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THE MULTIFLEX Z80A COMPUTER

Check out the independent review in May 81 ETI

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MULTIFLEX S-100 MEMORY CARDS

Multiflex Technology, Inc. is proud to announce a new series of S-100 dynamic memory cards. The first is based on the 8202 Dynamic Memory Controller chip, which minimizes the introduction of wait states and allows on-board refresh.

Each board can hold a maximum of 64K bytes, 200nS 4116 chips. The boards have a software bank-selection feature, which allows up to eight full boards to be used in a single system. Using a slightly modified addressing scheme, any microprocessor can access 512K bytes (one half Megabyte) of RAM.

To maximize flexibility, hardware jumpers are used to select certain functions of the boards, allowing for variations in user applications. Firstly, the refreshing of the 4116 chips may be done automatically by the 8202 (this is transparent to the user) or by response to an external refresh signal such as that generated by the Z80 microprocessor. Second, the parts of the board which answer to addressing can be defined by jumpers. This feature is used mainly with partially-populated boards, but also has limited applicability for write-protection.

The boards feature a buffered S-100 bus interface and have been designed for the Multiflex Z80A computer system, but they are fully compatible with most other S-100 microcomputers.

$350 KIT (WITH ALL MEMORY)
$450 A & T

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ECONO RAM

The second board is of simple design and construction for those people who want extra memory, but don't want to spend extra money. This board, which is ideal for the Multiflex Z80A Computer, uses 8 4164 single supply chips. The refreshing is done via the refresh signal provided by the Z80A CPU chip. Two important features are the 28 chip prototype area for custom circuits, and the fact that this board needs only a +5V power supply, lowering the cost of your power supply.

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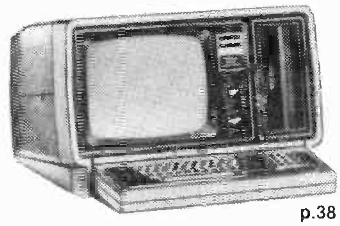
INTERNATIONAL

APRIL 1982 Vol. 6 No. 4

Features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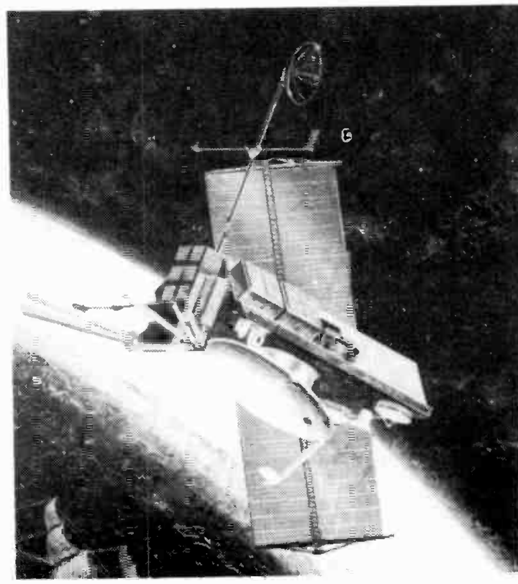
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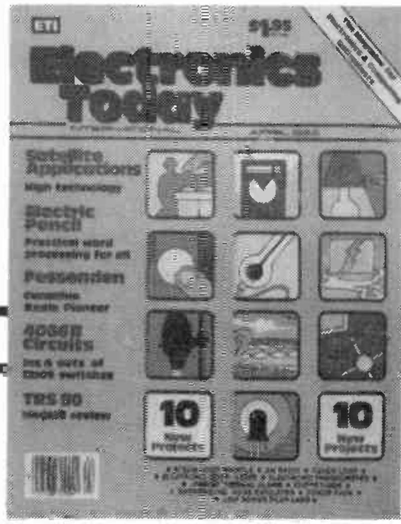
p.63


Our Cover: Ten projects to build and give as gifts to people who like peculiar soldered together stuff. Steam Loco Whistle, AM Radio, Touch Lamp, Electronic Doorbuzzer, Electronic Thermometer, uPower Thermal Alarm, Photo Timer, Background Noise Simulator, Power Pack. Low Power Pilot Light.



ISSN 0703-8984

Projects

Columns, News and Information

ADVERTISERS' INDEX

Editorial Queries
Written queries can only be answered when accompanied by a self-addressed, stamped envelope. These must relate to recent articles and not involve the staff in any research. Mark such letters ETI-Query. We cannot answer telephone queries.

Binders
Binders made especially for ETI are available for $8.00 including postage and handling. Ontario residents please add provincial sales tax.

Sell ETI and ETI Special Publications
ETI is available for resale by component stores. We can offer a good discount when the minimum order of 15 copies is placed. Readers having trouble in obtaining the magazine could ask their local electronics store to stock the magazine.

Component Notation and Units
We normally specify components using an international standard. Many readers will be unfamiliar with this but it's simple, less likely to lead to error and will be widely used everywhere sooner or later. ETI has opted for sooner!
Firstly decimal points are dropped and substituted with the multiplier: thus 4.7uF is written 4u7. Capacitors also use the multiplier nano (one nanofarad is 1000pF). Thus 0.1uF is 100nF, 5600pF is 5n6. Other examples are 5.6pF = 5p6 and 0.5pF = 0p5.
Resistors are treated similarly: 1.8Mohms is 1M8, 56kohms is the same, 4.7kohms is 4k7, 100ohms is 100R and 5.6ohms is 5R6.

PCB Suppliers
ETI magazine does NOT supply PCBs or kits but we do issue manufacturing permits for companies to manufacture boards and kits to our designs. Contact the following companies when ordering boards.
Please note we do not keep track of what is available from who so please don't contact us for information on PCBs and kits. Similarly do not ask PCB suppliers for help with projects.

K.S.K. Associates, P.O. Box 54, Morriston, Ont. N0B 2C0.
B&R Electronics, P.O. Box 6326F, Hamilton, O
L9C 6L9.
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L0R 2H0.
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Arkon Electronics Ltd., 409 Q
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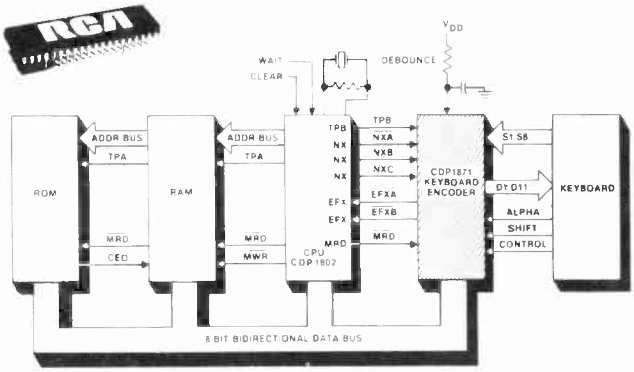
News



Keyboard Encoder

A complete, single-chip keyboard-to-microprocessor interface designed for the CDP1800 series of processors is available from RCA. Called the CDP1871, the 40-pin, silicon-gate CMOS IC interfaces directly between CDP1800 Series microprocessors and a mechanical single-pole, single-throw (SPST) keyboard array.

With the addition of the CDP1871, 1800-series processors can be applied in manual data-entry systems such as Point-of-sale terminals, credit card verifiers, industrial controllers and telephones.

The 1871 scans and generates code for 53 ASCII keys, and in addition, produces hex-coded outputs for 32 non-ASCII keys such as mechanical contact switches. Data-bus lines containing the ASCII and non-ASCII codes have three-state outputs.

The device is configured in two major sections: the counter/scan selection logic scans the keyboard array using drive and sense lines; the control logic interfaces with CDP 1800-series CPU I/O and timing lines to establish timing and status conditions for the chip.

Key features of the 1871 include alpha, shift and control inputs that allow modification of the chip's drive and sense lines. The alpha connects to a standard SPDT switch to provide an alpha-lock function. A debounce input permits users to select the key-debounce delay time with just a single external capacitor and resistor. A number of chip-selects are provided for enabling the three-state data-bus outputs, resetting the status flag and allowing I/O selection by an 1800-series processor.

The CDP1871CE is priced at $5.98 U.S., and the CDP1871E is priced at $8.98 U.S.

For further information, including technical data sheet No. 1232, contact RCA Solid State Division, Box 3200, Somerville, NJ 08876, Telephone (201) [illegible]06.

Magic Wand

Zenith Data Systems is now supplying Magic Wand, a sophisticated word processing program for its microcomputer systems. "With powerful features and a quality training course, Magic Wand is a flexible program and is easy to learn and use," says Brian Winks, ZDS general manager. "Even with advanced features, such as the ability to print and edit at the same time and make commands in a single keystroke, Magic Wand is still an affordable program at $380.

Magic Wand is compatible with CP/M, the most widely-used operating system for microcomputers. In addition, the program also can merge letters and pre-recorded addresses, greetings or other information. This special merge feature is built into Magic Wand, Winks said, while users of other word processors have to purchase a mailing package separately to accomplish the same tasks. With Magic Wand, a new document also can be prepared on the screen during printing.

Magic Wand's comprehensive training course is outlined in the step-by-step instructions in the owner's manual.

Basic functions are simple to learn, because most commands are made with a single keystroke. Even the more advanced commands in both modes — print and edit — can be learned with little training.

Features in Magic Wand's print mode include subscripts, superscripts, bold-facing, underscoring, justification and centering. Magic Wand's edit mode features include forward and backward scrolling; deletion of characters, lines or blocks of text; and the ability to move blocks of copy from one location to another within the same document.

Magic Wand is one of three word processing programs offered by ZDS. It is positioned between Electronic Typing and WordStar, which have suggested retail prices of $295. and $495. respectively. It is available for both 5.25- and 8-inch diskettes.

Zenith Data Systems sells Magic Wand through dealers across Canada and from the Heath mail order catalogue. It is also available from Heathkit Electronic Centres in Vancouver, Calgary, Edmonton, Winnipeg, Mississauga, Ottawa, and Montreal.

General Electronics

The advertisement in our March issue did not list their phone number. It is (416) 221-6174. We apologise for any inconvenience caused.

Direct-Dialing Goes to Sea

On February 1, 1982, INMARSAT (International Maritime Satellite Orgainization) will offer full satellite telecommunications services both to the world's shipping industry and to rigs engaged in oil and gas exploration and production. Teleglobe Canada, as the Canadian signatory to the INMARSAT operating agreement, will be providing communications between sea-borne vessels and the Canadian mainland.

While maritime satellite communications are not new, the involvement of Teleglobe Canada, through INMARSAT, will mean reduced rates for Canadian users of maritime telephone and telex services and will enable suitably equipped ships or oil and gas exploration rigs to dial direct to any destination in the world already served by direct-dialing.

By providing rapid, high-quality communications, the INMARSAT system will prove invaluable for cargo, fishing and passenger vessels as well as have special applications for exploration rigs. The immediate benefits include improved distress and safety communications and fast reliable communication of weather reports or commercial information.

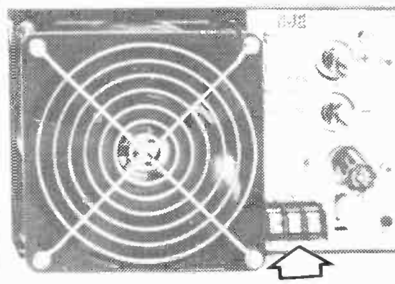
INMARSAT will operate with a network of land-based satellite transmitting stations and leased satellites. Ships equipped for INMARSAT service will transmit and receive messages using a small-diameter parabolic antenna mounted above deck in a protective radome. Electronic equipment will ensure that the antenna keeps pointing at the satellite regardless of course or ship movement.

For more information, please contact: Mr Philip van Leeuwen, Montreal (514) 281-5060, or Mrs. Grace Lake, Toronto (416) 364-8882.

Transformers

L.H. Frost Limited has introduced a 16 page catalogue of transformers and reactors. Low voltage rectifier transformers, audio line matching transformers and filter chokes will be of primary interest to electronic O.E.M.'s, while Class 2 and Control Transformers are designed for industrial control applications. To compliment the standard line, an information sheet enables Frost to quickly supply efficient, accurate custom designs.

For more information, contact Susan Blasko, L.H. Frost Limited, 1130 8th Line, Oakville, Ontario, L6H 2R4.



Switching Power Supplies

Just published, an illustrated product data bulletin introduces a new MK series of NJE switching power supplies which are warranted against defects in materials and workmanship for five years. Containing dimensional drawings and specifications, the new bulletin reports the new supplies to be designed to meet UL standards as well as continuous and extended operating requirements.

Among features highlighted are loss of sense protection, remote sensing, remote inhibit, power fail signal, overload and overvoltage protection, full rating to 50°C, and inrush limiting and turn-on, plus an optionally-available crowbar.

The bulletin lists 40 standard models with inputs ranging from 120 VAC, 47-63 Hz to 240 VAC, 47-63 Hz. Outputs range from 2 V at 150 A to 300 A up to 48 V at 18 A to 36 A. Units are described as being housed within industry standard cases (5" x 8" x 11").

A copy of Product Data Bulletin MK-101 can be obtained without charge by writing to NJE, P.O. Box 50, Culver Road, Dayton, NJ 08810., telephone (201) 329-4611.

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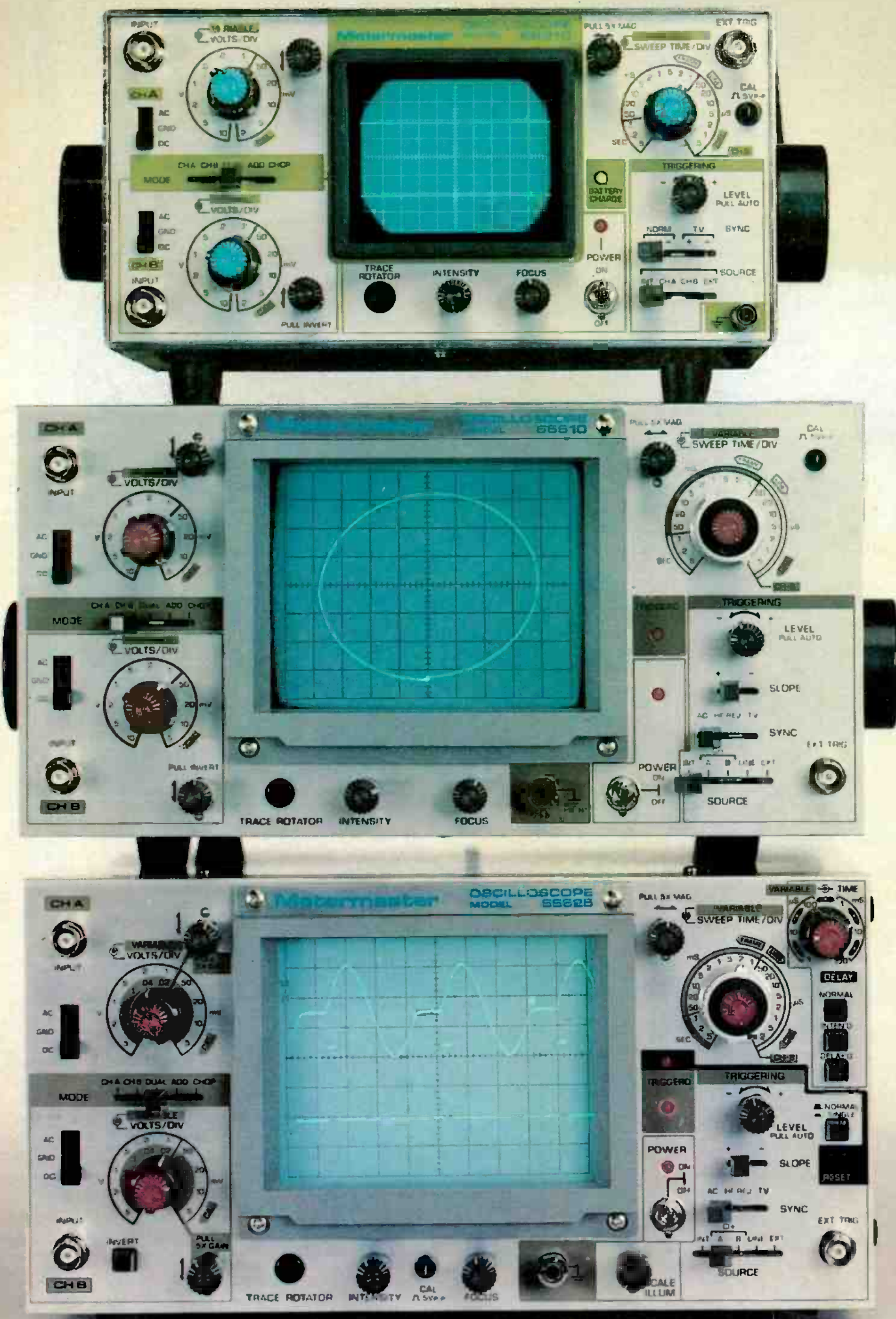

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Circle No. 11 on Reader Service Card.

Looking Back

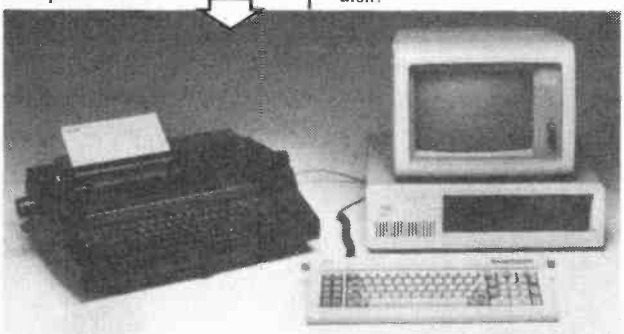
There are a few errors in the schematic for the Universal Counter project in the December '81 issue. Pin 12 should go to 0V, not -5V. The reset switch from pin 19 should also go to 0V, not -5V. The 100k resistor at pin 39 should go to 0V, as well. The PCB is okay.

In the power supply, the centre tap of the transformer should go to the other side of R27, and the ground lead of IC8 should go, in fact, to ground. Again, no hassle if you used the PCB.

Communicating Interface

A new interface product which supports the IBM Models 50, 60 and 75 electronic typewriters is announced by Network Data Systems Limited of Toronto.

The new interface, known as The Personal Computer Connection, allows IBM electronic typewriters to be used as word processing printers and communicating terminals, with all the advantages of a true, two-way input/output device.



The second in a growing family of Canadian designed and manufactured interface products, it joins the NDS interface for the Olivetti 121, 201 and 221 electronic typewriters, introduced in October of 1980, and currently installed in hundreds of typewriters across Canada and the U.S.

The company says a major advantage of its new interface is cost. The lowest priced letter quality word processing printer (read only) is around $4,000, whereas the new interface costs only $600 more than the price of an IBM electronic typewriter.

Convenience is another important factor. Today's executive can now have a word processing printer, an interactive terminal, an electronic mail facility — and an electronic typewriter — all as close as his secretary's desk.

The interface, which is completely enclosed within the typewriter, is also available as an upgrade kit to existing users of IBM electronic typewriters.

For more information, contact Network Data System Ltd., 245 Yorkland Blvd., Suite 302, Willowdale, Ontario M2J 4W9, telephone (416) 497-0910.

Hard Disk

An 8-inch Winchester disk drive with floppy disk back-up has been introduced by Zenith Data Systems for its business microcomputer systems.

The non-removable Winchester in the new Z-67 increases the storage capacity of Zenith microcomputers to almost 10 million bytes (or characters), with the eight-inch floppy diskette back-up providing an additional one million bytes.

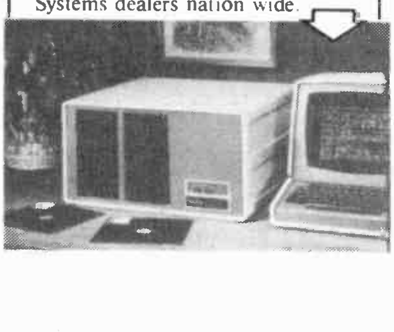
"Software like our Peachtree accounting packages can now be stored on a single disk instead of multiple floppy diskettes, speeding a manager's access to information," says ZDS director of marketing, Craig Oliver. The Winchester disk also reduces the time needed to retrieve stored information by finding and transferring data at faster speeds than floppy disk systems.

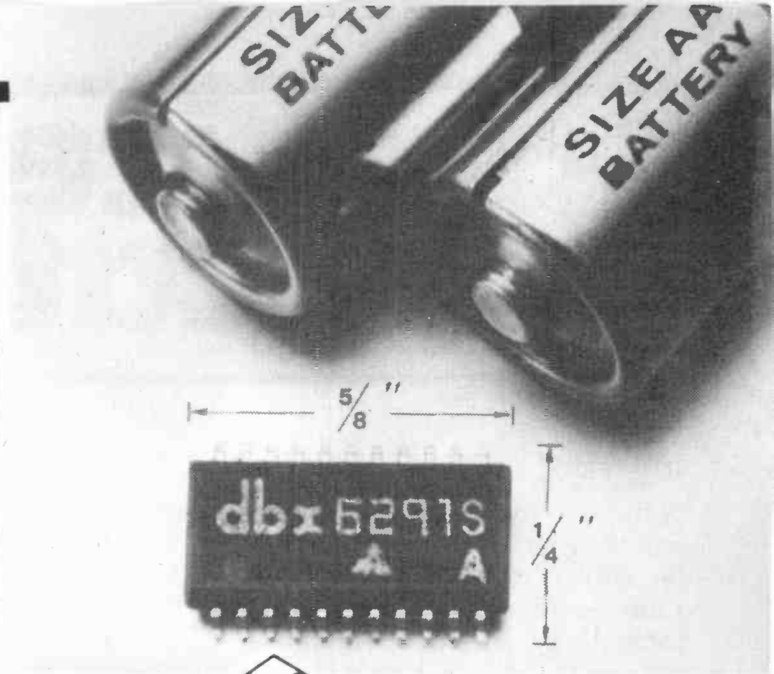
The Z-67 Winchester disk has a suggested retail price of $8450, including interface card and cables. The Z-67 features front panel switches to protect data on either the Winchester or floppy disk.

The floppy disk drive sits side-by-side with the Winchester drive in a 19" by 11" cabinet which is normally used as a desktop unit but which can also be mounted in a standard 19" equipment rack. A switching power supply is also built into the Z-67 to reduce heat generation and weight.

Zenith Data Systems is providing a utility software program to permit use of multiple operating systems. The new Winchester disk connects directly to the back of the Zenith Data Systems Z-89 or Z-90 microcomputers using a flat cable.

Zenith Data Systems microcomputer products are available from Heatkit Electronic Centres in Vancouver, Calgary, Edmonton, Winnipeg, Mississauga, Ottawa and Montreal and authorized Zenith Data Systems dealers nation wide.





dbx NRX Chip

Matsushita Electric Industrial Co., Ltd., will produce a new, low cost, low voltage integrated circuit for the dbx noise reduction system for operation in portable cassette units. In announcing the new NRX chip developed jointly by dbx and Matsushita, dbx president David Blackmer said, "The chip is a revolutionary development for the booming personal cassette player and autosound markets, enabling this equipment to provide wide dynamic range and full fidelity sound matching the sonic performance of digital audio systems in many important respects."

With this tiny chip, dbx noise reduction for both recording and playback will now be available at such a low cost that it is viable for mass market products. It is also expected to have wide impact on the personal portable market. The dbx NRX chip can operate on as little as 1.8 volts. This is important since most portable cassette players operate on batteries which provide 3 volts, but drop in voltage as they age. Such low (1.8) voltage operation has, up to now, been impossible with any noise reduction integrated circuit.

The dbx NRX chip solves two major performance problems inherent in portable cassette and car stereo players — limited dynamic range and tape hiss.

As large as the market is now for dbx noise reduction technology, dbx believes the system will be used universally when digital playback systems become viable as mass market equipment. The dbx system is the only system that will enable a digital disk to be copied onto analog tape with the full dynamics of the digital performance. Owners of digital playback systems who want to record the full impact of digital music on cassettes for home or automobile players can do so only with the dbx noise reduction system.

The immediate impact of the NRX chip will be felt in the portables and car cassette market, according to Mr. Blackmer, since it will enable the many thousands of people who now record with dbx system to play their cassettes on car stereo systems and in personal portable equipment. The extremely small size of this chip and its associated circuits makes dbx noise reduction viable for microcassette products. dbx believes this development will pave the way for an explosion in sales of these and other miniaturized audio and video products.

Through the combined efforts of dbx and its licensees (including Technics, BSR, Yamaha, Marantz, Teac, Alpine, among others), an estimated 200,000 units with dbx noise reduction are in use internationally at the present time. There is expected to be more than one million units in use in 1983. These include dbx's own outboard noise reduction systems and decoders as well as home cassette recorders and car cassette players manufactured by leading audio equipment manufacturers which incorporate the dbx system. The new dbx NRX chip will be made available only to dbx licensees.

