattmeter

Dicom of the USA have released a new version of their series 1000 RF Directional Wattmeter. Designated the series 1000A, the new instruments are housed in a stylish "tapered" case which features a larger square-look meter to improve visibility and reading accuracy. Important existing features like interchangeable plug-in elements and series 8000 quick match connectors have been retained.

The series 1000A instruments can be used to measure from 5 to 5000 watts over the frequency range 2-1000MHz. Terminating RF loads rated for up to 50 kilowatts are also available. Most popular items are available ex stock.

Further information on the series 1000A instruments is available from Warburton Franki, the Dicom distributors in Australia, with offices in all capital cities.

Hex thumbswitches

A binary coded 16-position hexadecimal thumbwheel switch has been added to the C & K product range. Compatible with the existing range of thumbwheels, the new switches are available ex stock in both front and rear mount versions.

Further details from C & K Electronics (Aust) Pty Ltd, 2/6 McFarlane Street, Merrylands (PO Box 101) 2160.

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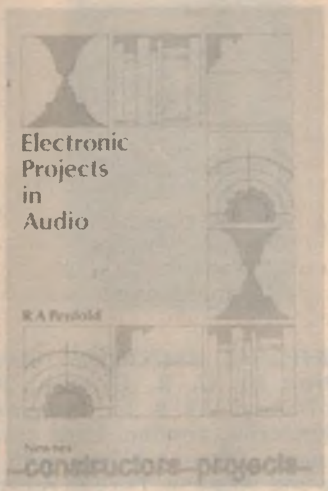

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Books & Literature

Op-amps update

OPERATIONAL AMPLIFIERS. Second Edition by G. B. Clayton, BSc. Published 1979 by Newnes-Butterworths, London. Hard covers, 410 pages 220mm x 145mm, with circuits and diagrams. Price in Australia $24.50.

The author, G. B. Clayton, is Principal Lecturer in Physics at the Liverpool Polytechnic (England). According to the jacket notes, this second edition has been extensively up-dated and rewritten and must surely be one of the best available texts for engineers and students, currently on the market.

The introductory chapter on "Fundamentals", followed by "Understanding Operational Amplifier Performance Parameters" add up to just on 100 pages of very informative reading, being quite outstanding in their presentation. But that is only the beginning. The remaining 300-odd pages cover (abbreviated) Op-Amp Testing, Basic Scaling Circuits, Non-Linear Circuits, Integrators and Differentiators, Switching and Positive Feedback Circuits, Measurement and Processing Applications, Practical Considerations, Exercises and Answers, Appendices and Index.

The book is essentially practical, containing a great many ideas and circuit configurations. However, being intended for those with applications ability, some values have to be deduced to meet individual requirements and, of course, there is no constructional information.

It's not a cheap book but, if you could use a text which takes a practical yet penetrating look at operational amplifiers, this one would have to be considered. Our review copy came from Butterworths, 586 Pacific Highway, Chatswood, NSW 2067. (W.N.W.)

Electronics course

TRANSISTOR ELECTRONICS by Howard H. Gerrish and William E. Dugger, Jr. Published 1979 by the Goodheart-Willcox Company, Inc. Hard covers, 368 pages 265mm x 200mm, illustrated by diagrams and photographs. Price in Australia $14.50.

At first glance, and from the title, one might judge this book to be concerned primarily with the physics, the characteristics and the application of transistors. In one sense it is, but it would be described more correctly as an electronics course — written in and for the solid-state era. As far as I could see, thermionic valves receive not a single mention!

In the manner of a comprehensive course, it begins with basic energy concepts and the structure of matter, progressing through electrical sources, conductors and semiconductors, resistive circuits etc. It covers resistance, capacitance and inductance, and takes in magnetism, generators and motors, with more than the usual attention to attendant electrical theory.

Not until page 194 does it really come to grips with transistors, etc, but it then proceeds to examine quite closely typical circuit applications such as for amplifiers, power amplifiers, oscillators and RF applications. Towards the end of the book, there is an abbreviated coverage of switching and logic, integrated circuits, computers and microcomputers.

A reference section, a dictionary of

terms and an index round out what must be described as an up-to-date, practical and well presented basic text. And, at today's prices, $14.50 is not too daunting a figure. The authors, both professors at American institutions, are to be congratulated on its presentation.