February Issue

We have had a lot of complaints about late delivery of subscriptions of the February 1982 issue. The issues were mailed on schedule on Jan. 19th but there were unusual delays in the Post Office. We do not know what went wrong but the Post Offices representatives took our complaints seriously and the March issue mailing was monitored by them and appears to have got out very rapidly.

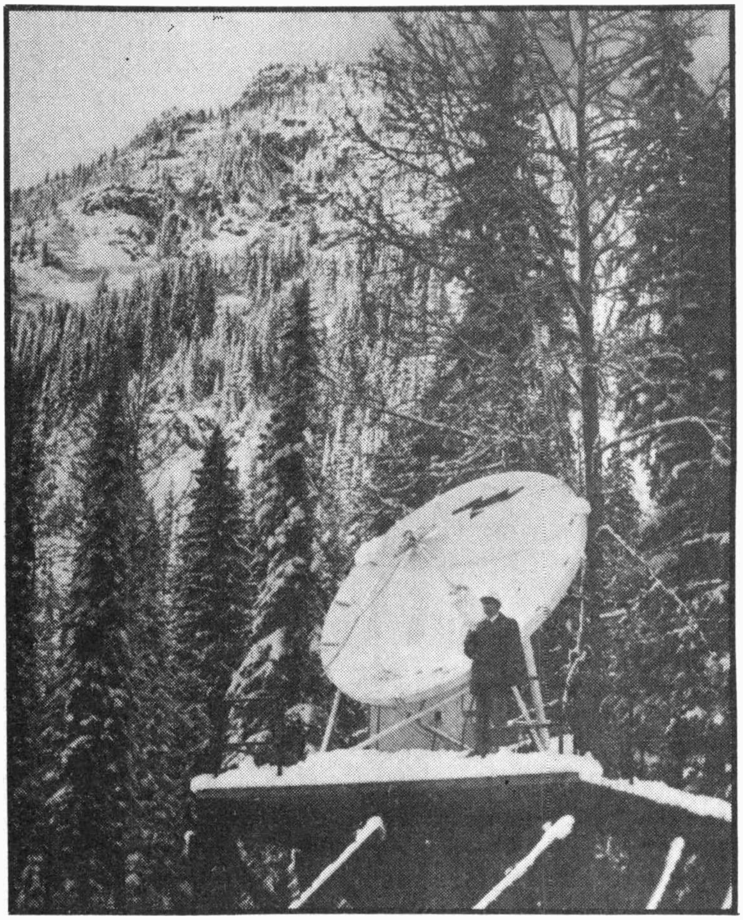
The problems all Canadian publishers are having with the mails are supposed to be considerably reduced within a few months as new procedures for handling magazines are going to be introduced.

We apologise for this delay and hope readers will understand that it was quite out of our control.

ETI

Satellite Applications

They relay phone conversations, produce weather maps and even bring the CBC to the far North (pity the far North). The uses of satellite technology, by Roger Allan



CNCP Communications dish. —CP Rail Photo.

With the rise of satellite communications over the past twenty-five years, and the passage of satellite technology ever more from the hands of government to those of civilian life, most of the major applications of satellite communication have not only been demonstrated but implemented to the point of becoming routine. Meteorlogical pictures, data communication, radio and TV transmissions, earth resource determinations, all have reached the point of being everyday, commonplace, ordinary. And rightly so, for they are the most major broad spectrum usages, being among the most useful and most income generating. But there are many other uses of satellite technology which, while not as broad spectrum have a more immediate pertinence to everyday life. And Canada, now being a world leader in satellite technology, is demonstrating their uses in ever increasing numbers.

Essentially, these novel but future routine usages fall into a number of categories: health, education, community, business and just plain novel. Currently, most of these demonstrations are of short duration, merely demonstrating that these concepts in fact work and are viable in the real world, but ever increasingly they are being implemented on a daily basis.

Possibly some of the most novel uses of satellite technology are found in the realm of "tele-health". For instance, two way voice and visual contact was used by a neurosurgeon in London, Ontario to diagnose a patient in Moose Factory, 1,124 km away, as not having a suspected brain tumour. This experiment was expanded by having a nursing station an isolated area connected to the Moose Factory base hospital by a satellite telephony link providing audio only. This, for the first time, permitted the isolated nursing station to have a reliable link to the base hospital. Customarily, HF radio contact could be blacked out literally for days on end by adverse atmospheric conditions.

This experiment had several other features of practical use. One consisted of the Northern television cameras being remotely operated by the doctors in the South; and secondly, the television cameras were mounted in the operating room, permitting Southern teaching hospital surgeons to "look in" on their colleagues' work at the Northern base hospital. Other information transmitted included X-rays, ultra-sound images and EKG tapes. Consultations over this link included psychiatric counselling and pathology, radiology and dentistry diagnosis.

A similar system was tested by Memorial University. Their Health Sciences Complex in St. John's was linked by a 3-metre terminal with four 2-metre terminals at the remote hospitals in Labrador City and Goose Bay in Labrador and Stephenville and St. Anthony on Newfoundland Island.

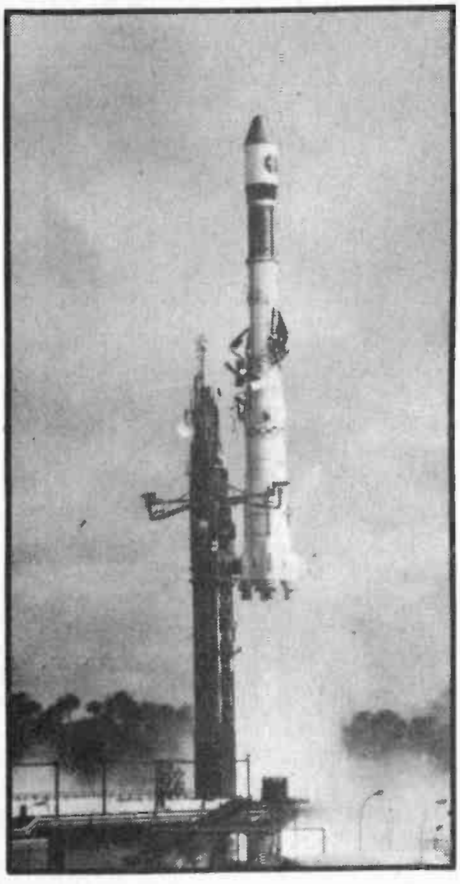
As well as providing professional services as in the London/Moose Factory experiment, the Memorial experiment utilized the satellite links for community health care programs in nutrition, pre-natal care, and diabetic diets. One of the more interesting uses permitted patients at the St. John's hospital to "visit home", as it were, with their relatives in these distant communities, thereby decreasing the loneliness of their hospital stays.

Another, similar experiment was conducted by the University of Montreal linking it with a small twenty bed hospital at James Bay. While successful, the experiment was deemed unworthy of continuation due to the high cost. Apparently, the existing land lines permit adequate communication, a factor not found in the London/Moose Factory or Memorial experiments.

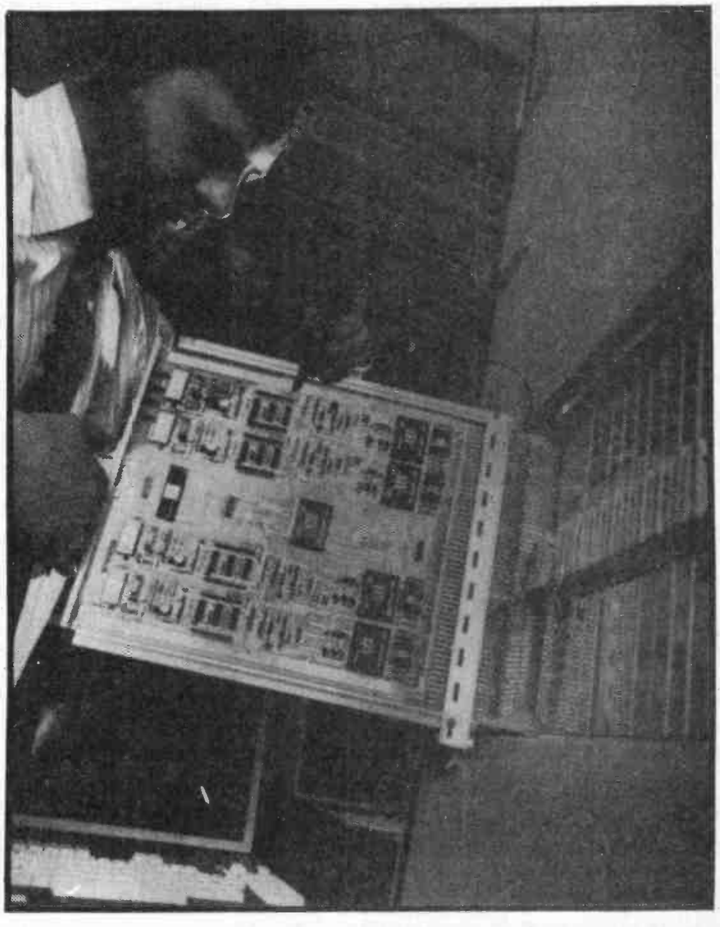
An example of a novel health usage which has gained acceptance primarily in the United States, but which was pioneered in Canada, involved a tele-medical symposium. In the Canadian originator, a satellite audio-visual link-up was arranged between Halifax, Montreal, Toronto and Vancouver, involving not only conference areas in the four cities, but hook-ups with local cable television networks. From the symposium centre in Toronto, doctors lectured on the usage of a new drug, dysmenorrhea. The visual-audio was then sent out by satellite to ground stations in the four cities and then fed into the local cable TV networks. Doctors could view the symposium from their home, office or clinic television sets. If they had questions, there were local telephone numbers they could call which patched them directly by satellite to the Toronto symposium centre where their questions would be answered "on air". While figures are hard to determine, and are possibly artificially high and therefore suspect due to the novelty of the process, it is none the less believed by CNCP that some 10,000 doctors participated in the experiment.

It is in the realm of "tele-education" that the greatest number of experiments (after strictly technical ones) have occured. Essentially, all experiments in this field are predicated on the same concern, i.e., how to deliver quality education at a distance, particularly to remote communities. A typical example, though possibly a bit more extensive than most, involved the British Columbia Ministry of Education.

The process involved a signal from a television studio at the British Columbia Institute of Technology (BCIT) up-linked to ANIK-B and down-linked to eleven communities. Six of the communities at Port Alberni, Terrace, Price George, Cranbrook, Dawson Creek and Whitehorse were capable of satellite audio return, with the remaining centres limited to land-line audio returns. Classes included both regular and continuing education courses originating from a number of institutions, but with the instructor at the BCIT studio. Audio



French *ARIANE* rocket launching from Kourou base in Gabon with SYMPHONIE satellite. —Gov't of France



return consisted of the student speaking into a telephone. Class sizes ranged from 15 to 200 students, with educational methodologies running the standard gamut from straight lectures to small group seminars.

The mix of twenty one courses was determined by a consortium method whereby all institutions involved had a say, selection being determined by the criteria of complementing courses offered by the community colleges or to provide specialized training for specific groups such as building inspectors, doctors and Ministry of Highway workers. The courses ranged from Construction Adminstration to Developmental Psychology, with the highest off-campus enrollment being Nursing Update (12 weeks, 3 students). Figures for on-campus students are not available. One of the more interesting courses offered was in Avalanche Prediction, a two week course taken by 83 students, while the longest course offered was Introduction to Mining at 33 weeks.

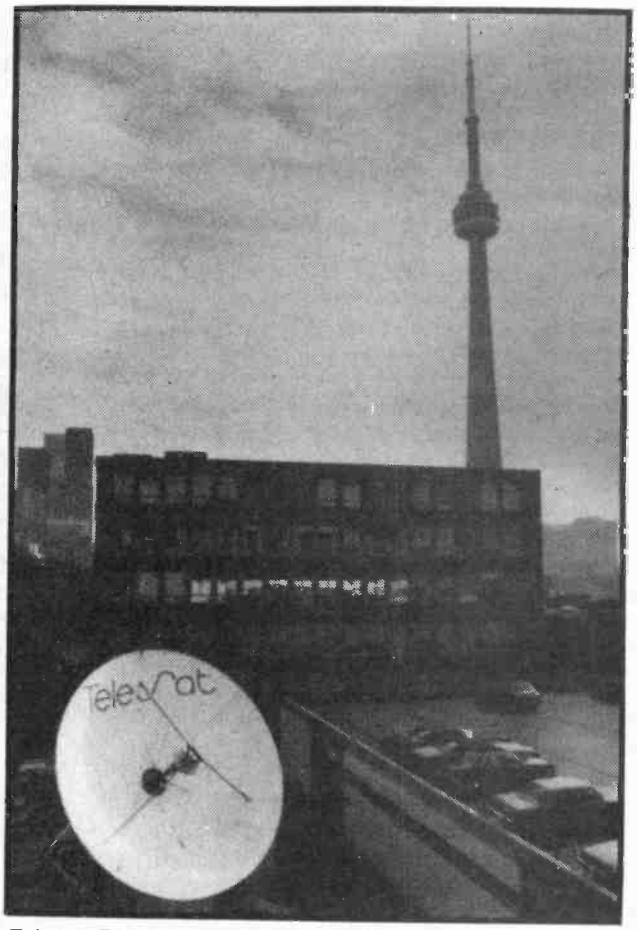
While such tele-educational processes are affordable by Canada and other industrialized nations, the greatest need and greatest use of such processes are to be found in those countries which cannot afford them. However, with simpler receiver station technology and steadily reducing operating costs of the higher-powered space transmitters, more prospects for transmitting tele-education programmes to the most distant or most inaccessible regions are beginning to be found.

For example, France and the Ivory Coast had a joint project, funded by France and using its Symphonie satellite program, to beam two-hour educational programmes from the French Pleumeur-Bodou station South of Paris to Ivory Coast primary schools. The experiment, which lasted two years, also benefitted Gabon.

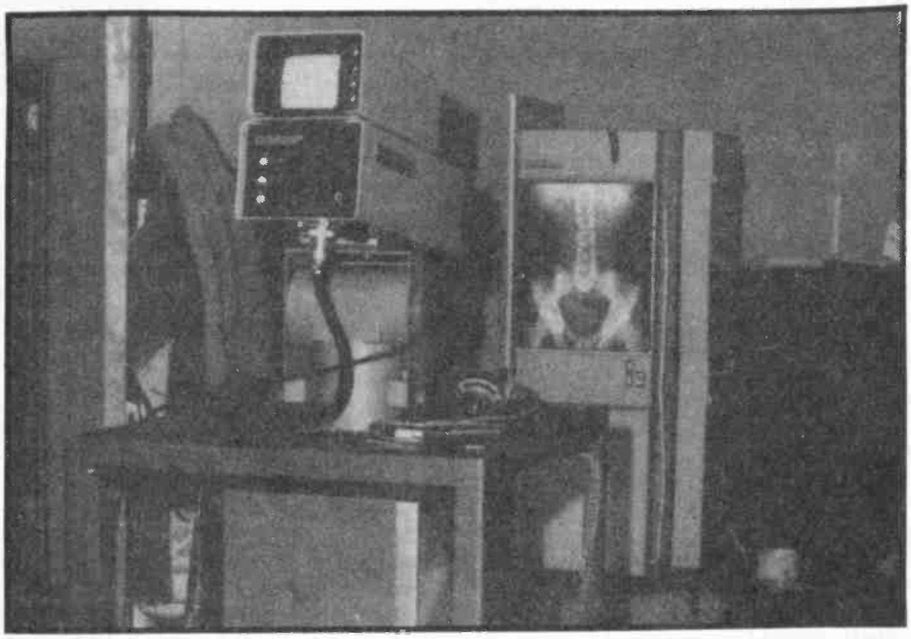
In India, the Space Applications Centre (SAC) at Ahmedabad conducted a Satellite Instructional Television Experiment (SITE) with the help of NASA's ATS-6 satellite, beaming television programmes into the heart of India for the first time. Specially augmented community TV sets were installed in 2,400 villages in such exotic sounding areas as Rajasthan and Madhya Pradesh. Following the success of the SITE experiment, India has subsequently built a terestrial rural TV service involving a chain of transmitters and repeaters which now cover a total of 9,560 villages. Most of the programming is educational, and the terestrial network was ultimately used solely due to cost factors.

Canada has an attribute which is not found in very many other countries; specifically, enormous areas with very little population, that population being of a different culture than is found elsewhere in the country. It was found, via two major experiments, that satellites can provide a means of protecting and even expanding the spartan population's culture.

A classroom involved in "tele-education". "Tele-health" at the University of Montreal.



Telesat Earth station at the Globe and Mail building in Toronto.



"Telemedicine" using the Canadian HERMES satellite. —DOC

Essentially, the Inuit, having given up their nomadic lifestyles and grouping themselves into permanent, though small, settlements, find that they need community-to-community communication to preserve their unity as a people. With personal travel expensive, and HF radio links intermitant and unreliable, satellite technology was felt to be of potential use. The first project, utilizing the ANIK-B, involved the Inuit of Northern Quebec. Five communities were supplied with the necessary equipment, one of the five also doubling as a production centre. Video programs in their native language, Inuktitut, were developed and broadcast, along with some Southern programming. Upon conclusion of the experiment, which was deemed very successful, the Inuit decided that they would like to continue the project using a mix of Southern and locally produced programming, contrary to Southern sociologists' customary "cultural invasion" fears.

A second experiment was similar to the first in nature and extent, but differed in that only Inuit programming was broadcast. The programmes were developed at three video production centres in the North. Programmes not only consisted of political, social, cultural and economic matters, but the somewhat more artistic areas of entertainment. So successful was this latter experiment that the Inuit Broadcasting Corporation was founded using the trained Inuit technicians, and now accepts contracts for work from other organizations, particularly the resource industries.

In the realm of business, satellite technology is increasingly being utilized, but to date for purposes which are pretty straight forward: telephone communication, data transmission and the like. The major benefit to business to date occured in the mid-seventies when the OPEC nations increased their price for crude oil, an action which provoked pandemonium on the world stock exchanges and money markets. It is felt that a major reason why the Western world's economies did not collapse, *a la* '29, was due to the speed at which business transactions, information and money was shunted around the globe. The speed and data carrying capacity of satellites was such that these transmissions could take place. It is felt that terrestrial methods of communication would not have been capable of withstanding the load, particularly at switching points, to have permitted the necessary quantity of information to be passed. It is therefore not an exageration to say that if the OPEC price rise had occured even ten years earlier that a depression would have occured in the Western economies, a depression thwarted by the satellite communication networks.

The major experiment in Canada to test satellite communication in the realm of business is one currently in progress and expected to last a year. It involves Telesat's ANIK-B, CNCP and the Department of Communications. Essentially, it is an attempt to establish a satellite business communication service for the federal government, involving electronic distribution of documents and personal messages. The system will also test satellite services for voice, computer communications and teleconferencing involving Environ-

ment Canada and the Canada Employment and Immigration Commission. At the end of the experiment, cost effectiveness studies will be undertaken regarding the transmission of weather maps between weather centres and the accessing by satellite of data stored in a central computer.

A second experiment, though not one testing technologies, involves Teleglobe Canada, which has started a one-year market trial in international "teleconferencing". Pitched at the communication needs of large multinational organizations, it is designed as either an alternative or a compliment to international travel for business meetings. It utilizes standard television broadcast facilities available either in house or from public studios.

A more routine use of satellites in the business community is operated by Canada Post in conjunction with Teleglobe Canada. Called Intelpost, it permits the facsimile transmission of documents within Canada between Halifax, Montreal, Ottawa, Toronto, Winnipeg, Calgary, Edmonton and Vancouver. Internationally, it permits transmission between Canada and London, New York, Washington, Amsterdam and Berne. The documents, which are transmitted in a matter of seconds, can either be picked up at the receiving end or placed into local postal systems for final delivery. The system's major advantage is speed and the decrease in error, particularly in design drawings and other complicated material.

Perhaps the most interesting of the novel uses of satellite technology in the business world involves the National Edition of the *Globe and Mail*. Using a red light low powered helium neon laser to break down the printed page of the Globe and Mail's Toronto Edition into 368,640,000 bits, the information is passed through a bundle of fibre optics to a coding unit and then up-linked to ANIK-A-3 over the Pacific Ocean. The solar powered satellite then down-links the signal to Earth, where it is picked up at Vancouver, Calgary, Ottawa, and Monkton. There the information is decoded and sent through an argon ion laser which plays a blue light across a sheet of photographic film producing a negative the size of a newspaper page. Printing plates are made from the negative and the National Edition is printed. Transmission time is one full page per minute.

A further novel use of satellite technology in the realm of journalism does not involve a new use of space technology, but rather a new type of ground technology. It is a culmination of processes developed in Chicago and the American West.

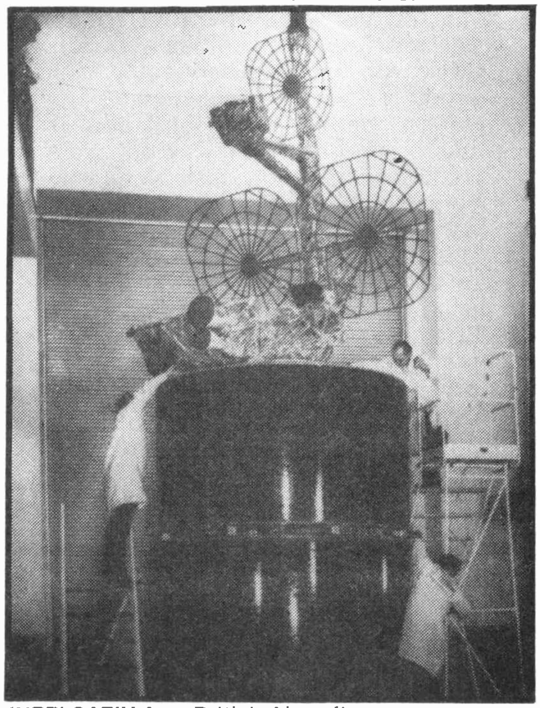
In Chicago, the local TV station news department has a van containing microwave apparatus for transmission of video and audio data to the home studio of the station. The reporters and camera team are connected to the van by long cables. This permits live video and audio coverage of events. Its disadvantage is that the receiving dish, mounted on top of a large building, must be within line of sight of the van's dish.

Another, similar type of system was experimented with in the Rockies. There, a van similar to the Chicago van has a microwave dish which broadcasts the signal straight up to a helicopter. The helicopter then retransmits the signal by microwave to the base TV studio, thereby missing or jumping the microwave blockage by the surrounding mountains. The system permites either live or on site news gathering in isolated areas without having to wait for the camera team with its video tapes to return to base.

In Canada, the Canadian Broadcasting Corporation in conjunction with the Communications Research Centre in Ottawa is experimenting with a unit which transmits TV signals directly up-linked to orbiting communications satellites, which are then down-linked to ground stations and re-transmitted by microwave to the CBC national network. The unit is mounted on a trailer and has relatively low power output. As such it needs a receiving dish of 30 feet plus to produce an optical image of sufficiently high quality. It is expected, if the experiment and field trails are successful, to provide increased coverage of newsworthy events in isolated areas, including live reporting over the national network.
work.

There are many other what would now be considered novel uses of satellite technology, but which will not be novel after a year or two of use. The American comedian, Steve Martin, for instance, publicized his movie *Pennies From Heaven* by holding a live television press conference in fourteen cities across North America simultaneously. It is believed that this is the first time a press conference has been carried out using satellites in so many cities simultaneously, but was worthy of only two reporters showing up at the Toronto downlink. This last Christmas, there was a programme which involved singers in some eleven different countries being transmitted one after another to an international network and broadcast live to all eleven countries. Rod Stewart's concert at the Los Angeles Forum in December was simulcast live by CHUM-FM and CITY-TV, both in Toronto, using a satellite connection, believed to be a first.

And finally, CNCP has had a problem for some years maintaining vital rail communications between Revelstoke and Golden, B.C.: avalanches kept tearing out their pole lines. The cost of constantly repairing the lines, and the cost of shutting down the rail link until communications could be restored was rather high. To end the problem in a definitive manner, in December 1981 they installed a system whereby whenever a locomotive engineer wants to communicate between Revelstoke and Glacier, his transmission travels via a buried land line to Telesat's satellite dish at Forest Lawn, near Calgary. The signal is then uplinked to ANIK-B and downlinked to a new 12 foot dish located at CP Rail's Glacier Station, about 50 miles west of Golden B.C. Unless the Golden dish is taken out by an avalanche, the communications link should remain secure.



INTELSATIV-A. —British Aircraft
British FRONTIER Satellite weather system. British Information Services

ETI BOOKS

COMPUTERS

(HARDWARE)

A BEGINNER'S GUIDE TO COMPUTERS AND MICROPROCESSORS — WITH PROJECTS.
TAB No.1015 **$13.45**
Here's a plain English introduction to the world of microcomputers — it's capabilities, parts and functions . and how you can use one. Numerous projects demonstrate operating principles and lead to the construction of an actual working computer capable of performing many useful functions

BP66: BEGINNERS GUIDE TO MICROPROCESSORS AND COMPUTING **$7.55**
E.F. SCOTT, M.Sc., C.Eng.
As indicated by the title, this book is intended as an introduction to the basic theory and concepts of binary arithmetic, microprocessor operation and machine language programming

There are occasions in the text where some background information might be helpful and a Glossary is included at the end of the book.

BP72: A MICROPROCESSOR PRIMER $7.70
E.A. PARR, B.Sc., C.Eng., M.I.E.E.
A newcomer to electronics tends to be overwhelmed when first confronted with articles or books on microprocessors In an attempt to give a painless approach to computing, this small book will start by designing a simple computer and because of its simplicity and logical structure, the language is hopefully easy to learn and understand In this way, such ideas as Relative Addressing, Index Registers etc will be developed and it is hoped that these will be seen as logical progressions rather than arbitrary things to be accepted but not understood

BEGINNERS GUIDE TO MICROPROCESSORS
TAB No.995 **$10.45**
If you aren't sure exactly what a microprocessor is, then this is the book for you The book takes the beginner from the basic theories and history of these essential devices, right up to some real world hardware applications

HOW TO BUILD YOUR OWN WORKING MICROCOMPUTER
TAB No.1200 **$16.45**
An excellent reference or how-to manual on building your own microcomputer All aspects of hardware and software are developed as well as many practical circuits

BP78: PRACTICAL COMPUTER EXPERIMENTS **$7.30**
E.A. PARR, B.Sc., C.Eng., M.I.E.E.
Curiously most published material on the microprocessor tends to be of two sorts, the first treats the microprocessor as a black box and deals at length with programming and using the "beast". The second type of book deals with the social impact None of these books deal with the background to the chip, and this is a shame as the basic ideas are both interesting and simple

This book aims to fill in the background to the microprocessor by constructing typical computer circuits in discrete logic and it is hoped that this will form a useful introduction to devices such as adders, memories, etc. as well as a general source book of logic circuits

HANDBOOK OF MICROPROCESSOR APPLICATIONS
TAB No.1203 **$14.45**
Highly recommended reading for those who are interested in microprocessors as a means of accomplishing a specific task. The author discusses two individual microprocessors, the 1802 and the 6800, and how they can be put to use in real world applications

MICROPROCESSOR/MICROPROGRAMMING HANDBOOK
TAB No.785 **$14.45**
A comprehensive guide to microprocessor hardware and programming. Techniques discussed include subroutines, handling interrupts and program loops

DIGITAL INTERFACING WITH AN ANALOG WORLD
TAB No.1070 **$14.45**
You've bought a computer, but now you can't make it do anything useful. This book will tell you how to convert real world quantities such as temperature, pressure, force and so on into binary representation

MICROPROCESSOR INTERFACING HANDBOOK: A/D & D/A
TAB No.1271 **$14.45**
A useful handbook for computerists interested in using their machines in linear applications Topics discussed include voltage references, op-amps for data conversion, analogue switching and multiplexing and more.

COMPUTER TECHNICIAN'S HANDBOOK
TAB No.554 **$17.45**
Whether you're looking for a career, or you are a service technician, computer repair is an opportunity you should be looking at The author covers all aspects of digital and computer electronics as well as the mathematical and logical concepts involved.

THE ESSENTIAL COMPUTER DICTIONARY AND SPELLER
AB011 **$9.45**
A must for anyone just starting out in the field of computing, be they a businessman, hobbyist or budding computerist The book presents and defines over 15 000 computer terms and acronyms and makes for great browsing.

HOW TO TROUBLESHOOT AND REPAIR MICROCOMPUTERS
AB013 **$10.45**
Learn how to find the cause of a problem or malfunction in the central or peripheral unit of any microcomputer and then repair it The tips and techniques in this guide can be applied to any equipment that uses the microprocessor as the primary control element

TROUBLESHOOTING MICROPROCESSORS AND DIGITAL LOGIC
TAB No.1183 **$13.45**
The influence of digital techniques on commercial and home equipment is enormous and increasing yearly This book discusses digital theory and looks at how to service Video Cassette Recorders, microprocessors and more

HOW TO DEBUG YOUR PERSONAL COMPUTER
AB012 **$10.45**
When you feel like reaching for a sledge hammer to reduce your computer to fiberglass and epoxy dust, don't. Reach for this book instead and learn all about program bug tracking, recognition and elimination techniques

THE COMPLETE HANDBOOK OF ROBOTICS
TAB No.1071 **$13.45**
All the information you need to build a walking, talking mechanical friend appears in this book Your robot can take many forms and various options — light, sound, and proximity sensors — are covered in depth

HOW TO BUILD YOUR OWN SELF PROGRAMMING ROBOT
TAB No.1241 **$13.45**
A practical guide on how to build a robot capable of learning how to adapt to a changing enviroment. The creature developed in the book, Rodney, is fully self programming, can develop theories to deal with situations and apply those theories in future circumstances

BUILD YOUR OWN WORKING ROBOT
TAB No.841 **$11.45**
Contains complete plans — mechanical, schematics, logic diagrams and wiring diagrams — for building Buster. There are two phases involved. first Buster is leash led, dependent on his creator for guidance, the second phase makes Buster more independent and able to get out of tough situations

COMPUTERS

(SOFTWARE)

BEGINNER'S GUIDE TO COMPUTER PROGRAMMING
TAB No.574 **$16.45**
Computer programming is an increasingly attractive field to the individual, however many people still overlook it as a career The material in this book has been developed in a logical sequence. from the basic steps to machine language.

BP86: AN INTRODUCTION TO BASIC PROGRAMMING TECHNIQUES **$8.25**
S. DALY
This book is based on the author's own experience in learning BASIC and in helping others, mostly beginners, to program and understand the language. Also included are a program library containing various programs, that the author has actually written and run These are for biorhythms, plotting a graph of Y against X, standard deviation, regression, generating a musical note sequence and a card game. The book is complemented by a number of appendices which include test questions and answers on each chapter and a glossary.

THE BASIC COOKBOOK.
TAB No.1055 **$9.45**
BASIC is a surprisingly powerful language . . if you understand it completely This book picks up where most manufacturers' documentation gives up With it, any computer owner can develop programs to make the most out of his or her machine.

PET BASIC — TRAINING YOUR PET COMPUTER
AB014 **$16.45**
Officially approved by Commodore, this is the ideal reference book for long time PET owners or novices. In an easy to read and humorous style, this book describes techniques and experiments, all designed to provide a strong understanding of this versatile machine.

PROGRAMMING IN BASIC FOR PERSONAL COMPUTERS
AB015 **$10.45**
This book emphasizes the sort of analytical thinking that lets you use a specific tool — the BASIC language — to transform your own ideas into workable programs The text is designed to help you to intelligently analyse and design a wide diversity of useful and interesting programs.

COMPUTER PROGRAMS IN BASIC
AB001 **$14.45**
A catalogue of over 1 600 fully indexed BASIC computer programs with applications in Business, Math, Games and more This book lists available software, what it does, where to get it, and how to adapt it to your machine

PET GAMES AND RECREATION
AB002 **$12.45**
A variety of interesting games designed to amuse and educate Games include such names as Capture, Tic Tac Toe, Watchper-son, Motie, Sinners, Martian Hunt and more.

BRAIN TICKLERS
AB005 **$8.00**
If the usual games such as Bug Stomp and Invaders From the Time Warp are starting to pale, then this is the book for you The authors have put together dozens of stimulating puzzles to show you just how challenging computing can be.

PASCAL
TAB No.1205 **$16.45**
Aimed specifically at TRS-80 users, this book discusses how to load, use and write PASCAL programs Graphic techniques are discussed and numerous programs are presented

PASCAL PROGRAMMING FOR THE APPLE
AB008 **$16.45**
A great book to upgrade your programming skills to the UCSD Pascal as implemented on the Apple II Statements and techniques are discussed and there are many practical and ready to run programs.

APPLE MACHINE LANGUAGE PROGRAMMING
AB009 **$16.45**
The best way to learn machine language programming the Apple II in no time at all The book combines colour, graphics, and sound generation together with clear cut demonstrations to help the user learn quickly and effectively

Z80 USERS MANUAL
AB010 **$14.45**
The Z80 MPU can be found in many machines and is generally acknowledged to be one of the most powerful 8 bit chips around This book provides an excellent 'right hand' for anyone involved in the application of this popular processor

HOW TO PROGRAM YOUR PROGRAMMABLE CALCULATOR
AB006 **$10.45**
Calculator programming, by its very nature, often is an obstacle to effective use. This book endeavours to show how to use a programmable calculator to its full capabilities The TI 57 and the HP 33E calculators are discussed although the principles extend to similar models.

BP33: ELECTRONIC CALCULATOR USERS HANDBOOK **$4.25**
M.H. BABANI, B.Sc.(Eng.)
An invaluable book for all calculator users whatever their age or occupation, or whether they have the simplest or most sophisticated of calculators Presents formulae, data, methods of calculation, conversion factors, etc, with the calculator user especially in mind, often illustrated with simple examples. Includes the way to calculate using only a simple four function calculator: Trigonometric Functions (Sin, Cos, Tan). Hyperbolic Functions (Sinh, Cosh, Tanh) Logarithms, Square Roots and Powers.

PROJECTS

BP48: ELECTRONIC PROJECTS FOR BEGINNERS **$5.90**
F.G. RAYER, T.Eng.(CEI), Assoc.IERE
Another book written by the very experienced author — Mr F.G Rayer — and in it the newcomer to electronics, will find a wide range of easily made projects Also, there are a considerable number of actual component and wiring layouts, to aid the beginner.

Furthermore, a number of projects have been arranged so that they can be constructed without any need for soldering and, thus, avoid the need for a soldering iron

Also, many of the later projects can be built along the lines as those in the 'No Soldering' section so this may considerably increase the scope of projects which the newcomer can build and use

221: 28 TESTED TRANSISTOR PROJECTS **$5.50**
R.TORRENS
Mr. Richard Torrens is a well experienced electronics development engineer and has designed, developed, built and tested the many useful and interesting circuits included in this book The projects themselves can be split down into simpler building blocks, which are shown separated by boxes in the circuits for ease of description, and also to enable any reader who wishes to combine boxes from different projects to realise ideas of his own

BP49: POPULAR ELECTRONIC PROJECTS **$6.25**
R.A. PENFOLD
Includes a collection of the most popular types of circuits and projects which, we feel sure, will provide a number of designs to interest most electronics constructors The projects selected cover a very wide range and are divided into four basic types. Radio Projects, Audio Projects, Household Projects and Test Equipment

EXPERIMENTER'S GUIDE TO SOLID STATE ELECTRONIC PROJECTS
AB007 **$9.45**
An ideal sourcebook of Solids State circuits and techniques with many practical circuits. Also included are many useful types of experimenter gear

BP71: ELECTRONIC HOUSEHOLD PROJECTS **$7.70**
R. A. PENFOLD
Some of the most useful and popular electronic construction projects are those that can be used in or around the home The circuits range from such things as '2 Tone Door Buzzer', Intercom. through Smoke or Gas Detectors to Baby and Freezer Alarms

BP94: ELECTRONIC PROJECTS FOR CARS AND BOATS **$8.10**
R.A. PENFOLD
Projects, fifteen in all, which use a 12V supply are the basis of this book. Included are projects on Windscreen Wiper Control, Courtesy Light Delay, Battery Monitor, Cassette Power Supply, Lights Timer, Vehicle Immobiliser, Gas and Smoke Alarm, Depth Warning and Shaver Inverter

BP69: ELECTRONIC GAMES **$7.55**
R.A. PENFOLD
In this book Mr R A Penfold has designed and developed a number of interesting electronic game projects using modern integrated circuits The text is divided into two sections, the first dealing with simple games and the latter dealing with more complex circuits

BP95: MODEL RAILWAY PROJECTS **$8.10**
Electronic projects for model railways are fairly recent and have made possible an amazing degree of realism. The projects covered include controllers, signals and sound effects. striboard layouts are provided for each project

ETI BOOKS

PROJECTS
(CONTINUED)

BP76: POWER SUPPLY PROJECTS $7.30
R.A. PENFOLD
Line power supplies are an essential part of many electronics projects. The purpose of this book is to give a number of power supply designs, including simple unstabilised types, fixed voltage regulated types, and variable voltage stabilised designs, the latter being primarily intended for use as bench supplies for the electronics workshop. The designs provided are all low voltage types for semiconductor circuits.

There are other types of power supply and a number of these are dealt with in the final chapter, including a cassette power supply, Ni-Cad battery charger, voltage step up circuit and a simple inverter.

BP84: DIGITAL IC PROJECTS $8.10
F.G. RAYER, T.Eng.(CEI),Assoc.IERE
This book contains both simple and more advanced projects and it is hoped that these will be found of help to the reader developing a knowledge of the workings of digital circuits. To help the newcomer to the hobby the author has included a number of board layouts and wiring diagrams. Also the more ambitious projects can be built and tested section by section and this should help avoid or correct faults that could otherwise be troublesome. An ideal book for both beginner and more advanced enthusiast alike.

BP67: COUNTER DRIVER AND NUMERAL DISPLAY PROJECTS $7.55
F.G. RAYER, T.Eng.(CEI), Assoc. IERE
Numeral indicating devices have come very much to the forefront in recent years and will, undoubtedly, find increasing applications in all sorts of equipment. With present day integrated circuits, it is easy to count, divide and display numerically the electrical pulses obtained from a great range of driver circuits.

In this book many applications and projects using various types of numeral displays, popular counter and driver IC's etc. are considered.

213: ELECTRONIC CIRCUITS FOR MODEL RAILWAYS $4.50
M.H. BABANI, B.Sc.(Eng.)
The reader is given constructional details of how to build a simple model train controller; controller with simulated inertia and a high power controller. A signal system and lighting for model trains is discussed as is the suppression of RF interference from model railways. The construction of an electronic steam whistle and a model train chuffer is also covered.

BP73: REMOTE CONTROL PROJECTS $8.60
OWEN BISHOP
This book is aimed primarily at the electronics enthusiast who wishes to experiment with remote control. Full explanations have been given so that the reader can fully understand how the circuits work and can more easily see how to modify them for other purposes, depending on personal requirements. Not only are radio control systems considered but also infra-red, visible light and ultrasonic systems as are the use of Logic ICs and Pulse position modulation etc.

CIRCUITS

BP80: POPULAR ELECTRONIC CIRCUITS — BOOK 1 $8.25
R.A. PENFOLD
Another book by the very popular author, Mr. R.A. Penfold, who has designed and developed a large number of various circuits. These are grouped under the following general headings, Audio Circuits, Radio Circuits, Test Gear Circuits, Music Project Circuits, Household Project Circuits and Miscellaneous Circuits.

THE GIANT HANDBOOK OF ELECTRONIC CIRCUITS
TAB No.1300 $24.45
About as twice as thick as the Webster's dictionary, and having many more circuit diagrams, this book is ideal for any experimenter who wants to keep amused for several centuries. If there isn't a circuit for it in here, you should have no difficulty convincing yourself you don't really want to build it.

BP39: 50 (FET) FIELD EFFECT TRANSISTOR PROJECTS $5.50
F.G. RAYER, T.Eng.(CEI),Assoc.IERE
Field effect transistors (FETs), find application in a wide variety of circuits. The projects described here include radio frequency amplifiers and converters, test equipment and receiver aids, tuners, receivers, mixers and tone controls, as well as various miscellaneous devices which are useful in the home.

This book contains something of particular interest for every class of enthusiast — short wave listener, radio amateur, experimenter or audio devotee.

BP87: SIMPLE L.E.D. CIRCUITS $5.90
R.N. SOAR
Since it first appeared in 1977, Mr. R.N. Soar's book has proved very popular. The author has developed a further range of circuits and these are included in Book 2. Projects include a Transistor Tester, Various Voltage Regulators, Testers and so on.

BP42: 50 SIMPLE L.E.D. CIRCUITS $3.55
R.N. SOAR
The author of this book, Mr. R.N. Soar, has compiled 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most inexpensive and freely available components — the Light Emitting Diode (L.E.D.). A useful book for the library of both beginner and more advanced enthusiast alike.

BP82: ELECTRONIC PROJECTS USING SOLAR CELLS $8.10
OWEN BISHOP
The book contains simple circuits, almost all of which operate at low voltage and low currents, making them suitable for being powered by a small array of silicon cells. The projects cover a wide range from a bicyle speedometer to a novelty 'Duck Shoot', a number of power supply circuits are included.

BP37: 50 PROJECTS USING RELAYS, SCR's & TRIACS $5.50
F.G.RAYER, T.Eng.(CEI),Assoc.IERE
Relays, silicon controlled rectifiers (SCR's) and bi-directional triodes (TRIACs) have a wide range of applications in electronics today. This book gives tried and practical working circuits which should present the minimum of difficulty for the enthusiast to construct. In most of the circuits there is a wide latitude in component values and types, allowing easy modification of circuits or ready adaptation of them to individual needs.

BP44: IC 555 PROJECTS $7.55
E.A. PARR, B.Sc.,C.Eng., M.I.E.E.
Every so often a device appears that is so useful that one wonders how life went on before without it. The 555 timer is such a device. Included in this book are Basic and General Circuits, Motor Car and Model Railway Circuits, Alarms and Noise Makers as well as a section on the 556, 558 and 559 timers.

BP24: 50 PROJECTS USING IC741 $4.25
RUDI & UWE REDMER
This book, originally published in Germany by TOPP, has achieved phenomenal sales on the Continent and Babani decided, in view of the fact that the integrated circuit used in this book is inexpensive to buy, to make this unique book available to the English speaking reader. Translated from the original German with copious notes, data and circuitry, a "must" for everyone whatever their interest in electronics.

BP83: VMOS PROJECTS $8.20
R.A. PENFOLD
Although modern bipolar power transistors give excellent results in a wide range of applications, they are not without their drawbacks or limitations. This book will primarily be concerned with VMOS power FETs although power MOSFETs will be dealt with in the chapter on audio circuits. A number of varied and interesting projects are covered under the main headings of Audio Circuits, Sound Generator Circuits, DC Control Circuits and Signal Control Circuits.

BP65: SINGLE IC PROJECTS $6.55
R.A.PENFOLD
There is now a vast range of ICs available to the amateur market; the majority of which are not necessarily designed for use in a single application and can offer unlimited possibilities. All the projects contained in this book are simple to construct and are based on a single IC. A few projects employ one or two transistors in addition to an IC but in most cases the IC is the only active device used.

BP 50: IC LM3900 PROJECTS $5.90
H.KYBETT,B.Sc., C.Eng.
The purpose of this book is to introduce the LM3900 to the Technician, Experimenter and the Hobbyist. It provides the groundwork for both simple and more advanced uses, and is more than just a collection of simple circuits or projects.

Simple basic working circuits are used to introduce this IC. The LM3900 can do much more than is shown here, this is just an introduction. Imagination is the only limitation with this useful and versatile device. But first the reader must know the basics and that is what this book is all about.

223: 50 PROJECTS USING IC CA3130 $5.50
R.A.PENFOLD
In this book, the author has designed and developed a number of interesting and useful projects which are divided into five general categories: I — Audio Projects II — R.F Projects III — Test Equipment IV — Household Projects V — Miscellaneous Projects.

224: 50 CMOS IC PROJECTS $4.25
R.A. PENFOLD
CMOS IC's are probably the most versatile range of digital devices for use by the amateur enthusiast. They are suitable for an extraordinary wide range of applications and are also some of the most inexpensive and easily available types of IC.

Mr. R.A. Penfold has designed and developed a number of interesting and useful projects which are divided into four general categories: I — Multivibrators II — Amplifiers and Oscillators III — Trigger Devices IV — Special Devices.

THE ACTIVE FILTER HANDBOOK
TAB No.1133 $11.45
Whatever your field — computing, communications, audio, electronic music or whatever — you will find this book the ideal reference for active filter design. The book introduces filters and their uses also presents many practical circuits including a graphic equalizer, computer tape interface and more.

DIGITAL ICS — HOW THEY WORK AND HOW TO USE THEM
AB004 $10.45
An excellent primer on the fundamentals of digital electronics. This book discusses the nature of gates and related concepts and also deals with the problems inherent to practical digital circuits.

MASTER HANDBOOK OF 1001 PRACTICAL CIRCUITS
TAB No.800 $20.45
MASTER HANDBOOK OF 1001 MORE PRACTICAL CIRCUITS
TAB No.804 $19.45
Here are transistor and IC circuits for just about any application you might have. An ideal source book for the engineer, technician or hobbyist. Circuits are classified according to function, and all sections appear in alphabetical order.

THE MASTER IC COOKBOOK
TAB No.1199 $16.45
If you've ever tried to find specs for a so called 'standard' chip, then you'll appreciate this book. C.L. Hallmark has compiled specs and pinouts for most types of ICs that you'd ever want to use.

ELECTRONIC DESIGN WITH OFF THE SHELF INTEGRATED CIRCUITS
AB016 $10.45
This practical handbook enables you to take advantage of the vast range of applications made possible by integrated circuits. The book tells how, in step by step fashion, to select components and how to combine them into functional electronic systems. If you want to stop being a "cookbook hobbyist", then this is the book for you.

AUDIO

BP90: AUDIO PROJECTS $8.10
F.G. RAYER
Covers in detail the construction of a wide range of audio projects. The text has been divided into preamplifiers and mixers, power amplifiers, tone controls and matching and miscellaneous projects.

HOW TO DESIGN, BUILD, AND TEST COMPLETE SPEAKER SYSTEMS.
TAB No.1064 $13.45
By far the greatest savings in assembling an audio system can be realized from the construction of speakers. This book contains information to build a variety of speakers as well as instructions on how to design your own.

205: FIRST BOOK OF HI-FI LOUDSPEAKER ENCLOSURES $3.55
B.B. BABANI
This book gives data for building most types of loudspeaker enclosure. Includes corner reflex, bass reflex, exponential horn, folded horn, tuned port, klipschorn labyrinth, tuned column, loaded port and multi speaker panoramic. Many clear diagrams for every construction showing the dimensions necessary.

BP35: HANDBOOK OF IC AUDIO PRE-AMPLIFIER AND POWER AMPLIFIER CONSTRUCTION $5.50
F.G.RAYER, T.Eng.(CEI),Assoc.IERE
This book is divided into three parts: Part I, understanding audio IC's, Part II, Pre-amplifiers, Mixers and Tone Controls, Part III Power Amplifiers and Supplies. Includes practical constructional details of pure IC and Hybrid IC and Transistor designs from about 250mW to 100W output.

BP47: MOBILE DISCOTHEQUE HANDBOOK $5.90
COLIN CARSON
The vast majority of people who start up "Mobile Discos" know very little about their equipment or even what to buy. Many people have wasted a "small fortune" on poor, unnecessary or badly matched apparatus.

The aim of this book is to give you enough information to enable you to have a better understanding of many aspects of "disco" gear.

HOW TO BUILD A SMALL BUDGET RECORDING STUDIO FROM SCRATCH. . .
TAB No.1166 $16.45
The author, F. Alton Everest, has gotten studios together several times, and presents twelve complete, tested designs for a wide variety of applications. If all you own is a mono cassette recorder, you don't need this book. If you don't want your new four track to wind up sounding like one, though, you shouldn't be without it.

BP51: ELECTRONIC MUSIC AND CREATIVE TAPE RECORDING $5.50
M.K. BERRY
Electronic music is the new music of the Twentieth Century. It plays a large part in "pop" and "rock" music and, in fact, there is scarcely a group without some sort of synthesiser or other effects generator.

This book sets out to show how electronic music can be made at home with the simplest and most inexpensive of equipment. It then describes how the sounds are generated and how these may be recorded to build up the final composition.

BP74: ELECTRONIC MUSIC PROJECTS $7.70
R.A. PENFOLD
Although one of the more recent branches of amateur electronics, electronic music has now become extremely popular and there are many projects which fall into this category. The purpose of this book is to provide the constructor with a number of practical circuits for the less complex items of electronic music equipment, including such things as a Fuzz Box, Waa-Waa Pedal, Sustain Unit, Reverberation and Phaser-Units, Tremelo Generator etc.

P81: ELECTRONIC SYNTHESISER PROJECTS $7.30
M.K. BERRY
One of the most fascinating and rewarding applications of electronics is in electronic music and there is hardly a group today without some sort of synthesiser or effects generator. Although an electronic synthesiser is quite a complex piece of electronic equipment, it can be broken down into much simpler units which may be built individually and these can then be used or assembled together to make a complete instrument.