Our copy came from the ANZ Book Co Pty Ltd, PO Box 459, Brookvale 2100. Phone (02) 938 2244. (W.N.W.)

Money maths

YOUR ELECTRONIC CALCULATOR AND YOUR MONEY. By F. A. Wilson CGIA, C.Eng., FIEE, FIERE, MBIM. Published 1979 by Bernard Babani (Publishing) Ltd. Stiff paper covers, 174 pages 182mm x 108mm. Price not quoted.

Seeing this book on the shelf, one rather expects to find advice inside on how to choose and "drive" a calculator, albeit in connection with money matters. In fact, it is more or less taken for granted that the reader already owns a normal 4-function calculator but can use some additional advice as to how it can be utilised to work out all manner of money problems.

What the reader gets, in effect, is a substantial tutorial on money-orientated arithmetic. Chapter 1 revises arithmetic fundamentals, then goes on to cover things like currency conversions, discounts, profits, simple and compound interest, etc.

This is followed by chapters on "The Calculator In The Home", "Investment", and "The Calculator In A Small Business". Appendices contain tabulated data on these and other subjects.

I can't imagine the average (even technical) reader toiling through all this but it could be of interest to those of a mathematical turn of mind, and of direct value to others who wish to increase their facility with small-business and even large-scale domestic economics.

Our advanced review copy came direct from the publishers. (W.N.W.)

AOCP exams

500 QUESTIONS FOR AOCP CANDIDATES, by Bill Dunn (VK2BDW), Ken Hargreaves (VK2AKH), Fred Santos (VK2BYJ), and Dave Wilson (VK2ZCA/NMW). Published by the WIA (NSW) and YRS Education Service. Soft Covers, 165mm x 235mm, 96 pages, many circuits and diagrams. Price (SRP) $2.50.

According to the preface, this book has been written to aid candidates preparing for the new multiple choice format AOCP examination. However, the authors point out that it has been difficult to set an accurate standard for the questions, due to the lack of previous examinations of this type as a guide. As a result, it is based largely on the standard of the previous essay type papers.

There are 12 subject headings: Electrical laws and circuits, Power supplies, Semiconductors, Vacuum tubes, Oscillators, Transmitters, Receivers, Antennas and transmission lines, Propagation, Test equipment and measurements, Interference, and other transmission modes. This is followed by a list of answers, and a proposed AOCP syllabus.

This appears to be a very good book for its intended role. If the authors have erred at all, it may be towards a greater degree of difficulty than to be expected in the actual exams, but this would be a good fault if it proves to be true.

One thing would seem to be certain: anyone who can answer all — or most — of these questions correctly should have no difficulty with a typical AOCP exam.

Inevitably, a few questions (or the answers) caused a raised eyebrow or two, even after only a casual browse. One was question 11 in the vacuum tube section, in which none of the suggested answers are really satisfactory. Another was question 19 in test equipment, in which it would seem that there is insufficient information to enable any answer to be given.

But don't let these minor points stop you. If you are planning to sit for the AOCP or the AOLCP exam, this book is a "must" — and very good value for money into the bargain.

Our copy from the publishers. (P.G.W.)

Digital techniques

BEGINNERS GUIDE TO DIGITAL TECHNIQUES by G. T. Rubarie. Published 1979 by Bernard Babani (Publishing) Ltd. Stiff paper covers, 64 pages 108mm x 107mm, with diagrams and tables. Price in Australia $2.70.

This little book starts off in the expected manner by contrasting analog and digital concepts. It then progresses to a normal treatment of decimal and binary numbering, briefly taking in octal and hexadecimal.

The pace then accelerates and the reader finds himself hurried through numbering codes, combinational and sequential logic, A/D and D/A conversion, &c. The remaining eight pages of "Applications" is devoted to computers and digital voltmeters.

In my sample reading, I saw no reason to question the accuracy of what is presented but I did question whether a "Beginner" could assimilate much from this very abbreviated treatment of a very extensive subject. But have a go, if you are so inclined. At the very modest purchase price, you will not be chancing a great deal!

Our advanced production copy came direct from the publishers. (W.N.W.)

INFORMATION CENTRE

MASTHEAD AMPLIFIER: I do not think the masthead amplifier published in the August 1979 issue goes far enough. What we need is a frequency selective amplifier with provision for extra stages for weak signal conditions. The problem usually is a powerful local signal which overloads the masthead unit preventing enough amplification for weak signals. I think if you can come up with a circuit along these lines you will please a lot of people. (G.W., Bibbenluke, NSW).