ELECTRONIC MUSIC SYNTHESIZERS
TAB No.1167 $10.45
If you're fascinated by the potential of electronics in the field of music, then this is the book for you. Included is data on synthesizers in general as well as particular models. There is also a chapter on the various accessories that are available.

See the order form on page 23

ETI BOOKS

TEST EQUIPMENT

BP75: ELECTRONIC TEST EQUIPMENT CONSTRUCTION $7.30
F.G. RAYER, T.Eng. (CEI), Assoc. IERE
This book covers in detail the construction of a wide range of test equipment for both the Electronics Hobbyists and Radio Amateur. Included are projects ranging from an FET Amplified Voltmeter and Resistance Bridge to a Field Strength Indicator and Heterodyne Frequency Meter. Not only can the home constructor enjoy building the equipment but the finished projects can also be usefully utilised in the furtherance of his hobby.

99 TEST EQUIPMENT PROJECTS YOU CAN BUILD
TAB No.805 $14.45
An excellent source book for the hobbyist who wants to build up his work bench inexpensively. There are circuits to measure just about any electrical quantity. The variety is endless and includes just about anything you could wish for!

HOW TO GET THE MOST OUT OF LOW COST TEST EQUIPMENT
AB017 $9.45
Whether you want to get your vintage 1960 'TestRite'signal generator working, or you've got something to measure with nothing to measure it with, this is the book for you. The author discusses how to maximize the usefulness of cheap test gear, how to upgrade old equipment, and effective test set ups.

THE POWER SUPPLY HANDBOOK
TAB No.806 $16.45
A complete one stop reference for hobbyists and engineers. Contains high and low voltage power supplies of every conceivable type as well mobile and portable units

BP70: TRANSISTOR RADIO FAULT-FINDING CHART $2.40
CHAS. E. MILLER
Across the top of the chart will be found four rectangles containing brief descriptions of various faults; vis: — sound weak but undistorted; set dead; sound low or distorted and background noises. One then selects the most appropriate of these and following the arrows, carries out the suggested checks in sequence until the fault is cleared.

ELECTRONIC TROUBLESHOOTING HANDBOOK
AB019 $9.45
This workbench guide can show you how to pinpoint circuit troubles in minutes, how to test anything electronic, and how to get the most out of low cost test equipment. You can use any and all of the time-saving shortcuts to rapidly locate and repair all types of electronic equipment malfunctions.

COMPLETE GUIDE TO READING SCHEMATIC DIAGRAMS
AB018 $9.45
A complete guide on how to read and understand schematic diagrams. The book teaches how to recognize basic circuits and identify component functions. Useful for technicians and hobbyists who want to avoid a lot of headscratching.

RADIO AND COMMUNICATIONS

BP79: RADIO CONTROL FOR BEGINNERS $7.30
F.G. RAYER, T.Eng.(CEI),Assoc.IERE.
The aim of this book is to act as an introduction to Radio Control for beginners to the hobby. The book will commence by dealing with the conditions that are allowable for such things as frequency and power of transmission. This is followed by a "block" explanation of how control-device and transmitter operate and receiver and actuator(s) produce motion in a model.

Details are then given of actual solid state transmitting equipment which the reader can build. Plain and loaded aerials are then discussed and so is the field-strength meter to help with proper setting up.

The radio receiving equipment is then dealt with which includes a simple receiver and also a crystal controlled superhet. The book ends with the electro-mechanical means of obtaining movement of the controls of the model.

BP91: AN INTRODUCTION TO RADIO DXing $8.10
This book is divided into two main sections one to amateur band reception, the other to broadcast bands. Advice is given to suitable equipment and techniques. A number of related constructional projects are described

No. 215: Shortwave Circuits & Gear For Experimenters & Radio Hams $3.70
Covers constructional details of a number of projects for the shortwave enthusiast and radio "Ham" Included are: an add-in crystal filter, adding an "S" meter in your receiver; crystal locked H.F. Receiver; AM tuner using phase locked loop; coverter for 2MHz, 40 to 800 MHz RF amplifier, Aerials for the 52, 144MHz bands, Solid State Crystal Frequency Calibrator, etc.

BP46: RADIO CIRCUITS USING IC's $5.90
J.B. DANCE, M.Sc.
This book describes integrated circuits and how they can be employed in receivers for the reception of either amplitude or frequency modulated signals. The chapter on amplitude modulated (a.m.) receivers will be of most interest to those who wish to receive distant stations at only moderate audio quality, while the chapter on frequency modulation (f.m.) receivers will appeal to those who desire high fidelity reception

REFERENCE

THE BEGINNER'S HANDBOOK OF ELECTRONICS
AB003 $9.45
An excellent textbook for those interested in the fundamentals of Electronics. This book covers all major aspects of power supplies, amplifiers, oscillators, radio, television and more.

ELEMENTS OF ELECTRONICS — An on-going series
F.A. WILSON, C.G.I.A., C.Eng.,
BP62: BOOK 1. The Simple Electronic Circuit and Components $8.95
BP63: BOOK 2. Alternating Current Theory $8.95
BP64: BOOK 3. Semiconductor Technology $8.95
BP77: BOOK 4. Microprocessing Systems And Circuits $12.30
BP89: BOOK 5. Communication $12.30
The aim of this series of books can be stated quite simply — it is to provide an inexpensive introduction to modern electronics so that the reader will start on the right road by thoroughly understanding the fundamental principles involved.

Although written especially for readers with no more than ordinary arithmetical skills, the use of mathematics is not avoided, and all the mathematics required is taught as the reader progresses.

Each book is a complete treatise of a particular branch of the subject and, therefore, can be used on its own with one proviso, that the later books do not duplicate material from their predecessors, thus a working knowledge of the subjects covered by the earlier books is assumed.

BOOK 1: This book contains all the fundamental theory necessary to lead to a full understanding of the simple electronic circuit and its main components.

BOOK 2: This book continues with alternating current theory without which there can be no comprehension of speech, music, radio, television or even the electricity utilities.

BOOK 3: Follows on semiconductor technology, leading up to transistors and integrated circuits.

BOOK 4: A complete description of the internal workings of microprocessor.

BOOK 5: A book covering the whole communication scene.

BP85: INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE $12.25
ADRIAN MICHAELS
This book will help the reader to find possible substitutes for a popular user-orientated selection of modern transistors Also shown are the material type, polarity, manufacturer selection of modern transistors. Also shown are the material type, polarity, manufacturer and use. The Equivalents are sub-divided into European, American and Japanese. The products of over 100 manufacturers are included. An essential addition to the library of all those interested in electronics, be they technicians, designers, engineers or hobbyists. Fantastic value for the amount of information it contains.

BP1: FIRST BOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES $2.80
B.B. BABANI
This guide covers many thousands of transistors showing possible alternatives and equivalents. Covers transistors made in Great Britain, USA, Japan, Germany, France, Europe, Hong Kong, and includes types produced by more than 120 different manufacturers

BP14: SECOND BOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES $4.80
B.B. BABANI
The "First Book of Transistor Equivalents" has had to be reprinted 15 times. The "Second Book" produced in the same style as the first book, in no way duplicates any of the data presented in it. The "Second Book" contains only additional material and the two books complement each other and make available some of the most complete and extensive information in this field. The interchangeability data covers semiconductors manufactured in Great Britain, USA, Germany, France, Poland, Italy, East Germany, Belgium, Austria, Netherlands and many other countries.

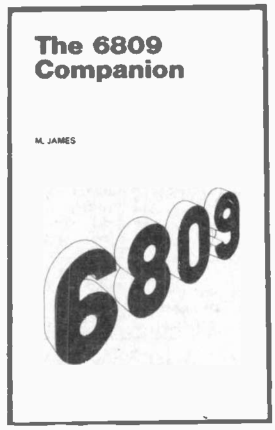
TOWER'S INTERNATIONAL OP-AMP LINEAR IC SELECTOR
TAB No.1216 $13.45
This book contains a wealth of useful data on over 5 000 Op-amps and linear ICs — both pinouts and essential characteristics. A comprehensive series of appendices contain information on specs, manufacturers, case outlines and so on.

CMOS DATABOOK
TAB No.984 $14.45
There are several books around with this title, but most are just collections of manufacturers' data sheets. This one, by Bill Hunter, explains all the intricacies of this useful family of logic devices. . . the missing link in getting your own designs working properly. Highly recommended to anyone working with digital circuits.

BP68: CHOOSING AND USING YOUR HI-FI $7.25
MAURICE L. JAY
The main aim of this book is to provide the reader with the fundamental information necessary to enable him to make a satisfactory choice from the extensive range of hi-fi equipment now on the market.

Help is given to the reader in understanding the equipment he is interested in buying and the author also gives his own opinion of the minimum standards and specifications one should look for. The book also offers helpful advice on how to use your hi-fi properly so as to realise its potential. A Glossary of terms is also included.

See the order form on page 23



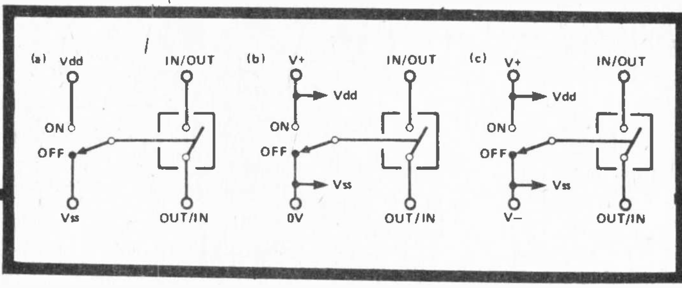
Book Of The Month

The 6809 Companion .... BP102 .... $8.10

The 6809 is a fairly popular processor; in fact, we expect to be looking at a system using one in next month's ETI. Similar in many respects to the 6502, it can be found in some CBM machines, the Radio Shack colour computer, and there's a 6809 card available for the Apple. They're creeping up on you.

If you already have a fair idea of how machine code works, this is the ideal book for you. It explains the peculiarities of 6809 archetecture, and provides a library of the processor's commands. Interrupts are covered, and there's even a section on converting 6800 programs. Small, compact, and, most important, yellow, this is the book for anyone contemplating ML programming on this popular little beast.

4066B Circuits



The CMOS family contains many useful ICs, and this month, Ray Marston takes an in-depth look at the 4066B quad bilateral switch.

Fig. 2 (a) The basic bilateral switch is turned off by taking the control terminal to V_{SS} and turned on by taking the control to V_{DD}. (b) In digital switching applications, V_{DD} is V+ and V_{SS} is 0V. (c) In analogue switching applications where a split power supply is used, V_{DD} must go to V+ and V_{DD} to V−.

THE 4066B CMOS IC is described in the manufacturer's literature as a 'quad bilateral switch', a pretty fair description since the device contains four independed electronic switches, each capable of passing signals in either direction and being controlled (turned on or off) by a single high-impedance terminal. The switches have a very high off impedance, an on impedance of about 90R, and can be used to switch both analogue and digital signals. The ICs typically cost a mere 50 cents each, not bad for four independent SPST switches.

Basic 4066B Circuits

Fig. 1 shows the outline and pin notations of the 4066B quad bilateral switch, which can be used with any supply voltage in the range 3 to 18V. Note that, since the switches are of the bilateral type, either switch terminal can be used as the input or output.

Fig. 2a shows the basic way of using the bilateral switch; the switch can be turned off (open circuit) by taking the control terminal to V_{SS} or turned on by taking

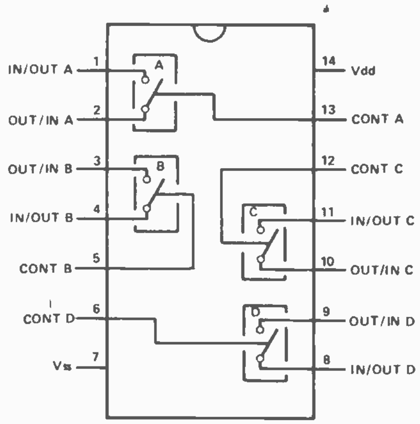


Fig. 1 Outline and pin notations of the 4066B quad bilateral switch.

the control terminal to V_{DD}. In digital switching applications (Fig. 2b) the IC can be used with a single-ended supply, with V_{SS} at 0V and V_{DD} at the desired positive supply. In analogue switching applications (Fig. 2c), a split power supply (either true or effective) must be used, with the positive rail to V_{DD} and the negative to V_{SS}; in this case, of course, the maximum supply limits are restricted to ±9V. Typically, the bilateral switch in-

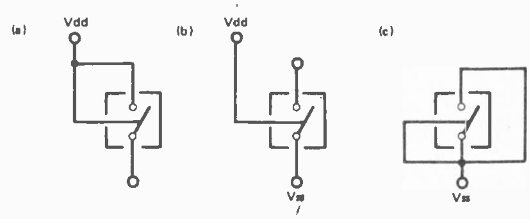


Fig. 3 Unused bilateral switches must be disabled, either by taking the control terminal to V_{DD} and one of the switch terminals to V_{DD} (a) or V_{SS} (b), or by taking all three terminals to V_{SS}.

troduces less than 0.5% of signal distortion when used in the analogue mode.

Certain simple precautions must be observed when using the 4066B. First, the switch signals must in no circumstances be allowed to rise above the V_{DD} voltage or fall below the V_{SS} voltage. Each unused switch in the 4066B package must be disabled (see Fig. 3) either by taking its control terminal to V_{DD} or V_{SS} (as most convenient), or by taking all three terminals to V_{SS}.

Fig. 4 shows how the 4066B can be used to implement the four basic switching functions of SPST, SPDT, DPST and DPDT. Fig. 4a shows the SPST connections, which we have already discussed. The SPDT function is implemented by wiring an inverter stage (a 4001 or 4011, etc) between the IC1a and IC1b control terminals as shown. The DPST switch (Fig. 4c) is simply two SPST switches sharing a common control terminal, and the DPDT switch (Fig. 4d) is two SPDT switches sharing a common inverter stage in the control line.

Note that the basic switching functions of Fig. 4 can be expanded or combined in any desired way by simply adding extra switches/4066B-packages, as appropriate. Thus, a 10-pole double-throw switch can, for example, be made by using five of the Fig. 4d circuits and joining their control inputs together.

Six Latching Circuits

Fig. 5 shows how a 4066B switch can be used as a simple but very useful push button activated latch; the LED is merely used to indicate the state of the latch and can be replaced with a short circuit if preferred. Circuit operation is easily understood.

Suppose initially that the latch is off (switch open). In this case the output, and hence the control bias applied via R2, will be zero, so the switch will maintain its off state. If PB1 is now momentarily closed the control voltage will go high and turn the switch on, thus driving the output high and maintaining the control drive high (switch on) once PB1 is released. This new state will be maintained until PB2 is closed, at which point the switch will latch into the off state again. R1 is used in the circuit to ensure that a supply short will not occur if both buttons are pressed at the same time; with R1 in the position shown, the switch will turn off if both buttons are pressed at once; if R1 is moved to the low side of PB2, the switch will turn on if both buttons are pressed at once.

The Fig. 5 circuit has a couple of interesting characteristics. First, the control bias resistor can be given any desired value up to practical limits. Fig. 6, for example, shows how the value can be increased to 10M to make a latching touch switch that can be activated by placing a finger across the upper or lower set of touch contacts. R1 and C1 are used to suppress hum signals and ensure positive switching.

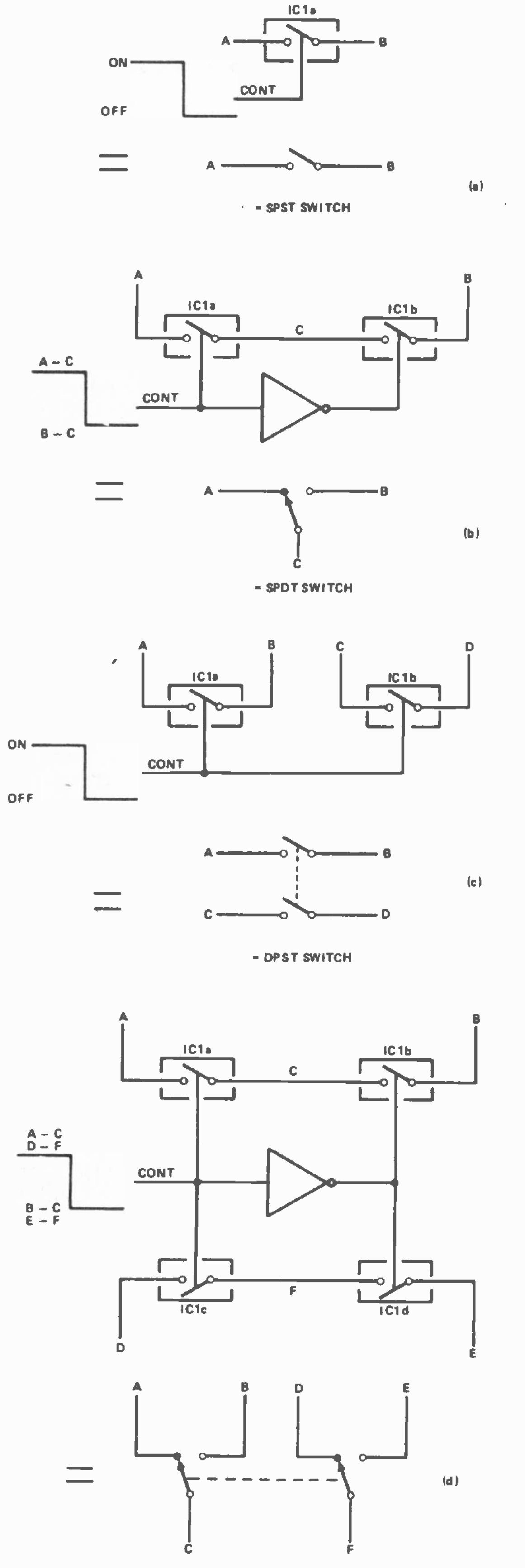


Fig. 4 Using the 4066B to implement the four basic switching functions.

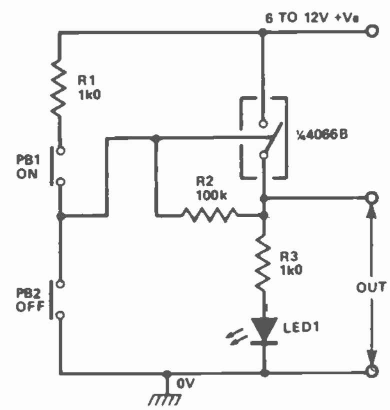


Fig. 5 Push-button latch using the 4066B.

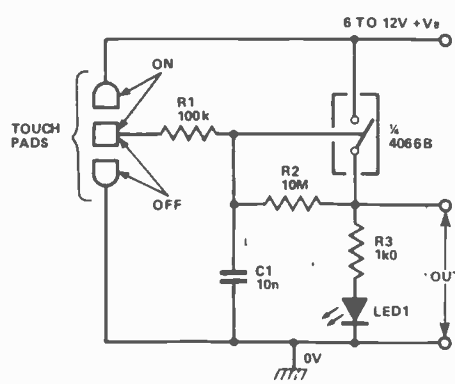


Fig. 6 A latching touch-switch.

Another useful feature is that, since the on resistance of the switch is only 90 R or so, the voltage loss across the switch can be quite low (90 mV at 1 mA): in practice, the on current should be limited to 10 mA maximum. Fig. 7 shows how this low-loss effect can be exploited to make a push-button power switch that can be used to connect or disconnect the power supply to a piece of electronic equipment (amplifier, test gear, etc).

When the switch is off, Q1 is cut off and the circuit consumes a typical standby current of less than 1 uA. When the switch is on, Q1 acts as a voltage follower with its base tied to the positive line via IC1a, so the output voltage is high. The actual voltage drop between the output and the supply is equal to the IC1a drop plus the base-emitter drop of Q1 and typically ranges from 600 to 800 mV. The available output current depends on the gain and current rating of Q1, but currents of a few hundred milliamps are readily available from a single transistor.

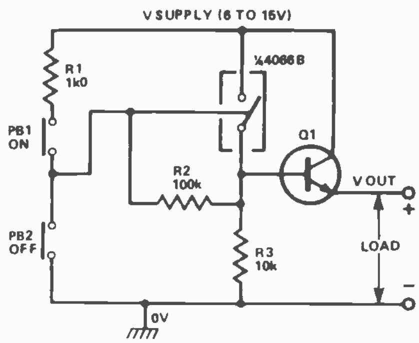


Fig. 7 This push-button activated power switch can be used to replace a conventional slide or toggle switch.

A slightly more efficient version of the push-button power switch is shown in Fig. 8. In this case the load is wired between the collector of Q1 and the positive supply rail. The voltage drop in this circuit is determined only by the saturation characteristics of Q1 and may typically be in the range 200 to 600 mV.

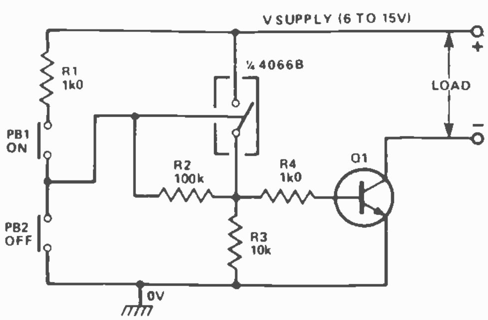


Fig. 8 An alternative version of the push-button power switch.

Fig. 9 shows how the above circuit can be modified for use as a 'close-to-activate' burglar, panic or fire alarm, in which Q1 output feeds directly to a heavy duty 'alarm' relay which, in turn, actuates an external bell or siren. Any number of normally-open sensors/switches can be wired in parallel in the 'PB' positions. The circuit consumes only a microamp or so when in the 'ready' or off mode.

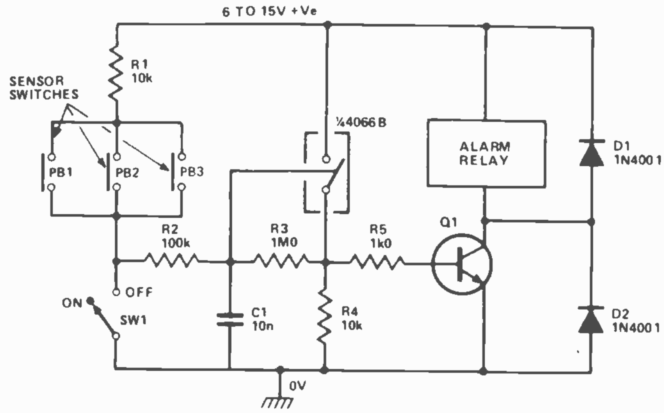


Fig. 9 A close-to-activate burglar/panic/fire alarm.

Finally, Fig. 10 shows how a pair of 4066B switches can be used to make a break-to-activate burglar alarm in which any number of normally-closed sensor switches can be wired in series and which typically consumes a standby current of only 1 uA or so. Here, if any of the switches open, the control terminals of IC1a and IC1b are pulled high by R1 and cause both switches to close; IC1a then shorts out R1, ensuring that the switches will not turn off again when the sensor switches close. Simultaneously IC1b activates the alarm relay via Q1. Note that, once this alarm circuit has been activated, it can only be turned off again by resetting the sensor switches and momentarily breaking the supply connections via SW1.

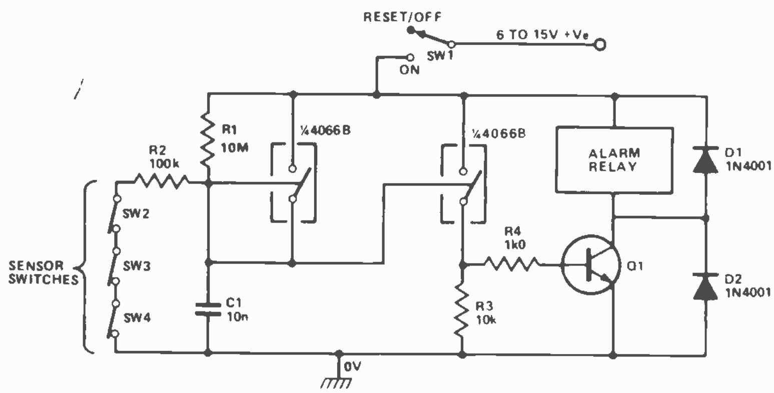
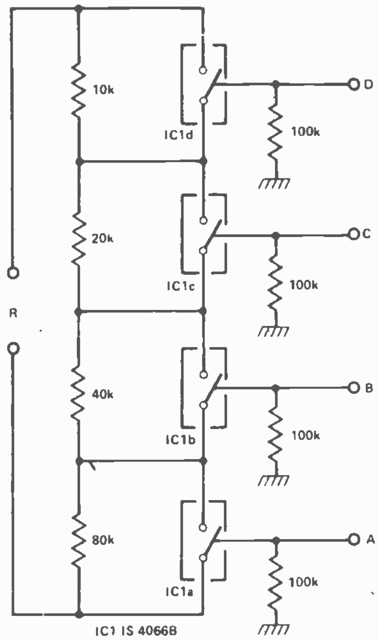


Fig. 10 A break-to-activate burglar alarm.

Digital Control

The 4066B can be used to digitally control or vary resistance, capacitance, impedance, amplifier gain or oscillator frequency in any desired number of discrete steps. Fig. 11 shows how the four switches of a single 4066B can be used to vary the effective value of a resistance in 16 digitally-controlled steps of 10K each.



A	B	C	D	R
0	0	0	0	150k
0	0	0	1	140k
0	0	1	0	130k
0	0	1	1	120k
0	1	0	0	110k
0	1	0	1	100k
0	1	1	u	90k
0	1	1	1	80k
1	0	0	0	70k
1	0	0	1	60k
1	0	1	0	50k
1	0	1	1	40k
1	1	0	0	30k
1	1	0	1	20k
1	1	1	0	10k
1	1	1	1	0

Fig. 11 This circuit gives 16-step digital control of resistance. R can be varied from zero to 150k in steps of 10k.

In practice, of course, the step magnitudes can be given any desired value (determined by the value of the smallest resistor) so long as the four resistors are kept in the ratio 1-2-4-8.

Fig. 12 shows how four switches can be used to make a digitally-controlled capacitor that can be varied in sixteen steps of 1n0 each.

Note that in the Fig. 11 and 12 circuits the resistor/capacitor values can be controlled by operating the 4066B switches manually, or automatically using simple logic networks, microprocessors, up/down counters, and so on.

The circuits of Figs. 11 and 12 can be combined in a variety of ways to make digitally-controlled impedance and filter networks. Fig. 13, for example, shows three different ways of using the circuits to make a digitally-controlled first-order low pass filter.

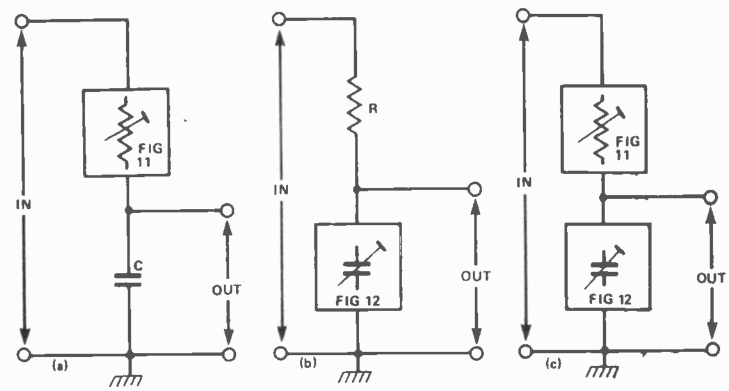
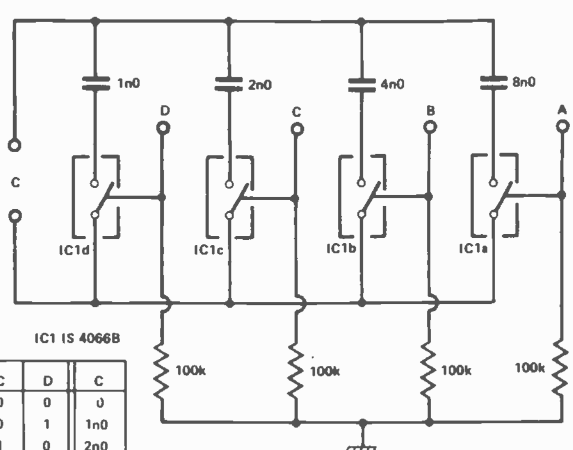


Fig. 13 Three ways of using the circuits of Fig. 11 and Fig. 12 to make a digitally-controlled first-order low pass filter.

Digital control of amplifier gain can be obtained by hooking the 'resistance' circuit of Fig. 11 into the feedback or input path of a standard op-amp inverting circuit, as shown in Figs. 14 and 15. The gain of such a circuit is equal to R_F/R_{IN}, where R_F is the feedback resistance and R_{IN} is the input resistance. Thus, in the Fig. 14 circuit, where the controlled resistance is in the feedback loop, the gain can be varied from zero to unity in 16 discrete steps of 'one fifteenth' each, ie giving a sequence of 0, 1/15, 2/15, 3/15, ..., 14/15, 15/15.



A	B	C	D	C
0	0	0	0	0
0	0	0	1	1n0
0	0	1	0	2n0
0	0	1	1	3n0
0	1	0	0	4n0
0	1	0	1	5n0
0	1	1	0	6n0
0	1	1	1	7n0
1	0	0	0	8n0
1	0	0	1	9n0
1	0	1	0	10n
1	0	1	1	11n
1	1	0	0	12n
1	1	0	1	13n
1	1	1	0	14n
1	1	1	1	15n

Fig. 12 A similar circuit to that of Fig. 11 gives 16-step digital control of capacitance. C can be varied from zero to 15n in steps of 1n0.

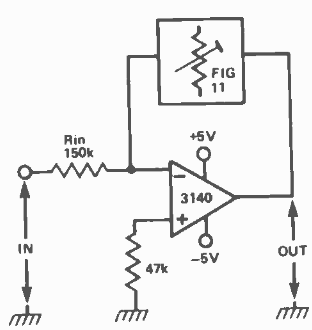


Fig. 14 Digital control of gain using the Fig. 11 circuit. The gain can be varied between zero and unity in 16 steps.

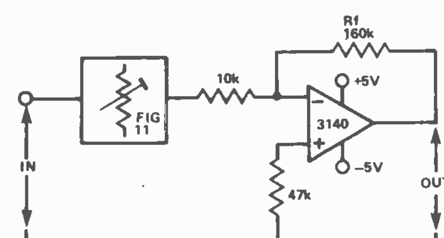


Fig. 15 This application of the Fig. 11 circuit gives digital control of gain between unity and X16 in 16 steps.

In the Fig. 15 circuit, where the controlled resistance is in the input path, the gain can be varied from unity to X16 in 16 steps, giving a gain sequence of 1,2,3,4,5,6. . . . Note that in both of these circuits, the op-amp uses a split power supply so the 4066B control voltage must switch between the negative and positive supply rails.

Fig. 16 shows how the Fig. 11 circuit can be used to digitally control the frequency of an oscillator in 16 discrete steps. In this example the circuit is that of a 555 astable, but the general control principle can be applied equally well to many other types of oscillator circuit.

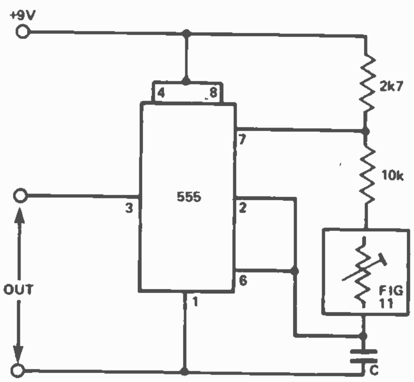


Fig. 16 Digital control of the frequency of a 555 astable. The frequency can be varied in 16 steps.

Fig. 17 shows how a trio of 4066B switches can be used to implement digital control of the decade range selection of 555 astable. Here, only one of the switches must be turned on at any time. Naturally, the circuits of Figs. 16 and 17 can be combined to form a wide-range oscillator that can be digitally controlled by a computer, for example.

Synthesized Multi-Gang Pots

The synthesizing principle is quite simple and is illustrated in Fig. 18, which shows the circuit of a synthesized four-gang 10k-100k rheostat for use at signal frequencies up to about 15 kHz.

Here, the 555 is used to generate a 50 kHz (nominal) rectangular waveform whose mark/space ratio can be varied from 11:1 to 1:11 by RV1, and this waveform is used to control the switching of the 4066B stages. All of the 4066B switches are fed with the same control waveform, and each switch is wired in series with a range resistor (RA, RB, etc), to form one gang of the 'rheostat' between the pairs of terminals, as shown.

Remembering that the switching rate of this circuit is very fast (50 kHz) relative to the rheostat's maximum signal frequency (15 kHz), it can be seen that the mean or effective value of the 'rheostat' resistance can be varied with mark/space ratio control RV1. Thus, if IC2a is closed for 90% and open for 10% of each dury cycle (mark/space ratio of 9:1), the apparent (mean) value of the resistance will be 10% greater than RA, i.e., 10k. If the duty cycle is reduced to 50%, the apparent RA value will double, to 18k2. If the duty cycle is further decreased, so that IC2a is closed for only 10% of each duty cycle (mark/space ratio 1:9), the apparent value of RA will increase by a decade, to 91k. Thus, the apparent resistance of each 'gang' of the 'rheostat' can be varied by RV1.

There are some important point to note about the Fig. 18 circuit. First, the circuit can be given any desired number of 'gangs' by simply adding an appropriate number of switch stages and range resistors. Since all switches are controlled by the same mark/space ratio waveform, perfect tracking is automatically assured. Individual gangs can be given different ranges, without affecting the tracking, by giving them different range resistor values. The sweep range and the log of the rheostat can be changed by changing the characteristics of the mark/space ratio generator.

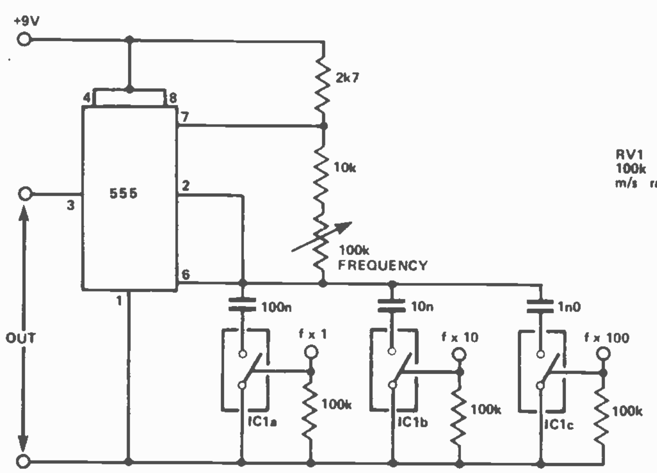


Fig. 17 Digital control of decade range switching of a 555 astable.

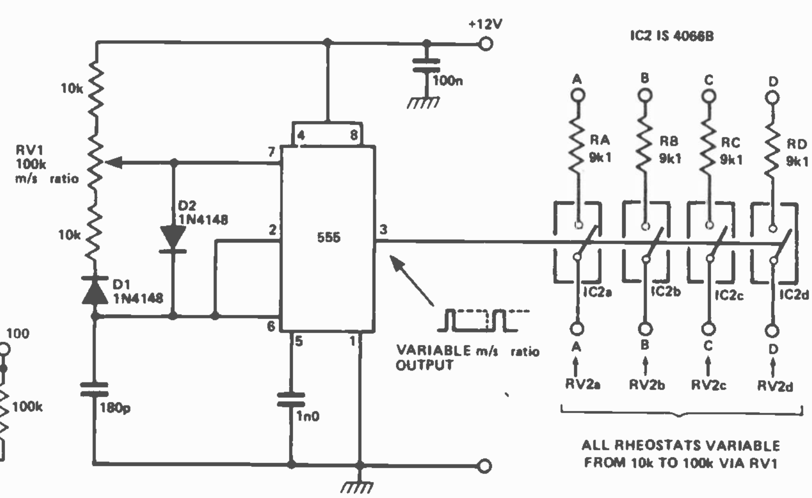
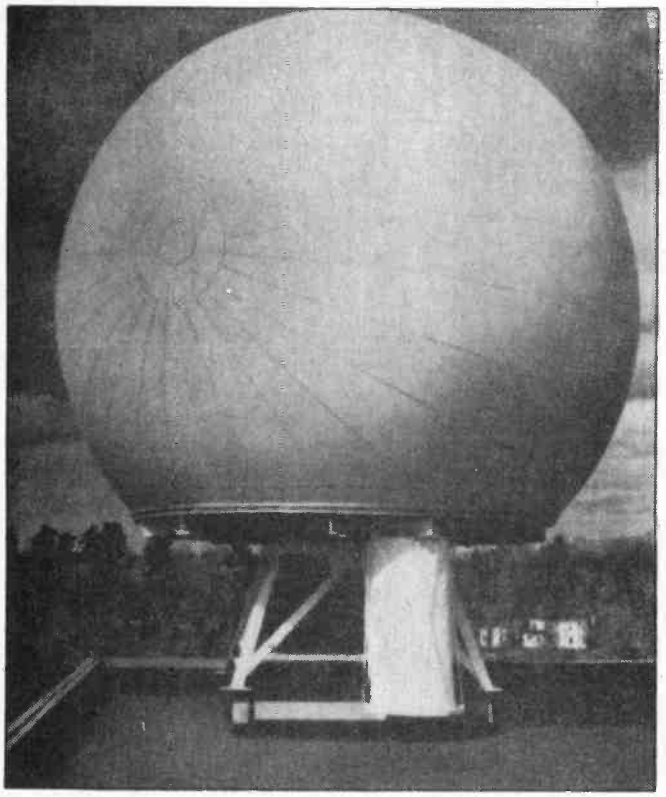


Fig. 18 Synthesized precision four-gang rheostat.

PULLING THE PLUG



Big Round Things

THEY'RE BIG, they're round and, of course, they're wholly useless for any practical purpose, but they're available now, and we wouldn't be surprised if they became the next great fad. Available in twelve sizes, all about fifty feet across, and in a wide variety of colours (bloody kids and their spray paint), these huge spheres will make you the talk of the neighbourhood, the toast of your friends, and the laughing stock of anywhere you go. And, for a limited time only, anyone buying one of these spheres will receive, at no extra charge, a truckload of dead livestock and five, yes five, rusty old Fords to use in any way they see fit.

Can you afford to pass up a deal like this? Well, to sweeten the pot a bit, consider the features of these amazing spheres. Each one utilizes a shape originally devised by the ancient Fungalarian tribesmen of Northwestern Crete for reasons now lost in the mists of time, but believed to be the technological predecessor of many of our modern developments, including the golf ball and the Shepherd's caster. These revolutionary devices are capable of being looked at, walked around, pushed off cliffs, burned, blown up and shot at with elephant guns, all without the purchase of any additional accessories. They make attractive gifts for people you really despise, and great lawn ornaments for wierdos and esthetic vegetables. Made of all sorts of durable materials too numerous to mention, these spheres are guaranteed to last a lifetime or your money cheerfully retained.

Start a sphere club. Form a user's group and publish a news letter. Organize sphere parties. We'll provide you with free information on how to plan sphere fund raising drives to buy more spheres so we'll get rich faster. Spheres are bigger than frisbees, more useless than pet rocks and even less attractive than Mongolian mouse eating swampweeds. They're just perfect for the man or woman who has everything and doesn't know why.

These spheres will be available for a limited time only (until we either sell them all or are forced to flee the country). You can buy your sphere(s) by sending $305,000.69 plus $1500.00 postage and handling (we accept VISA) to;

Spheres
Abominably Stupid Sales Co., Ltd.
P.O. Box 69
Android, Nova Scotia
T5R 9I8

Allow six to eight weeks for delivery, but please be patient. Packages do become lost in the mail from time to time.

Pulling the Plug is a digest of the most up to the minute inaccuracies, delusions and falsehoods in the fast moving world of technical navel contemplation. As such, much of it may prove unsuitable for situations requiring the truth.

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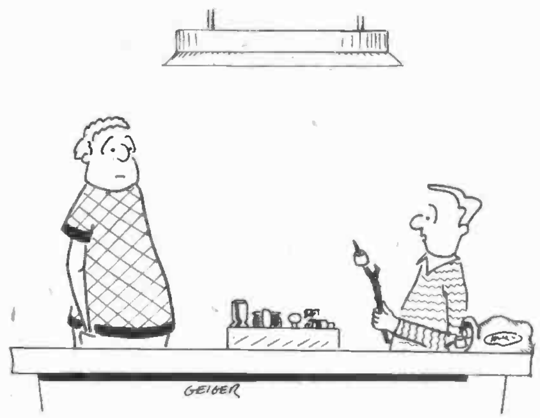
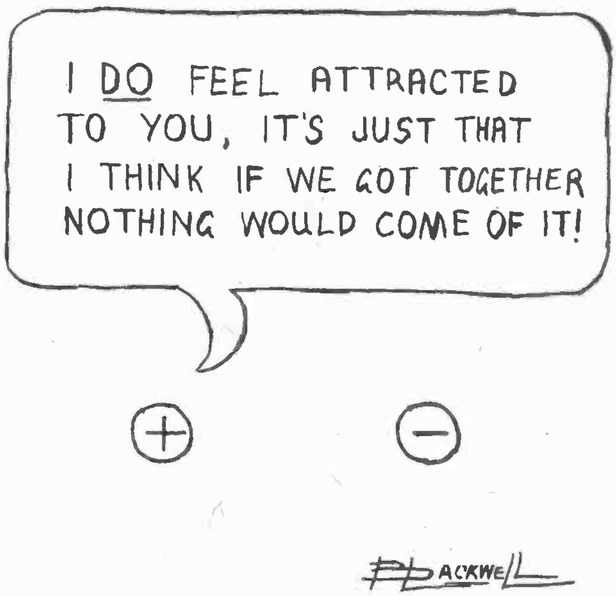
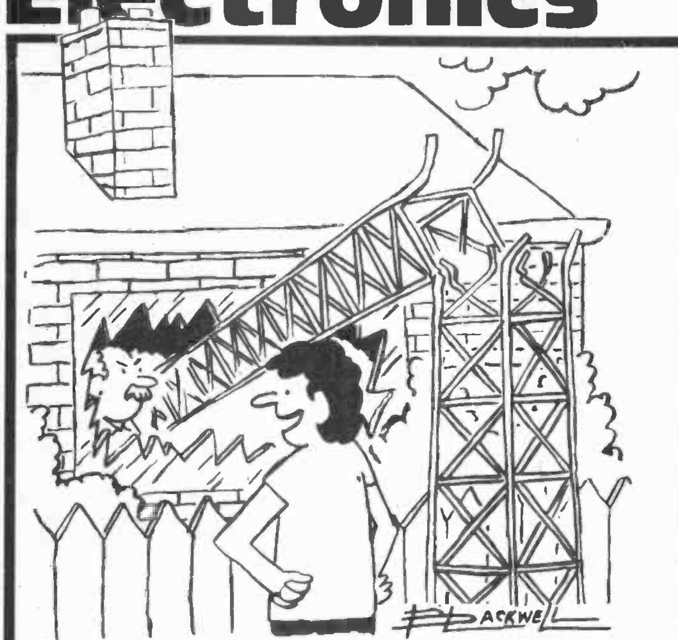
The Fun of



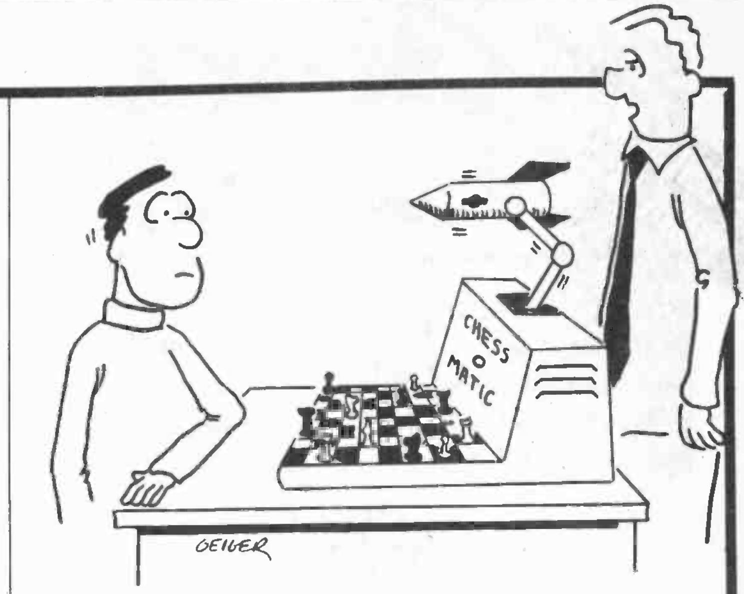
Most of my projects burst into flames when I turn them on, so now I keep a bag of marshmallows handy, just in case.



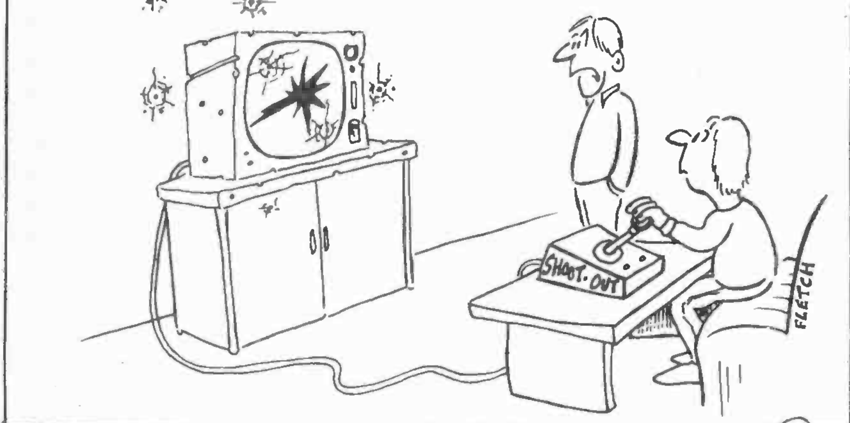
Electronics



I'm glad you pointed this out to me, Mr. Roth, I was wondering why I was getting such poor reception!



It wants you to reconsider your last move.



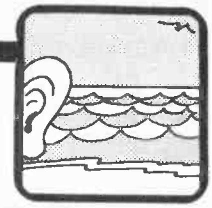
It's a bit too realistic for me!

How long have you had this irrational fear of being replaced by a computer?

We wanna jam with your computer.

Of course, it only works on very stupid burglars.

Background Noise Simulator



At last — a psycho-physical project, which helps you concentrate and relax.

IT IS A medical fact that human concentration operates in short bursts (up to about 20 minutes) after which the individual requires a few seconds of relaxation before continuing with the work at hand. You can see this effect yourself when reading a book or studying: every now and again you break from concentration and look up, perhaps simply to see what time it is or to make a cup of coffee.

It is also known (and fairly obvious) that the level of background noise can affect the length of concentration bursts — for instance, too much noise prevents you from working at all (just try concentrating when workmen are digging up the road outside!). Not so obvious is the effect caused by too little background noise. Concentration under such a condition becomes very difficult and can be impossible with absolutely no background noise.

Well, the ETI Background Noise Simulator has been designed to deal with the last problem. After building this project readers who suffer from lack of concentration, due to lack of background noise, can breathe sighs of relief. Of course, we can't guarantee that you will all be transformed into geniuses able to rewrite relativity theories, but we can promise that you should be able to experiment with some interesting psychological effects. For instance we tried the project out with our art department, along the corridor in the ETI offices and they told us that if we didn't go drown our machine in the nearest bucket of water and let them get back to sleep, they wouldn't invite us to next year's Christmas party. With that threat in mind we left them to it.

Construction

This project offers a choice of con-

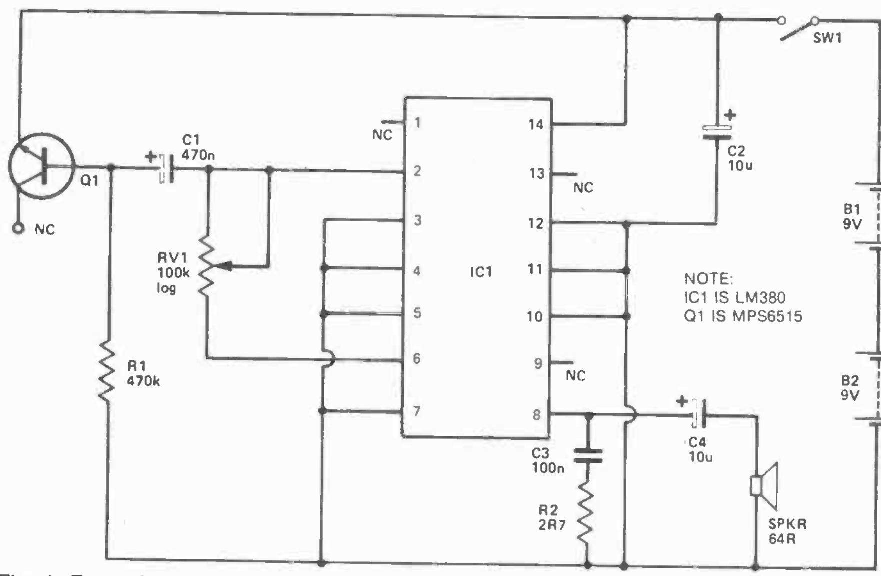


Fig. 1. From this circuit diagram you can see the unusual way Q1 is in circuit.