● No doubt you are right in saying that a tuned masthead amplifier would be useful in many locations but it is unlikely that we could produce one or more circuits which would satisfy all possible situations. Where you wish to receive one or more weak stations and have to cope with a strong local station it may be more useful to consider the masthead amplifier in conjunction with a tuned stub to attenuate the strong station.

A stub can be made from a piece of coaxial cable connected in parallel with the cable from the antenna. The cable should be cut to an exact quarter-wavelength (at the frequency of the strong station to be attenuated) and the unconnected end should be open-circuit. In practice, you start with a length about 10cm longer than that calculated and fine-tune the "stub" by cutting off small pieces and noting the reception on the screen.

One further point to be considered is the "velocity factor" of the cable you use. This factor gives the ratio between the physical length and the effective electrical length. Typical coax cables with solid polythene dielectric have a velocity factor of 0.67 while semi-air spaced cables have a higher figure ranging up to 0.85.

SOLAR CELLS: I am a year 10 student and I have to do an assignment on solar energy. I was asked to find out how large a bank of solar cells would be needed to produce 100MW of electricity, assuming that today's solar cells are 10% efficient. I have referred to many books, and some of your magazines, but there was not sufficient information to help me. I will be very grateful for anything you can send me. (C. C., Arncliffe, NSW).

● In our January 1979 issue we described a typical solar panel, consisting of 18 cells, and measuring 483mm x 165mm x 29.3mm. It delivered 4.23 watts so, if you have enough paper, or a big enough calculator, you can work it out from there! Actually, it would take 236,407 such panels to generate 1MW (1,000,000 watts) and 100 times this, 23,640,662, to generate your suggested 100MW — that is, while the sun is shining.

The cost? Well, those panels were advertised at a special price of $145, which would work out at, approximately, $3,475,200.00. (Of course, you might get a discount for quantity!). How big? No, you can work that one out yourself.

More seriously, C. C., we wonder if you have seen our August 1978 issue, which had a very good article on present solar cell techniques, and quoted typical figures for systems up to 500kW. Significantly, a 5ha site was quoted as being required for such an installation.

CAPACITOR DISCHARGE IGNITION: I have constructed several of your CDI systems (File No. 3/TI/12, July 1975) for myself and friends. The problem is that they sometimes suddenly cut out. They can do it when hot or cold and at high or low revs. I am not sure whether it is the SCR which is at fault. I have found that one unit would cut out when the input voltage rose to 16V but if connected via long wires it would cut out at 13V input. Another unit was not effected in the same way but still cuts out every now and again.

A great part of the problem with these faults is the difficulty of simulating them on my work bench. I have to drive around with the unit open on the seat next to me until it cuts out and then quickly see if I can find what is wrong with it. I consider that there must be a fault or weakness in the original design. Needless to say I have had my construction checked by several friends with an electronic interest. (S. W., Esperance, WA).

● As you can see we have condensed your letter while still maintaining the general theme. Clearly, any unit which cuts out in the range 13 to 16V input is suffering from voltage breakover in the SCR, dv/dt switching of the SCR or a combination of both effects. You do not state the output voltage of the inverter. It should be within 10% of the nominal 300V with a 12V input and around 400V with 16V input. Higher voltages will cause problems of unreliability.

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REPLIES BY POST: Limited to advice concerning projects published within the past two years. Charge $2. We cannot provide lengthy answers, undertake special research or discuss design changes.

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COMMERCIAL, SURPLUS EQUIPMENT: No information can be supplied.

COMPONENTS: We do not deal in electronic components. Prices, specifications, etc., should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

for the C122E SCR. This is a rugged and proven device while other types which are nominally equivalent are an unknown quantity.

We sympathise with you in your frustration over these problems of intermittent failure but cannot agree that this necessarily indicates a fault in the basic design. Many thousands have been built and are giving reliable service. ●

NOTES & ERRATA

2650 EXPANSION BOARD (November 1978, File No. 2/CC/32): It has been pointed out that both the inverted WRP signal and the PAGE O-bar signal from the expander board are currently described as being taken to pin 4 (G2-bar) of the 74LS138 decoder on the main board. This is an error; one of the signals should be taken to pin 5 (G3-bar) instead. It does not matter which signal. Note that the link taking pin 5 to ground must be cut, in order for this to be effective.