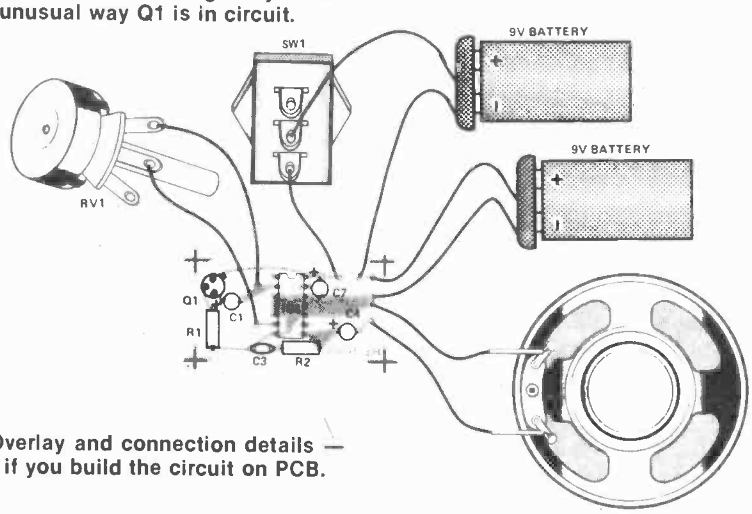


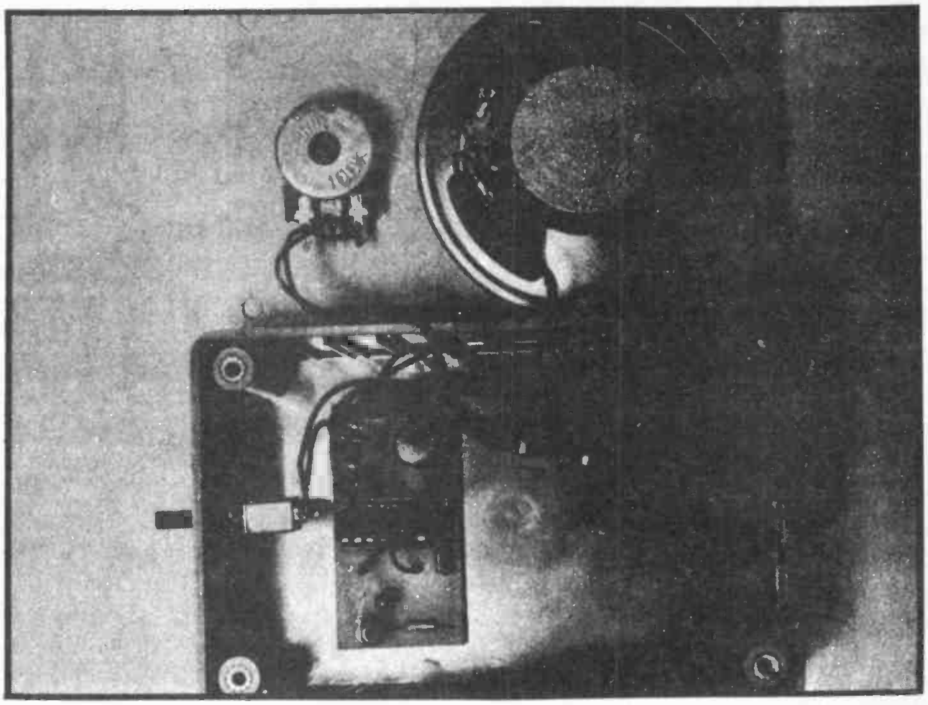
Fig. 2. Overlay and connection details — use this if you build the circuit on PCB.

struction techniques: either Veroboard or PCB can be used to build it up. Overlay and connection details are given for them both in Figs. 2 and 3.

When using Veroboard, remember to break the tracks where necessary, as indicated in the underside view of the board in Fig. 2 and check that no short circuits are formed by loose swarf or solder bridges between tracks. Track breaks can be made using either the correct tool or simply a hand-held 1/8" drill bit, by holding it on the hole in question and twisting gently clockwise.

Insert resistors first, followed by capacitors and finally semiconductors. The diagrams show component position and connection details. Follow them carefully, making sure all polarised components are inserted the same way round as indicated.

After connection of the speaker and a suitable power supply, the project should work satisfactorily first time. It then only remains to build the board into a suitable case.



PARTS LIST

RESISTORS

R1	470k
R2	2R7

POTENTIOMETER

RV1	100k logarithmic potentiometer

CAPACITORS

C1	470n, 16V tantalum
C2,3	100n polyester
C4	10u, 16V printed circuit mounted electrolytic

SEMICONDUCTORS

IC1	LM380 2W power amplifier
Q1	MPS6515 NPN transistor

MISCELLANEOUS

SW1	single-pole, single-throw toggle switch

IC socket (14-pin)
Miniature speaker —64R
Batteries and clips

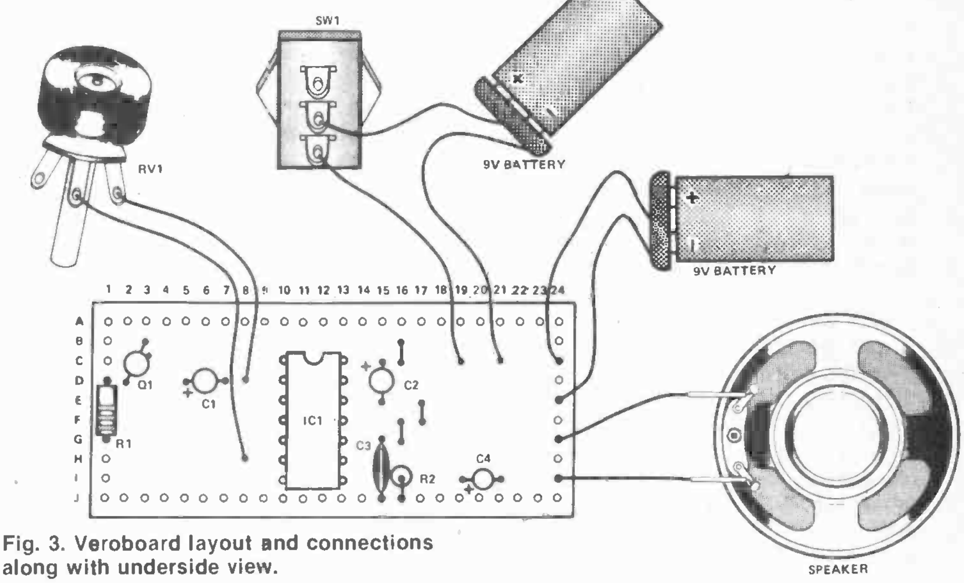
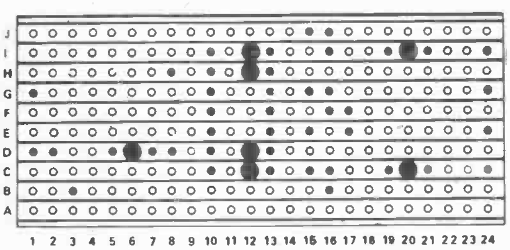


Fig. 3. Veroboard layout and connections along with underside view.

See page 66 for the PCB pattern.



HOW IT WORKS

The heart of this project is none other than our old friend the LM380. The IC has all the necessary circuitry to form an amplifier with over 2W of output power. Of course we don't need all of that power in this application — in fact only ¼ W is ample — but the LM380 remains one of the cheapest amplifier ICs around (regardless of output power) so we stuck with it.

Transistor Q1 forms the noise generator. It is connected in a rather unusual manner (see the circuit diagram in Fig. 1), with its emitter positive relative to its base. In this mode, a transistor is transmogrified into what is essentially a zener diode — a noisy one at that, providing a fairly large amplitude (50 mV) of noise at its base. Integrated circuit IC1 amplifies the noise (RV1 acting as a volume control) to drive the speaker and give the background noise.

Low Power Pilot Light

Build yourself this simple circuit to fit inside battery-powered equipment — it will warn you that you have left the equipment on and that you are wasting valuable battery power.

HOW MANY TIMES have you gone to your radio to listen to your favourite program, only to find that the battery is dead because the last time you tuned in you forgot to turn it off? This sort of thing can happen quite often to battery-powered equipment and the chances are you won't have any fresh batteries.

Now, wouldn't it be nice if you could fit a LED pilot light to the equipment to give a visual warning when it has been left on? The problem with such a method is that the current drawn by the LED (about 20 mA) could result in the pilot light using more power than it saves.

A more practical alternative is to use a low power pilot light such as this one. The ETI Low Power Pilot Light flashes a LED for only very short periods, at intervals of about 1s. Because the LED is on for only a small fraction of the total time, the average current consumption is very low. Thus battery life will not be significantly reduced with the use of this project, even if the battery is a small, low capacity type.

A flashing LED pilot light also has the advantage of being more noticeable than a non-flashing type.

Construction

Insert and solder the five resistors into the Veroboard, according to Fig. 2, followed by the two capacitors. Make sure you polarise the capacitors correctly.

Now, mount transistors Q1 and 2, checking before you solder each one in that it is the right way round.

Solder in LED1, the same way round as shown in Fig. 2. Now, bend it down so that it lies in a horizontal line with the Veroboard.

Finally, solder a couple of coloured leads from the corresponding points (red to +9V; black to 0V) long enough to go to the supply points of the equipment into which the project fits.

The circuit board does not need to be fastened down because it is adequately mounted when LED1 is fitted into its panel clip. So, all you need to do now is drill a hole in the panel of your battery-powered equipment to fit the LED panel clip, push in the LED (complete with circuit board) and connect the board to the supply points of the equipment.

PARTS LIST

RESISTORS (All ¼ W, 5%)	
R1	1M2
R2	100k
R3	18k
R4	10k
R5	1k8
CAPACITORS	
C1	1u0, 16V electrolytic
C2	10u, 16V electrolytic
SEMICONDUCTORS	
Q1	MPS6515 NPN transistor
Q2	2N3905 PNP transistor
LED1	0.2" red LED + panel clip
MISCELLANEOUS	
Veroboard, 8 strip x 11 hole, 0.1" matrix	

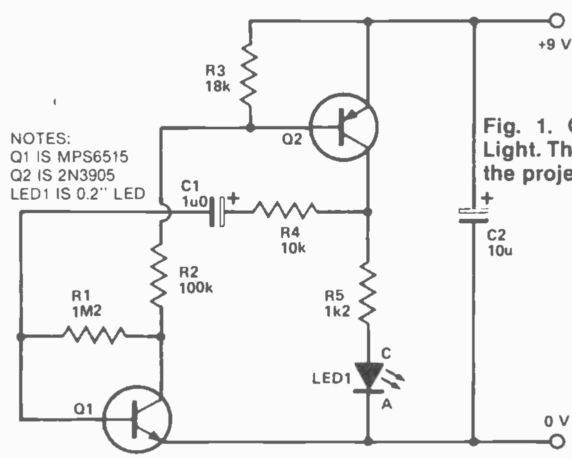
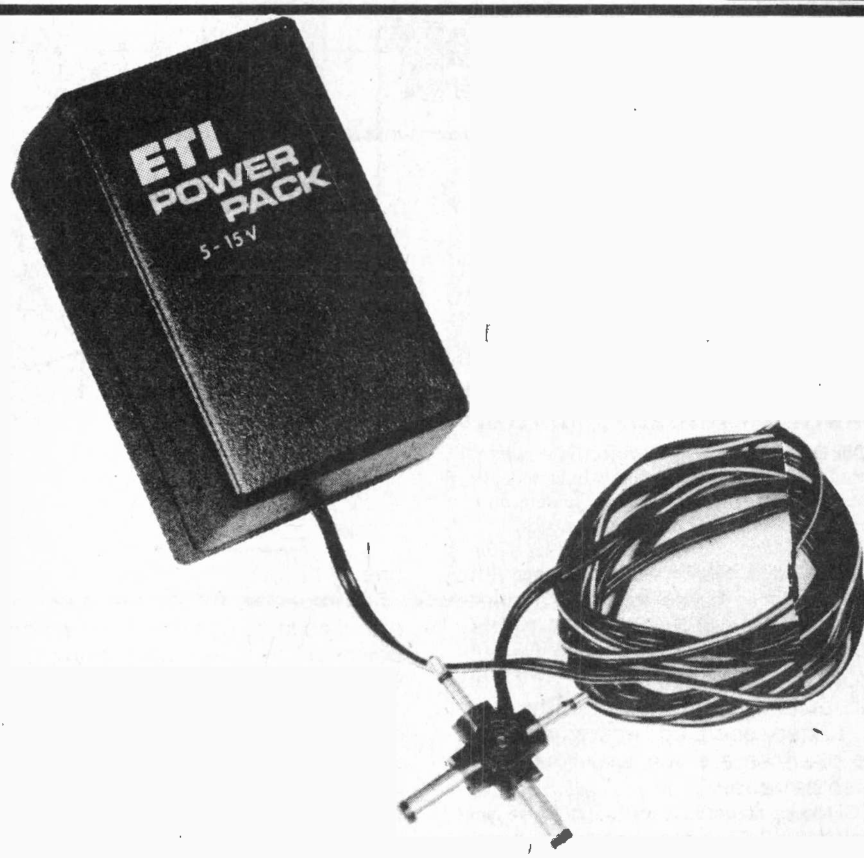


Fig. 1. Circuit of the Low Power Pilot Light. The suggested Veroboard layout for the project is in Fig. 2.

Continued on page 32

Power Pack

An ideal project for users of battery-powered calculators, radios, cassette players etc, because the ETI Power Pack can be adjusted to give the voltage you require.



Our circuit (Fig. 1) gives a regulated output of between 5V and 15VDC, adjusted and set by a preset resistor. Current output is anything up to about 350 mA.

An integrated circuit is used in the project to regulate the output voltage and although this IC (the 7805) is normally used in a fixed-voltage (5 VDC) supply we have adapted the circuit so that it will give a variable output voltage.

Construction

Insert and solder the two diodes into the printed circuit board (PCB) making sure that they are the correct way round, as shown in the overlay in Fig. 2. The bodies of the diodes must be mounted as close to the surface of the PCB as possible.

Solder in PCB pins wherever connections are to be made to the circuit board, then insert and solder all remaining components, following the overlay diagram. Clip the heatsink on to IC1.

Now open the plastic power supply case and take out the sub-chassis. Break or cut off the transformer mounting lugs so that the transformer will fit into the case.

Using good quality contact adhesive and following manufacturers' instructions as to use, stick the transformer to the sub-chassis.

Next, using the contact adhesive, stick the PCB to the sub-chassis to fit underneath the edge of the transformer. Fig. 3 shows a view of the project in which you can see the details at this stage.

Wire up the project carefully following the connection details given in Fig. 2.

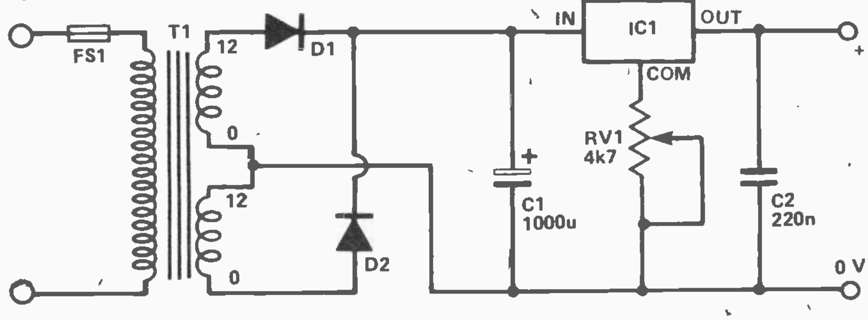
• Solder leads to the transformer terminals, inside the power supply case, and bend the leads up to the top of the case. Refit the sub-chassis and then solder the remaining ends of the AC power leads to the PCB and the transformer, where shown in Fig. 2.

Tightly attach a cable tie to the output lead, so that no damage will occur if it is pulled. A view of the project at this stage is shown in Fig. 4.

Stick a small piece (about 1" by ½") of foam sponge onto the inside lid of the case, positioned so that when the two halves of the case fit back together. The sponge pushes down onto the transformer, preventing movement.

Finally, plug the supply into a wall outlet, turn on, and measure the voltage at the supply output. By adjusting preset resistor RV1 you should obtain an output voltage variable between about 5 VDC and 15 VDC. Set the output voltage to what you require, switch off, remove the supply from the outlet and screw the two halves of the case together.

Fig. 1. Circuit of the Power Pack.



NOTES:
IC1 IS 7805
D1,2 ARE 1N4001

PARTS LIST

POTENTIOMETER

RV1	4k7 miniature horizontal preset

CAPACITORS

C1	1000u, 25V electrolytic
C2	220n polyester

SEMICONDUCTORS

IC1	7805, 1A voltage regulator
D1,2	1N4001, 1A diodes

MISCELLANEOUS

T1	0-12-0-12V, 6VA miniature transformer
Printed circuit board mounting fuse clips	
FS1	500 mA, fuse
Case.	

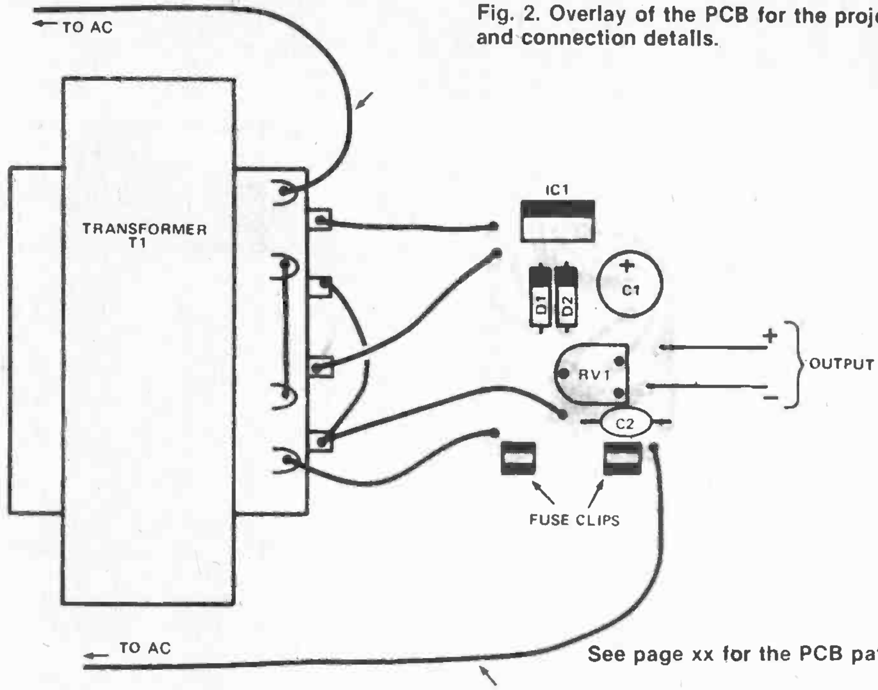


Fig. 2. Overlay of the PCB for the project and connection details.

See page xx for the PCB pattern

HOW IT WORKS

The workhorse of this project is a voltage regulator integrated circuit which sets the output voltage (V_{OUT}) to a value determined by the setting of the preset resistor.

The input voltage (V_{IN}) comes from the rectified output of transformer T1. Diodes D1 and 2 give full-wave rectification of the 12 VAC transformer output.

Capacitor C1 provides smoothing of the rectified voltage and V_{IN} will be about 18 VDC.

Integrated circuit IC1 is a 5V voltage regulator, and whatever the output voltage of the circuit, V_{REG} will always be 5 VDC.

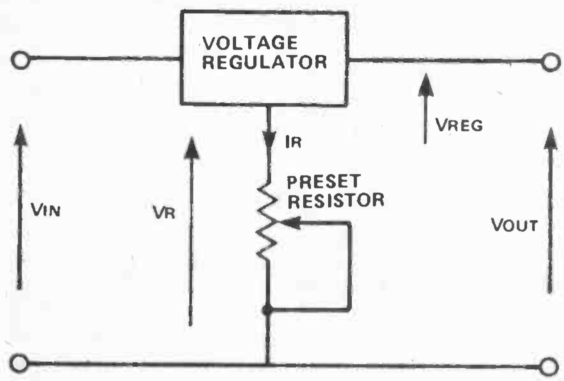
The value of current I_R, is 1.5 mA for IC1 (from manufacturers' data) so we can calculate the voltage across the preset resistor from Ohm's law. For example, if the value of the preset is 1k0 then:

$$V_R = 1.5 \text{ mA} \times 1000, = 1.5 \text{ V}.$$

The output voltage is simply the sum of the two voltages, ie,

$$V_{OUT} = 1.5 + 5 = 6.5\text{V}.$$

Thus, by varying the value of the preset resistor the output voltage can be varied.



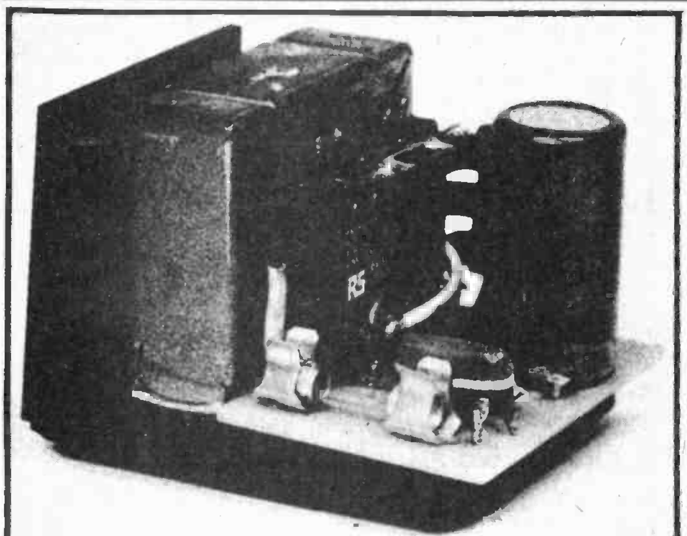


Fig. 3. View of the project fitted to the sub-chassis, before insertion into the case.

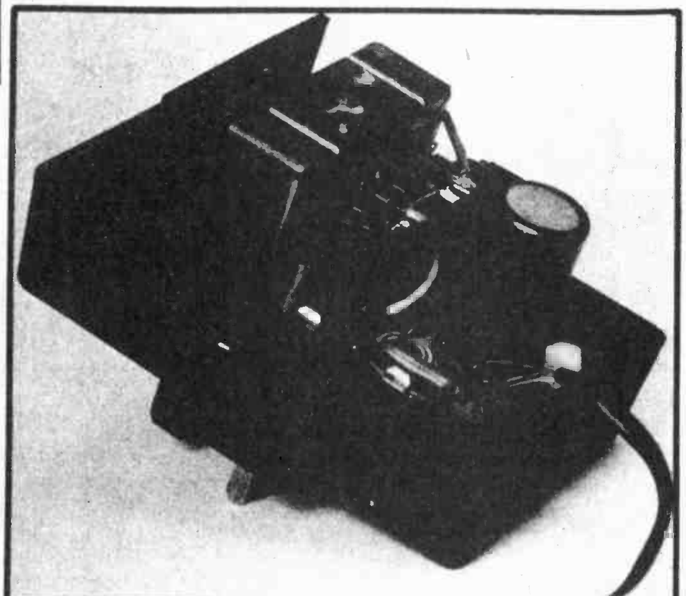


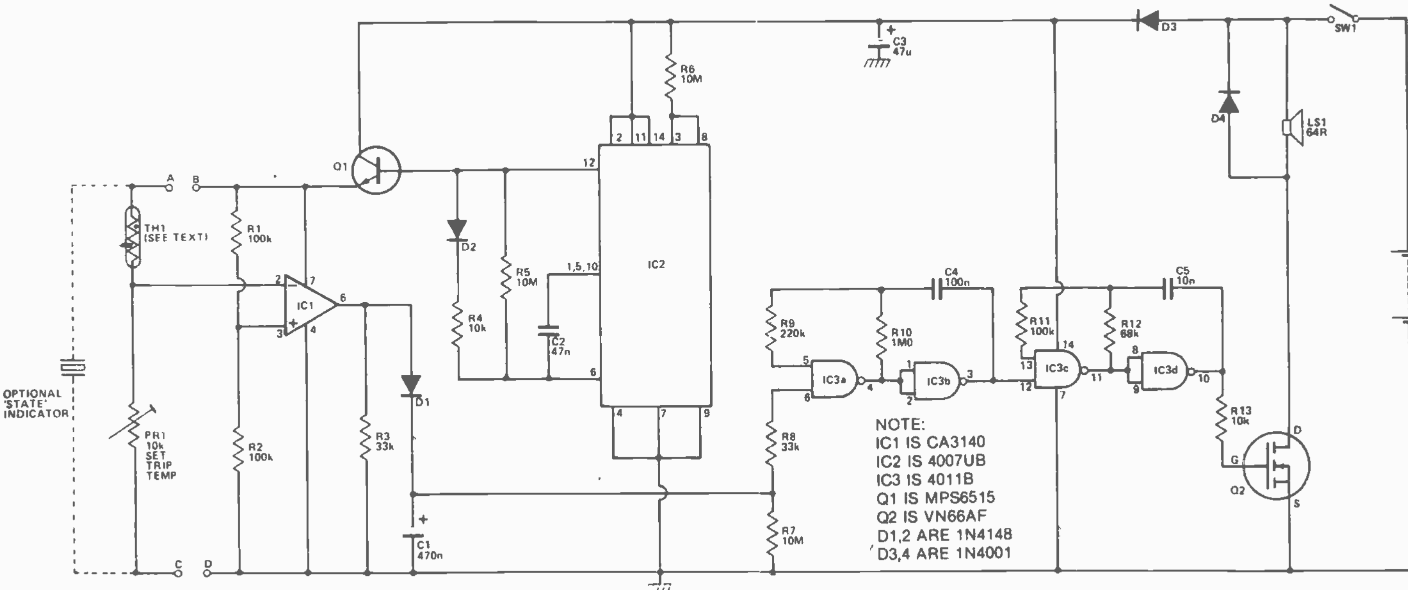
Fig. 4. Internal details of the Power Pack.

uPower Thermal Alarm

This over - or under-temperature alarm consumes a mere 3.5 uA of quiescent current, yet the alarm delivers 1W of peak audio power.

If you liked this project, please circle Reader Service Card number 55. If you didn't, circle number 56.

PRECISION TEMPERATURE ALARMS have a variety of practical uses in the home: they can be used to indicate ice conditions in the attic, over-temperature conditions in the greenhouse or fire conditions in any part of the building. Trouble is, all conventional systems draw quiescent currents of several milliamps and will flatten a 9V battery after less than two days of continuous operation. Drag!



ETI's new Micropower Thermal Alarm system can be used as either an over- or under-temperature alarm; it is specifically desined to overcome the battery flattening problem using the principles described in Designer's Notebook of a few months back.

Construction

The entire circuit, other than the thermistor, speaker and battery, is mounted on a small PCB and construction should present few problems. Note, however, that the circuit uses some high-value resistors, so take care to keep the board clean during and after assembly; when construction and testing is complete, you can coat the entire circuit with varnish, to exclude the shunting effects of moisture and dirt.

The circuit is designed to work with a negative-temperature-coefficient (NTC) thermistor that has a resistance in the range 1k0 to 10k at the desired alarm temperature; the VA1066S is suitable for use at all 'normal' temperatures. TH1 and PR1 can be configured to give either over or under-temperature alarm operation; with the connections shown in the circuit diagram, the unit acts as an under-temperature (ice warning, etc) alarm; for over-temperature operation, simply transpose the TH1 and PR1 positions using the links provided on the PCB. In practical use, the thermistor is mounted remote from the PCB.

When construction of the unit is complete, fit the speaker and battery in place and give the unit a functional check by adjusting PR1 so that the alarm activates; then back-off PR1 so that the alarm seconds delay). Finally, raise (or turns off again (after a few lower) the TH1 temperature to the desired alarm value and then trim PR1 so that the alarm activates.

If desired, an acoustic transducer can be wired between points A and C of the circuit to act as a state indicator. This transducer will generate an audible click once every second when the circuit is working correctly, and adds only a fraction of a microamp to the total current consumption of the unit.

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LOW POWER PILOT LIGHT

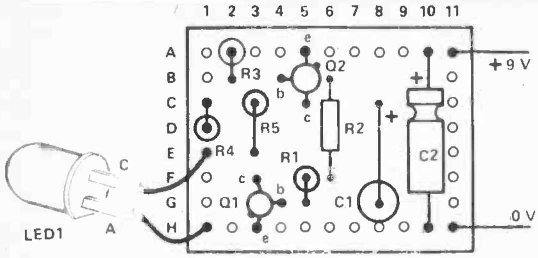
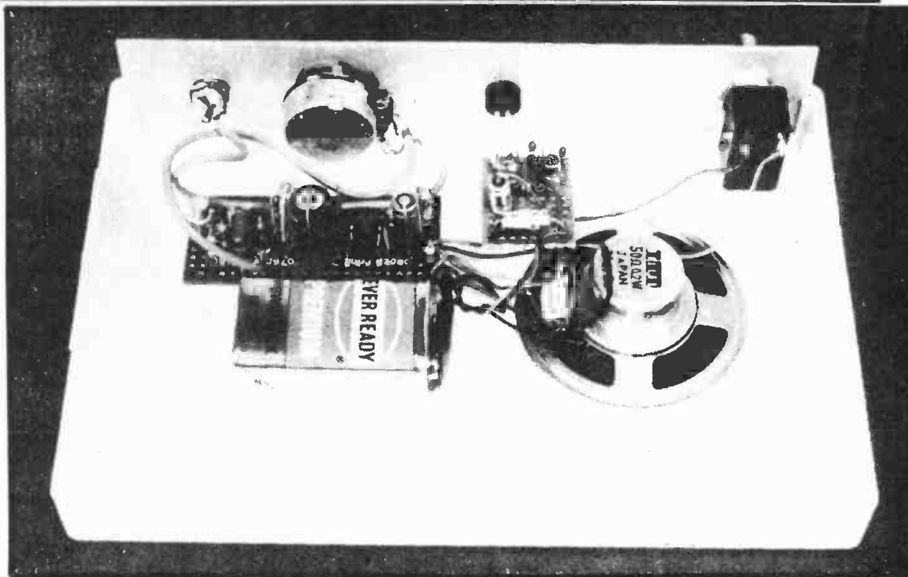


Fig. 2. Veroboard layout. Note no track breaks are required.



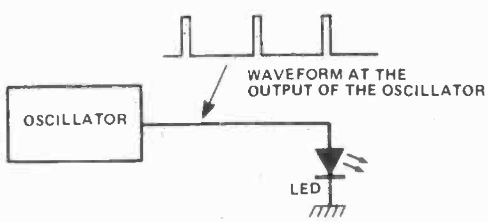
HOW IT WORKS

This project consists of a simple oscillator, producing pulses which light the LED at about one-second intervals.

The LED is on for only about 5% of the total time. Thus the average current consumed by the circuit is very small, so it won't waste battery energy while doing its job.

Initially transistor Q1 is biased into conduction by resistor R1, and it in turn biases Q2 into conduction via current limiting resistor R2. Transistor Q2 therefore supplies a current to LED1 through R5. Capacitor C1 then charges from the supply lines through Q2, R4, and the base circuit of Q1, causing a substantial base current to flow into Q1. This results in Q1, Q2 and LED1 all being switched on.

Capacitor C1 soon becomes fully charged, and the large base current to Q1 ceases. Transistors Q1 and Q2 then start to switch off, and the voltage at Q2's collector falls, forcing a reduction in the potential at Q1's base since the voltage across C1 remains unaltered. This results in Q1, Q2 and LED1 all switching off. Capacitor C1 now discharges through R4, R5, LED1, and the base circuit of Q1, reverse biasing Q1 and holding it in the off state. The discharge path has a higher resistance than the charge path, giving the required relatively long off time of the LED. When C1 has discharged, R1 again biases Q1 into conduction, and the cycle commences from the beginning once again.

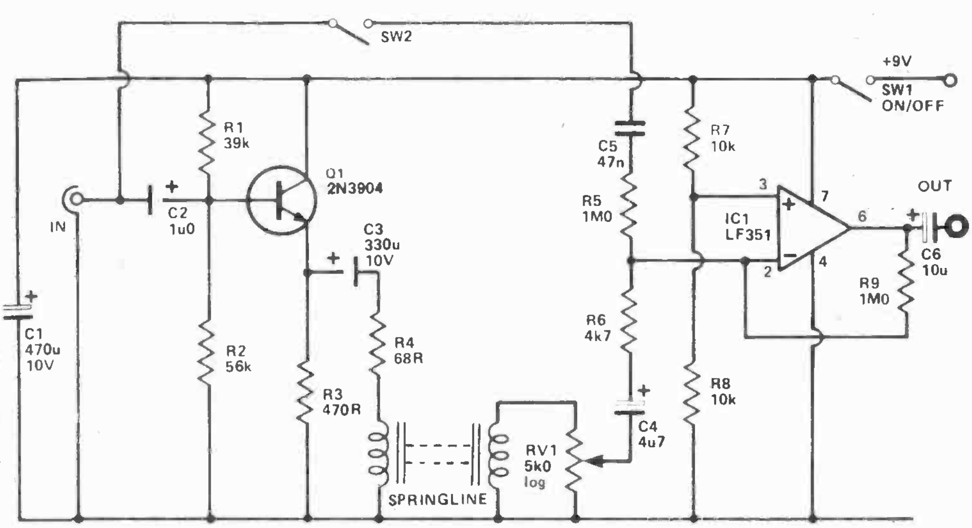


Resistor R3 is needed to ensure that leakage currents do not cause Q2 to be partially switched on when it should be turned off, which would reduce the efficiency of the unit. Capacitor C2 is a supply decoupling component and it prevents the pilot light circuit transmitting noise spikes to the main equipment via the supply lines. ETI

Designer Circuits

Reverberation Unit

This unit simulates the long reverberation time of a large hall (usually around 2 S or so) and can be employed as a musical effects unit or to improve certain types of home-recording. Reverberation is caused by sounds being reflected around the interior of a room and in the case of a large hall the sounds are usually reflected many times before losing sufficient energy to render them inaudible. This, coupled with the fairly long distances covered by the sound waves between reflections, gives the long reverberation time and reverberant sound of a large hall.

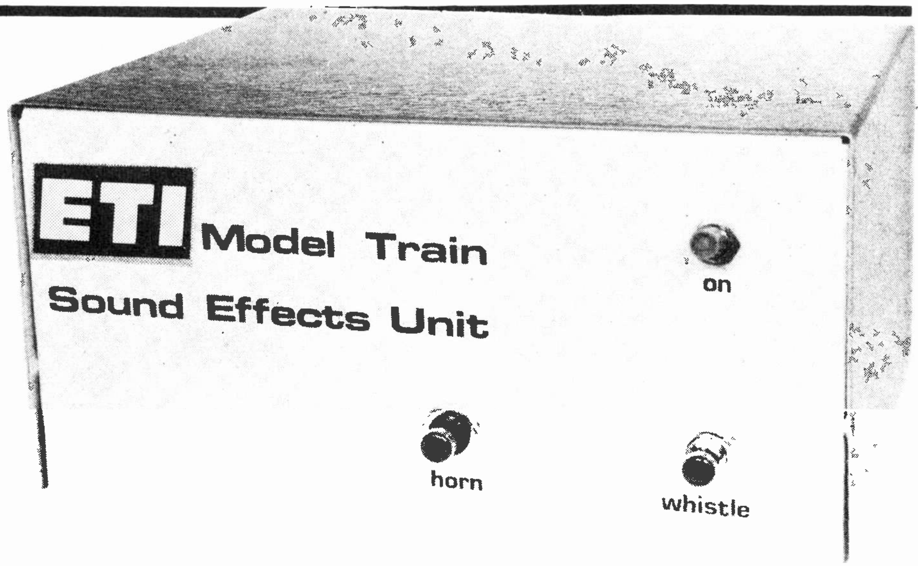


In this circuit the input signal is fed to the low impedance input transducer of a short springline via an emitter follower which gives a reasonably high input impedance of about 10k or so. This uses Q1 in a conventional configuration. The output of the springline unit is fed to one input of a mixer circuit. This is based on IC1 and again uses a conventional and well known arrangement. There are substantial losses through the springline and so the mixer is designed to boost the output of the springline by over 46 dB (200 times). The other input of the mixer is fed with the input signal, but the high value of R5 gives only about unity voltage gain at this input, so that the main signal does not overwhelm the reverberation signal.

RV1 enables the amount of reverberation signal mixed into the main signal to be controlled.

Steam Loco Whistle

Some additional sounds to frighten the tiny plastic people around your model railway.



OUR LATEST MODEL train sound generator of this very popular series is a realistic steam locomotive whistle, created electronically.

Four transistors are used to generate the whistle sound and a single integrated circuit mixes this sound with that produced by our previous train sound effects circuits.

The whistle can be built and used individually or as an integral part of a complete sound effects unit, built in one case like ours.

Construction

The whistle is built on a printed circuit board (PCB) so construction is very easy. Follow the layout in Fig. 1 inserting and soldering each component in turn, starting with the resistors followed by capacitors and finally semiconductors. The IC is cheap (a 741) so you may not feel it worth the cost of a holder. If so, solder it carefully, allowing each pin to cool before soldering the next.

Connection details for this project are given also in Fig. 1 and this shows where the other sound effects are connected if you put them all together in one case, as we did. Drill the case for all connections and switches and simply parallel connect the power supply, i.e., the 9 V battery, to each circuit at the board side of the on/off switch. The output lead from the whistle board to the output jack socket should be a screened lead, with the shielding taken to 0V.

If you intend to connect your projects together, you will need to make a slight change to the Two-tone Train Horn board, and this modification is shown in Fig. 3. Simply unsolder and take out capacitor C5 and insert the two resistors Rx and Ry as shown. The output from this board was originally fed to a loudspeaker and the resistors simply act as a potential divider, dropping this output level to one which suits the input of the mixer formed by IC1.

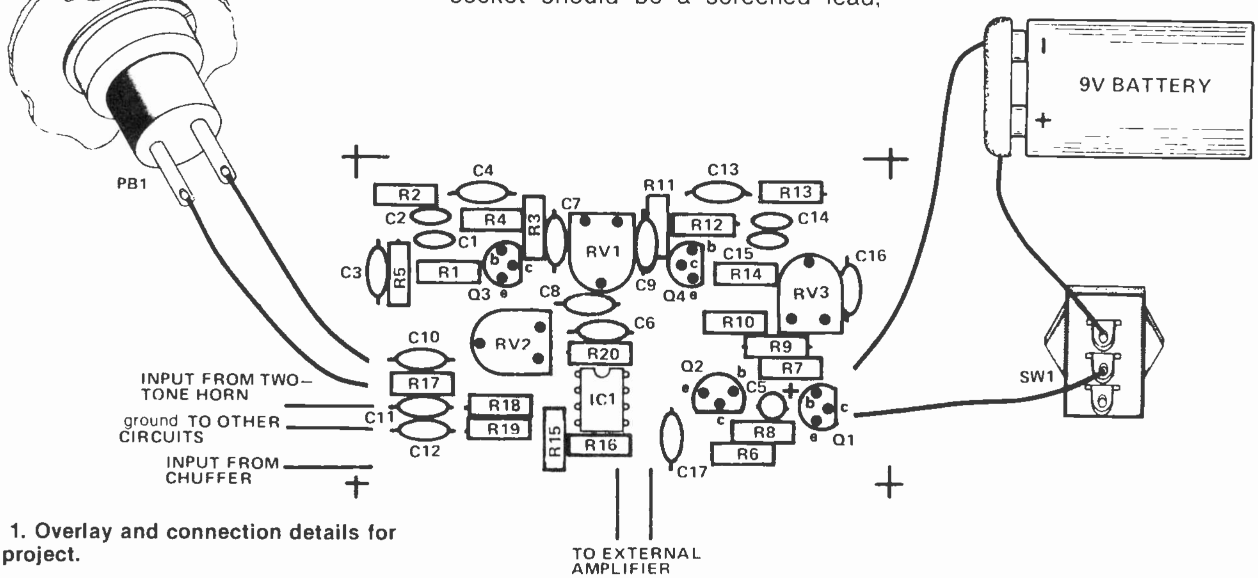


Fig. 1. Overlay and connection details for the project.

HOW IT WORKS

The waveform of a steam whistle is a complex combination of two main things: white noise and an audio frequency oscillation. Both are fairly easy to recreate electronically.

White noise is usually made by a 'noisy' zener diode, the output being amplified to the required level. The generator we used is of the same type as in the 'Chuffer' project; i.e., a transistor (Q1) biased into zener mode and a simple trnasistor amplifier (Q2).

The audio frequency oscillation is a straightforward mixture of two similar (but not identical) sinewaves, which after their addition produce a more complex waveshape than either of the two individual waves. The sinewave generators are known as 'Twin-T' oscillators because the feedback components (e.g. R1,2 and C3, and C1,2 and R5) around the transistor (Q3) are in the shape of two letter Ts. The frequency is set by the values of the feedback components and in this circuit is fixed. The other oscillator frequency is variable because one of the resistors is replaced by a preset (RV3). At RV3's mid-position the frequency is about the same as that of the other oscillator.

Preset RV1 mixes the two sinewaves so that an appropriate waveform is obtained. Similarly, RV2 mixes this waveform with the white noise produced elsewhere in the circuit. Adjustment of all three presets will result in the required sound.

Integrated circuit IC1 is an operational amplifier used as a simple mixer/amplifier which combines the steam whistle, chuffer, and two-tone horn sounds into one, suitable for amplification by an external amplifier (say your stereo system).

The gain of the mixer is determined by the ratio of R20 to the input resistances, R17, 18 or 19, of the channel concerned and so by varying the chosen resistor the levels of the individual sounds in the mix can be altered to suit.

PARTS LIST

RESISTORS (All ¼W, 5%)

R1,2,8,18	100k
R3,11	47k
R4,12	1M0
R5	12k
R6	6k8
R7	470k
R9	15k
R10	1k
R13,14	82k
R15,16,17	22k
R19	27k

POTENTIOMETERS

RV1,2	1M0 miniature horizontal preset
RV3	22k miniature horizontal preset

CAPACITORS

C1,2,14,15	4n7 ceramic
C3,16	47n ceramic
C4,13	10n polyester
C5	470n, 35V tantalum
C6,7,8,9,10,11,12,17	100n polyester

SEMICONDUCTORS

IC1	741 operational amplifier
Q1-4	2N2925 NPN transistor

MISCELLANEOUS

SW1	single-pole, single-throw toggle switch
PB1	push-to-make switch

Case to suit.
Battery and clip

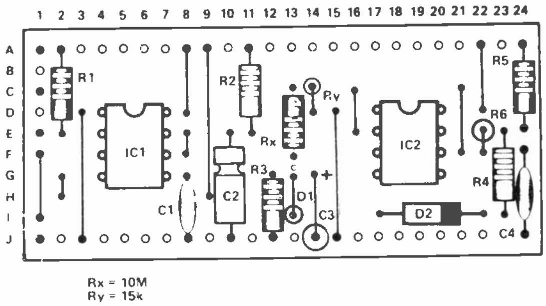


Fig. 3. The modification to the Two-Tone Train Horn board — take out C5 and insert Rx and Ry.

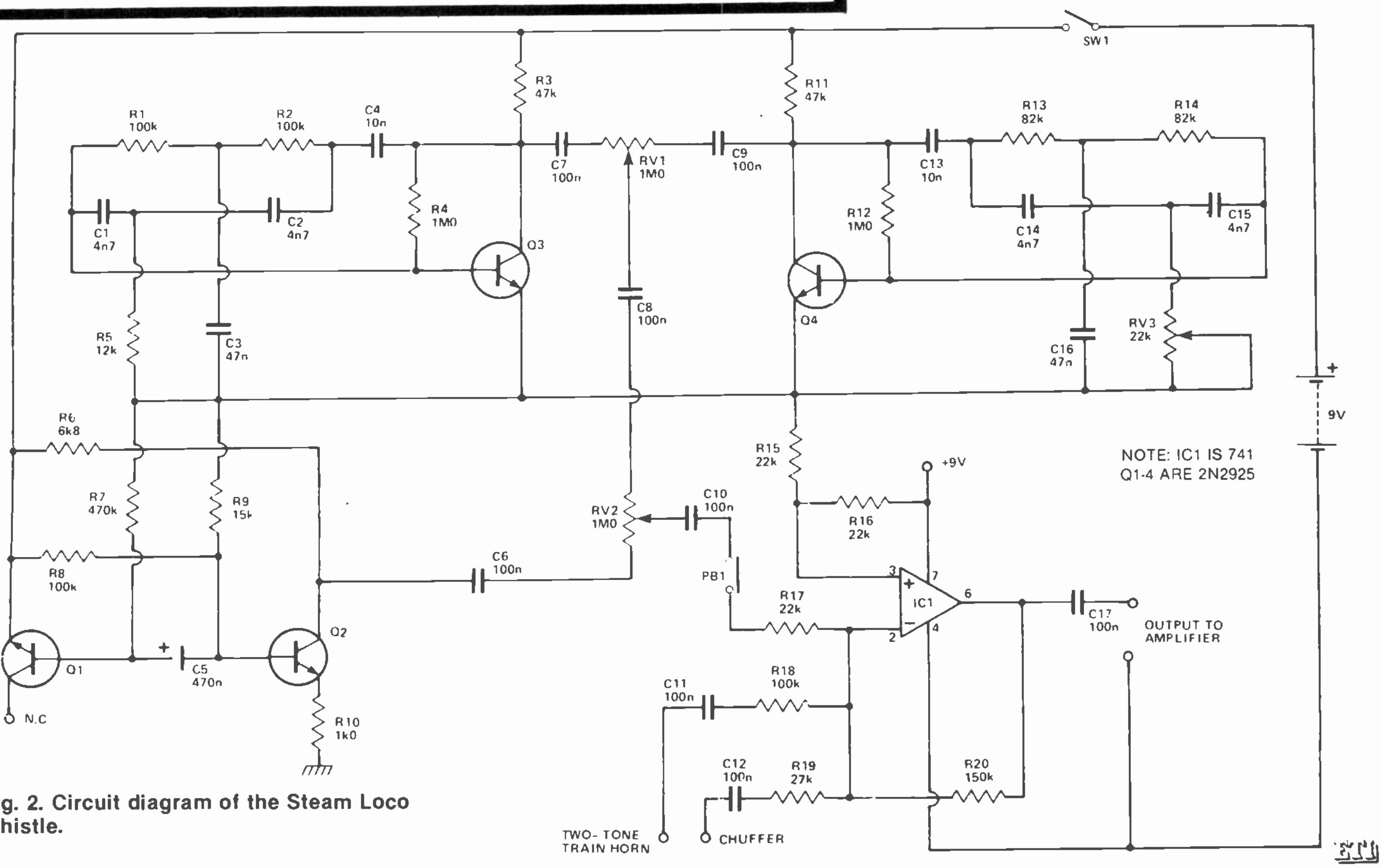


Fig. 2. Circuit diagram of the Steam Loco Whistle.

TRS 80 Model 2 review

A look at the TRS-80 Model II business system

THIS MONTH, we're going to have a look at what is probably one of the least reviewed computers going, the Radio Shack TRS-80 Model II. Announced at some hazy time in the past with very little fanfare at all, it is a model that very few frequenters of the local 'Shack will ever have seen. It's marketed only by the Radio Shack Computer Centres. . . for the simple reason that it is, by no means, a home computer (nor is it promoted as one).

The major reason for the lack of reviews of this machine is that most manufacturers won't lend out equipment for the time it would take to do a decent job on a system of this complexity, and most magazines aren't about to devote the six or eight months it would take to fully learn how the little mice that live inside work. We, on the other hand, noble and splendid beings that we are actually went out and *bought* one just so you could learn all the amazing secrets of the Model II. It's entirely incidental that we also do our reader service cards, and some of our subscriptions and half-a-dozen other jobs on the thing as well!

Big and Grey

For those familiar with TRS-80 Model I, it should be pointed out that the Model II bears little relation to its near namesake. It's quite solid, rugged, and nicely designed. The insides are clean and well planned. Ours has stood up to six months of daily use and frequent movings around without so much as a peep. . . to be sure, it would be most distressing if it did peep, as it doesn't have a speaker.

The Model II comes in two versions, one with 32K and the other with 64K. Ours is the latter. It has no onboard language, but accepts BASIC, PASCAL, and its own mighty disc and utility system TRSDOS, from its disk drive. The basic machine consists of a case containing the computer, its monitor and one eight inch soft sectored floppy drive. Plugged into this are the dumb keyboard, a printer (if desired), up to three more disks (also if desired, but everyone likes disks) and anything one wishes to hang off its two RS-232 ports (modems, terminals, etc.).

Upon power up, the Model II boots itself up with a simple routine to clean up its internals and drags its TRSDOS operating system in from the disk. Then it asks for the date (which it insists upon knowing) and the time (which it will let you get away without). Even here there is an indication of either the level of sophistication of the system or the degree of nit picking undertaken by the designer; it won't accept dates not falling within the twentieth century.