MASTHEAD AMPLIFIER (August 1979, 6/MS/5): An improvement in the protection against damage from nearby lightning strikes can be obtained by connecting a 15V zener diode across the output from the masthead unit. Normally non-conducting, the 15V zener will effectively remove any lightning induced voltage spikes from the cable to the masthead. In providing this protection, the zener may be "blown" but this is preferable to damage to the OM350.

INFRA-RED . . . from page 48

unaffected by visible light but the BPW34 has no filter and it is necessary to use an external filter placed directly in front of the photodiode to reduce interference.

Kodak Wratten gelatin filter No. 87 is the recommended infra-red filter and it can be obtained from any of the larger photographic suppliers such as Kayell Photographics, 143 York Street, Sydney. The filter is normally supplied as a sheet, 75mm square and costs more than $5 which is fairly steep considering that a piece about 20mm square is all that is required. We hope that kitset suppliers will make suitable arrangements.

The photodiode is mounted underneath the board and soldered to two lengths of wire so that it hangs about 10mm below the board, though the distance is best determined by actually pushing the board down onto the plastic board supports and checking that the photodiode has the best "window".

Two other lengths of stout wire are soldered to the earth track just in front of the photodiode. These are bent upward at the bottom so that they can support the infra-red filter, which should be placed so it completely covers the front surface of the photodiode. The filter is not necessary if you are using the Siemens BP104 photodiode. The only point to note when using the BP104 is that the cathode is marked with a blue dot.

The only other item to be mounted on the board is a metal shield. This is located over the audio buffer section next to one of the uA4136 op amps as can be seen in the photograph of the receiver. The purpose of the shield is to prevent any audio signals from being coupled to the input of the infra-red circuitry. The shield can be fashioned from some tin plate and it is fastened to

(Continued on page 128)

Marketplace

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2SB405	50c
2SA351	50c
2SA350	50c
BD238	50c
B1544	50c
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B514E	50c
C1048D	50c
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AT473	50c
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47 ohm, 5W, 20c
12 ohm, 3W, 20c
2.5 ohm, 3W, 20c
33 ohm, 3W, 20c
8 ohm, 10W, 25c
4000 ohm, 10W, 25c
1000 ohm, 5W, 20c
330 ohm, 10W, 25c
220 ohm, 5W, 20c
5 ohm, 5W, 20c
220 ohm, 10W, 25c
950 ohm, 3W, 20c
115 ohm, 5W, 20c
10 ohm, 5W, 20c
1k ohm, 5W, 20c
5000 ohm, 5W, 20c
6.8k ohm, 3W, 20c
330 ohm, 10W, 25c
6800 ohm, 10W, 25c
1500 ohm DUAL, 21W, 50c
50 ohm, 5W, 20c
330 ohm, 5W, 20c
1k ohm, 5W, 20c
820 ohm, 5W, 20c
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0.068uF	400V	5 for $1
2200PF	630V	10 for $1
0.47uF	250V	10 for $1
0.10uF	400V	5 for $1
0.082uF	160V	10 for $1
26k	250V	10 for $1
0.041uF	400V	10 for $1
0.033uF	250V	5 for $1
0.027uF	100V	20 for $1

SPEAKERS

MSP 9 x 6 15 ohm	$6.00
9 x 6 8 ohm	6.00
12 watt 8 inch dual cone 8 ohm	9.00
7 x 5, 15 ohm	5.50
7 x 5, 8 ohm	5.50
6inch dual cone, 8 ohm	5.00
6 inch single cone, 15 ohm	5.00
6 inch dual cone, 27 ohm	8.50
5 inch dual cone, 27 ohm	5.00
5 inch single cone, 3.5 ohm	3.50
5 inch single cone, 8 ohm	3.50
5 inch single cone, 15 ohm	3.50
4 inch dual cone, 4 ohm	6.00
6 inch dual cone, 3.5 ohm	6.00
4 inch single cone, 15 ohm	3.00
4 inch single cone, 27 ohm	4.50
5 x 3, 27 ohm	3.50
5 x 3, 47 ohm	3.50
7 x 5, 3.5 ohm	5.50
12 watt 8 inch dual cone, 3.5 ohm	8.50
5 x 7 single cone, 27 ohm	5.50
3 inch, 8 ohm	2.50
6 x 4, 8 ohm	2.50
6 x 4, 15 ohm	2.50
6 x 9, 27 ohm	6.50
6 x 9, 47 ohm	6.50

SPEAKERS SPECIAL

$1 pair 2¼ inch
5 x 3, 8 ohm
2 for $3

SPECIAL

8 x 4, 15 ohm, $4
8 x 4, 8 ohm, $4
3¾ inch, 8 ohm, $1.50
6 x 9, 3.5 ohm, $6

6 inch dual
cone, 4 ohm, $5

SPECIAL

100 mixed resistors, all useful, $2
100 Mixed capacitors, fresh stock, $2

AUDIO LEADS

3.5m to 3.5m, 7ft, 75c
3.5m to 6.5m, 7ft, 75c
6.5m, 7ft, 50c

MICRO SWITCH

5A, 250V AC, 75c each

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2 and 3 gang, $1 each
min 2 gang, 50c

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0.5A, 2A, 3.25, 10 for $1
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RCA jack plugs and sockets, 40c pair

PILOT LIGHTS

Screw in 6.3V, 10 for $10.50
12V, 10 for $1
24V, 10 for $1

100 Mixed Resistors, all useful
$2.00

Special! 100 mixed capacitors — fresh stock, all useful
$2.00

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Transistor
NT3030
NT3032
Colour—PP $1
$10 ea

Infra-red remote control. . .ctd from p125

the board via wire links which are soldered both to the shield and to the underlying earth pad.

After completing the board the transformer and RCA sockets should be mounted. A rectangular cutout is required for the RCA sockets and this can be done by drilling a series of holes or by using a nibbling tool and then filing the edges straight. The earth connections on the socket are soldered together and then soldered to an adjoining lug on the chassis via a 10k resistor. The purpose of the resistor is to ensure that the case isn't "floating". We've used a resistor rather than a link to prevent any ground loop problems.

Since the power consumption of the receiver is very low we have omitted a power switch. This simplifies the wiring and also the operation. You need not bother to turn the unit off when you turn the rest of your system off. With an estimated power consumption of about five watts the cost of leaving the unit running for a year is about $1.30, assuming a cost of three cents per kilowatt-hour.

Now the board can be finally mounted on the chassis with the transformer leads and the shielded cable connected. With power applied first check that the ±12 and +5 volt supplies are operational. If there is nothing seriously wrong with the board then at least one of the display LEDs should be on — so far so good. To check the overall operation though you'll have to assemble the transmitter.

We housed the transmitter in a small plastic box that is inexpensive, and readily available from part stockists. The "up" and "down" buttons are mounted on the aluminium front panel of the plastic case, about 18mm from one end of the panel and about 21mm apart from each other. The only other modifications to make to the box are to drill two holes for the infra-red LEDs. These should be drilled 8mm from the bottom of the case and about 8mm apart from each other.

The PC board has no mounting holes and is designed to sit at the bottom of the case, being held in place by the battery and the lid of the box. There should be no problems with this arrangement. In fact there are some distinct advantages; no screws underneath the case to scratch furniture (the prized coffee table) and it also makes assembly easier.

The IR LEDS should protrude from the case by at least 5mm so that the emitting portion of the diodes is completely exposed to improve the range of the transmitter within a room.

The capacitors should be laid flat on the board so that they have a low profile. This is necessary in order to accommodate the battery which sits immediately between the board and the lid of the case, albeit with a thin layer of foam sandwiched between them. The foam helps to keep the battery and board firmly in position.

With the transmitter completed, you should now be in a position to check the remote control out. If it fails to work at all check the polarity of all the electrolytics and diodes and the orientation of the voltage regulators and the ICs. If it works but not with the range you expected you may have the BPW34 (BP104) receiver diode in the wrong way or it may not have a good view through the front panel — this is very important. The larger the window available to the diode the better it will perform.

The receiver may also suffer from interference. If electrical interference is a severe problem it can be solved by shielding of the first stage of the infra-red circuitry with tin plate. Flourescent lights will also effect performance if the receiver is pointed directly at them.

With all checks complete you are ready to sit back and enjoy the luxury and convenience of infra-red remote control. Set the maximum volume levels as described above, tune in to your favourite station and enjoy your latest addition to hifi appreciation. We hope you like it!

ADVERTISING INDEX

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