With TRSDOS working, one can either do something with the vast array of utilities, or call up whatever language is on the disk. Leaving the utilities for the time being, let's have a peer at the most likely of the available languages, the Microsoft BASIC interperter.

Not Basic BASIC

The BASIC that comes with the TRSDOS system is very, very nice. If you would like all the extra whizzbangs and functions of, say, the PET's system with a couple of utility ROMs jammed in, you'll love this one. The BASIC part of the manual, with each statement or function occupying an average of a page and a half or so, runs for something more than two hundred pages. There are seven or eight different sorts of PRINT statements for example.

The syntax of the BASIC is about the same as any of the more commonly found Microsoft versions, with "?"

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TTL
STANDARD AND LOW POWER SCHOTTKY

7400N	32
7401N	.33
7402N	.31
7403N	31
7404N	34
7405N	34
7406N	47
7407N	.47
7408N	34
7409N	.36
7410N	.33
7412N	61
7413N	55
7414N	55
7416N	.59
7417N	.59
7420N	.38
7422N	.48
7423N	.48
7425N	42
7426N	51
7427N	.42
7428N	.62
7430N	29
7432N	55
7433N	55
7437N	49
7438N	.49
7440N	33
7442N	57
7445N	1.24
7446N	1.09
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7453N	38
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74110N	68
74111N	94
74116N	1 79
74120N	1.79
74121N	62
74122N	70
74123N	62
74125N	90
74126AN	62
74128N	83
74132N	59
74136N	68
74141N	1 09
74142N	4.25
74143N	4.93
74144N	4 93
74145N	87
74147N	1 72
74148N	1 16
74150N	1 87
74151N	57
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74163AN	83
74164N	.83

74165N	83
74166N	.88
74170N	2.55
74172N	6.44
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74179N	1 76
74180N	98
74182N	.68
74184N	3.11
74185N	3.07
74190N	.88
74191N	88
74192N	88
74193N	.94
74194N	.94
74195N	72
74196N	1.03
74197N	.94
74198N	1.95
74199N	2 02
74221N	.88
74246N	1.87
74247N	1.68
74251N	1.03
74259N	2.46
74273N	3.11
74276N	1.55
74278N	3.09
74279N	77
74283N	1.43
74293N	1.16
74298N	1.09
74351N	2.86
74365AN	90
74366N	.90
74367AN	75
74368AN	75
74390N	1.25
74393N	1.68
74LS00N	25
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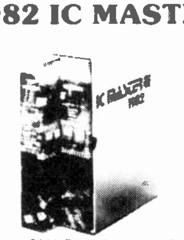

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Circle No. 2 on Reader Service Card. Advertisement valid through April 1982 representing PRINT, and so on. User statement tokenization isn't possible, except for PRINT, but, since nobody ever really remembers these things, this isn't really a hassle. Furthermore, with logical lines of 160 characters, statement crunching becomes of dimishing importance.

The first thing one finds when beginning to write BASIC programs for the Model II is that there are special purpose functions for very nearly everything imaginable. For instance, you and I might draw a horizontal line like this;

FOR X = 1TO80:PRINT"■";:NEXTX

Well, you don't have to. There's a function in Model II BASIC called STRING$ which will return a string of characters, "■", if you like, as long as you want. Therefore, something like

100 PRINT STRING$(80,158)

would do the same thing. Some of these things are just convenient, but some save an amazing amount of time and space.

One of the things missing from the Model II's BASIC is any way of communicating directly with the system's RAM. No PEEKs, no POKEs. This is a moderate drag, because most of us are used to using these very powerful statements quite a bit. However, the limitations of not having them is not nearly so great as one might initially suspect, because there are a lot of BASIC functions which do the things which would ordinarily be taken care of by PEEKing and POKEing. For example, the USR function address is set by something called DEFUSER, (which may also double as a statement to deactivate the explosive self destruct feature, I think). The cursor position is given by ROW and POS functions. PRINT@ can be used just like a POKE to the screen.

While it doesn't give you the same sort of feeling of being on the same phychic plane as your computer, this type of arrangement is actually a lot easier to use, in many cases, than would be squirreling around in a memory map trolling for bytes.

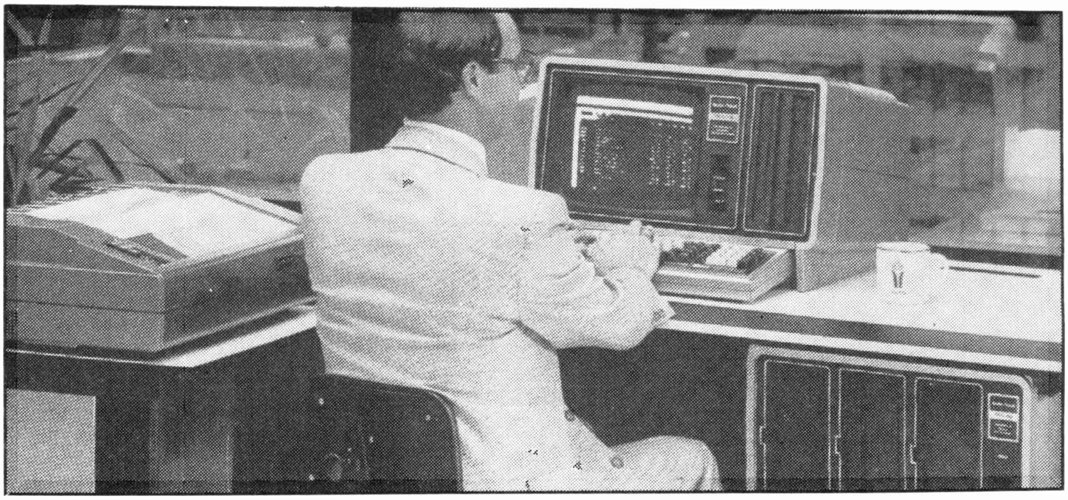
The BASIC contains a pretty fair selection of utilities, all of which, curiously enough, actually work. This is not totally without a bit of wonder; BASIC handies tend to behave strangely when asked to do unusual things in many systems. The Model II's utilities include a RENUMberer, with selectable start, stop and increment values, DELETE, to exterminate great howling masses of program text without popping each line separately, and MERGE, to jam two programs together. Still tricky, this last bit, as it requires that the two routines be carefully renumbered into non-overlapping spaces. . . or else!

The Model II's editor is. . . well, I tend to judge editing systems against that of the PET/CBM, which is really about as easy to use as can be imagined. With that as a ten, the Model II's would get about a seven.

In order to edit a line, you type EDIT, and then the line number. The number then appears, with the cursor after it, and, as you space bar your way along, the line is revealed. Backspacing the cursor covers it over. There are several editing functions that can thereupon happen; if you type "C", for example, the next character typed will replace the one under the cursor. "D" will delete a character, "X" extend a line, "I" permit insertion, and so on. This not a terribly easy system to use, but you do get used to it, and it is actually pretty fast after a while. There is one combination of of control codes which freaks it out (it isn't too predictable, so I couldn't say which one), in which case it goes into a very long wait, during which the programmer begins to consider tears, trying, vainly, to get out of the editor. It does drop out of its own accord after a minute or two. . . although one does wonder what it's doing in the interval.

Unlike many other systems which we won't mention quite a lot of devotion and fidgeting has gone into the documentation for the Model II's software. It comes in a rather huge binder, and is very well laid out. The index is good, and there is plenty of data on everything the system can do. The manual can be used effectively by anyone from a "computer scientist", if any still exist, right on down to an apprentice baboon just by jumping in at the right spot. For the beginner, should one feel moved to buy a five thousand dollar computer, there's a good introductory section on the mysteries and rituals of BASIC programming.

The BASIC is not fabulously fast, but is certainly acceptable. It is quite huge; about 32 of our 64K of RAM are full of operating system, and there have been times when we'd thought how nice it would be to have a second, much more rudimentary BASIC for those situations where in fairly simple programs have to deal with huge amounts of data.



DOS Kapital

The other half of the Model II owner's manual deals with the actual operating system and disk pacifier, TRSDOS. Not a pleasant name, TRSDOS; you try pronouncing a word with four consonants all in a row.

TRSDOS is, first off, only slightly a disk operating system. While it does have really extensive peripheral handling features, it is also about the biggest collection of utilities ever assembled under one roof.

Before you ask, no, the utilities don't all get loaded into the thing's RAM at once, and killing some of them off will *not* get back any of that tied up 32K. When you call a TRSDOS routine, it gets brought in from disk for the occasion.

If you've never worked with a real expensive system, you may not be familiar with exactly what these sorts of utility programs are for. Unlike BASIC, which is pretty common, every big system has its own deck of these things, so we'll have a look at some of the neater ones.

There are, first off, many disk manipulators. Disks can have passwords to keep out unwanted intruders. They can be duplicated, formatted, and have files killed and copied. A disk directory can be printed, and the contents analyzed as to the nature of each track. And so on.

AUTO is a function which allows the building of a small start-up routine into the booting stuff that transpires when TRSDOS is loaded. It causes the system to jump into a specific program right after the obligatory typing of the date. It can, for example, bounce into BASIC, or even start the running of a BASIC program. The system can thus be made turnkey for non-computer type operators.

DEBUG is the rather sophisticated Z80 machine language program monitor. It can set breakpoints, and clear them all automatically. It can find strings, move memory blocks around, change memory and dump the display to the printer port. Machine language programs can be set up as disk files, and called up by TRSDOS.

There are several routines which do typewriter-like things with the screen, keyboard and printer. DUAL echos the screen and printer, SCREEN dumps the screen contents to the printer, and ECHO makes the keyboard come up on the screen without any interpertation by TRSDOS.

TRSDOS has an extensive HELP library. Typing HELP displays a catalog of the topics in the library, and typing HELP followed by a specific listing from the catalog causes an explaination of the topic to be displayed.

HOST allows the Model II to be tied to a remote terminal through one of its RS-232 ports. Similarly, the Model II can itself become a terminal to something else using, the TERMINAL routine. Another routine, called SETCOM, allows the specification of the baud rate, word size, and so forth which the port will use to talk to the outside world.

There are also a number of routines to make life happy for the printer. The size of a line and the length of a page can be set up, and the system can be adjusted to feed into different sorts of printers.

The basic machine language routines that do things like keyboard scanning, disk handling and communications can also be accessed from machine language programs, and a decent hunk of the manual is given over to these.

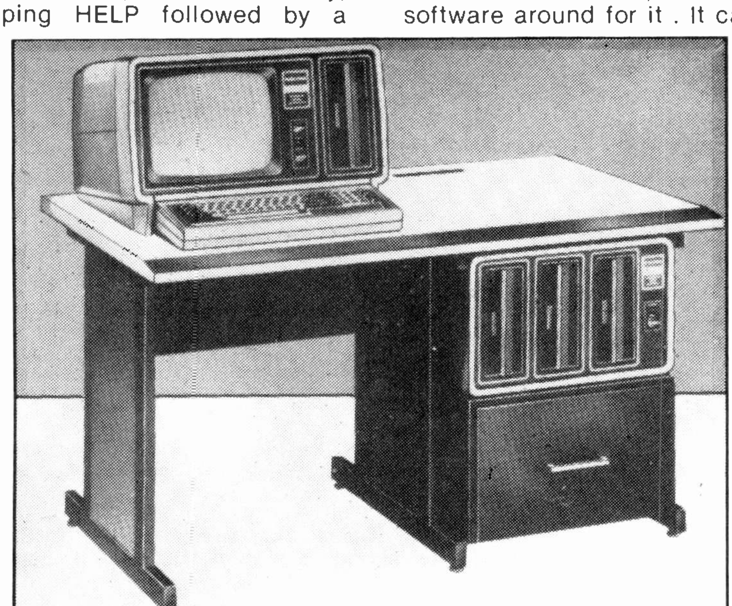
All in all, a powerful little brute.

Applications

If you're considering trading in your 4K Superboard for something a bit more powerful, the Model II just may not be the ideal machine. In fact, it's not really a "small" system at all, even if you do have the bucks to spring for one. For instance, it has limited graphics capability, a black and white output, and no sound effects or joystick. Actually, what we have here is a machine for the user who has to crunch a lot of data.

The Model II is probably about the best deal going for small (or not so small) businesses who need a computer to do bookkeeping or keep track of inventory. It also can do things like word processing quite well. Because it's a fairly well established machine, there's a lot of software around for it . It can do all sorts of smart and dumb terminal things, and can drive anything that can be spoken to via its RS-232 ports. Radio Shack's crop of assorted printers makes it good for doing mailings, forms and labels, and, of course, you can always program it to play poker when things get slow.

Most of the gripes one comes up with in looking at computers are not owing to bad engineering so much as they are the result of economic compromises and the cutting of fiscal corners. With the TRS-80 Model II there's not much to beef about because very few corners seem to have been cut; it's designers obviously didn't have to worry about being able to pay for one and still eat. It's a nicely done little box, and a good consideration for the large microcomputer system user.



For more information on the TRS 80 Model II please circle no. 30 on the Reader Service Card.

ETI's EXPERIENCE

A year ago ETI was paying a computer bureau about $800 a month to process the Reader Service cards. This also involved a staff member here preparing cards for the keyers (about 30 minutes a day). The process took about 1½-2 weeks from a Card being received to the request being passed on to the advertisers.

The Model II now handles all of this, saving little (if any) increase in time for the staff member · also the average period from receiving the card to its dispatch from here is now 3 days. The program was written in house.

We also use the Profile II software from Radio Shack for four other jobs. Profile II is not an easy program to explain without demonstration. Basically you set up your own data base and you can pull off the information as and how you need it. It's a superb piece of software which must have uses in practically all companies.

We do not have Scripsit (the word processing program) or VisiCalc but we have had several glowing reports on both.

We have not been so successful with the accounts programs — they're just not tailored to our requirements. However we were given 30 days to try out the software, which couldn't be fairer. Some minor modifications will probably be made some time to make it more applicable.

We have plans at the moment for putting two other major jobs on the computer which we know can be done — both jobs that you would normally think of as being suitable only for a main frame computer.

All in all a true success story — the system has paid for itself directly in 10 months and indirectly probably in 5 months; not a bad return on investment which was originally $8,100 including a printer, software, cables, disks and taxes.

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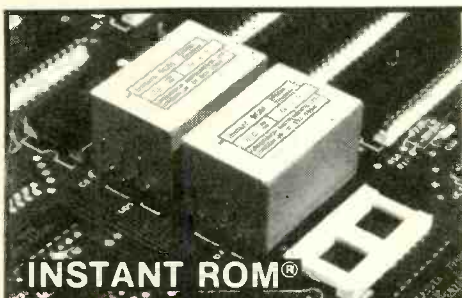

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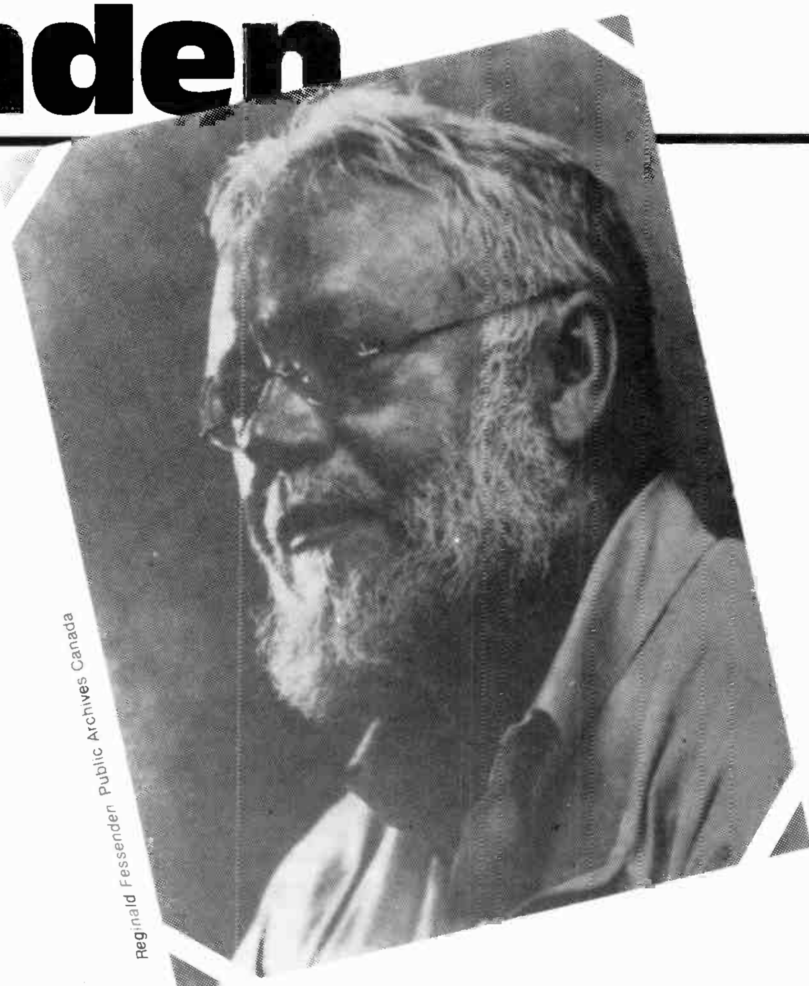
Circle No. 25 on Reader Service Card.

Fessenden

The father of modern radio broadcasting was not Marconi, says Jim Essex, but a little known Canadian inventor named Reginald Fessenden



Reginald Fessenden Public Archives Canada

REGINALD A. FESSENDEN first came into popular prominence with Ormond Raby's book, published in 1970 claiming Fessenden as "radio's first voice". However, the claim has forever been in doubt, and this book doesn't appear to have changed things. The name Fessenden today is not, as is Marconi's, synonymous with radio. Even his overall electrical achievements, themselves phenomenal with some 300 patents to his credit, are apparently given short shrift by an ungrateful country. For example, as Engineering Commissioner for Ontario Hydro's mammoth harnessing of Niagara, with which Fessenden was closely associated beginning in 1903, the name Fessenden is not even mentioned in today's newspaper accounts celebrating Hydro's 75th Anniversary. Sir Adam Beck, the man who hired him to harness Niagara, is remembered by a large plaque in the Kitchener school grounds; Fessenden, who spent his boyhood just east of Kitchener in the Rectory at Fergus, is not marked. Both went on to serve their country; one was knighted, the other wasn't. In fact, only a few subsequently engaged in the early halcyon years of radio itself recall his name, although he was closely associated with this period.

Yet, but for Fessenden the Canadian and not Marconi the Italian, we might all still be listening to the dot and dash of Morse rather than the radio we know today. For it was Fessenden's dream, not Marconi's, to transmit the human voice across the air waves farther than a man could shout. This included music as well as voice, and both only became possible as a result of Fessenden's long arduos search covering nearly a dozen years. From this, radio's first verified radio broadcast went out on the air waves Christmas Eve of 1906, when the pristine sounds of "Oh Holy Night" astounded a surprised public. Fessenden himself played his violin, thereby producing the first "live" radio show, unique in broadcasting. He also introduced the first use of records, a practice which provides us with broadcasting as we know it today.

Who can gauge the difficulties Fessenden must have experienced in his feat? Not only had he not the vacuum-tube to generate the basic radio frequency energy to get "on the air" later broadcasters enjoyed, but Fessenden had to rely on the miniscule amplification embodied in a crude carbon microphone for his audio. Because Fessenden decried the then prevalent carbon-arc used to generate radio waves, he insisted on continuous waves to replace the ubiquitous arc to generate his R.F. This led him to the alternator as an R.F. generator, allowing modulating of the field for transmitting the voice. As a result of this, one report had the announcer "singeing his lips" from contact with the high currents involved in the asbestos lined microphone.

Yet, despite the obvious difficulties in method, Fessenden in his day radiated a kilowatt. The commonly used turn-of-the-century antenna consisted of a copper wire strung between two poles, the "L" or Marconi antenna. Fessenden's frequency was somewhat low, however, at 50 kHz. Fessenden realized the road to obtaining continuous waves to radiate his signal wouldn't be easy. The ubiquitous arc transmitter favored by Marconi wouldn't transmit sound because of the "whip-lash" effect of the arc, which created too much noise. Fessenden persevered.

In a somewhat prophetic mood, A. Lampman, a school friend attending Trinity College with him while at Port Hope, wrote a poem that gently described Fessenden's singular pursuit. "Be strong therefore; resume thy load and forward stone by stone go singing, though the glorious road thou travellest alone". That it was glorious, there's no doubt, but singing would appear to be understating the difficulties. Lampman went on to become one of Canada's great poets, whose works are read by school children even today. Fessenden seems to have been lost in the antiquity of time. Our bland acceptance of radio today, without regard to the

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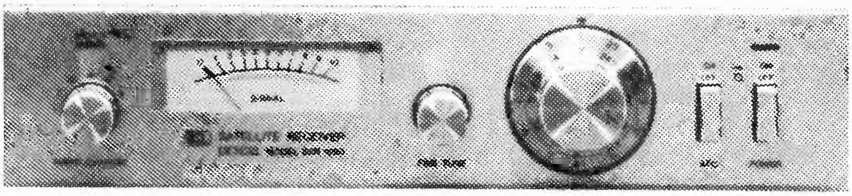

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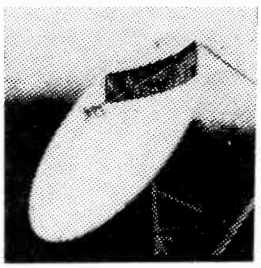

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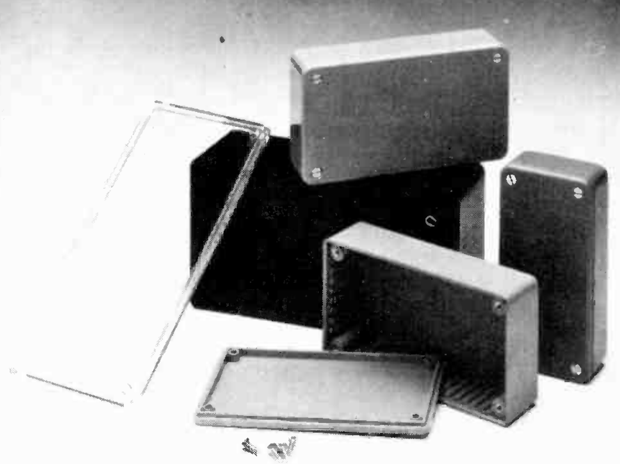

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Circle No. 3 on Reader Service Card.

difficulties in developing the art, gives the lie to Fessenden's giant leap forward with radio's first broadcast in 1906. Nor was this the only reason he should be remembered. Consider, for example, a few of his other achievements, taken at random from just two encyclopedia, the Canadian and Britannica. Here, Fessenden is credited with, to name only a few, the discovery of the heterodyne principle, whereby the incoming radio frequency is converted to a lower intermediate, or "I.F.", frequency more easily amplified with consequent greater gain and selectivity. (This, incidentally, has been wrongly credited to Armstrong.) He perfected a detector two thousand times more sensitive than the prevailing coherer common in Marconi receivers, perfected a more reliable wireless transmitter utilizing an alternator to generate continuous waves achieving frequencies of 50 kHz and higher, invented the radio compass, developed greater control for ships' propellors by coupling them to high speed Parson's turbines with a combination of electric generators and motors, developed submarine signalling devices and, more important to the successful outcome of the First World war, introduced the sonic detector allowing Allied ships to locate enemy submarines.

Fesseden was born in East Bolton, Quebec near Sherbrooke in 1866, just a year before Cyrus Field in the U.S. successfully spanned the Atlantic with undersea cable. Thus, the stage was set already for communication wonders, with a galaxy of pioneers already in the cast. Men like Galvani, Canton, Cavendish, Volta, Franklin, Oerstad, Ampere, Farady, Henry; all were contemporary with the onward rush of electrical discoveries preceding Fessenden, with many of the names now enshrined in electrical units commonly used today. Fessenden embraced all of them to push forward his idea and what eventually became an obsession; for the human voice to be made to go through the air waves.

Fessenden's circumstances were anything but auspicious, encumbered by constant moves and an education on the fly. The family's move to the Rectory in Fergus, where the Anglican Church promised an improved stipend hardly measured up their needs. And, like many born into a theological setting, science was given short shrift (even if some will argue it's the oldest science). However, the book-lined rooms of his minister father provided ready made incentive to study, where he learned to read at three years of age. When the local school offered no more challenge, his father accepted a call to Niagara, where educational opportunities improved. Fessenden was to return to Niagara later in life and, mute witness to his success in studies, as chief Commissioner of the giant Hydro project taming Niagara at the invitation of Adam Beck, his childhood neighbour.

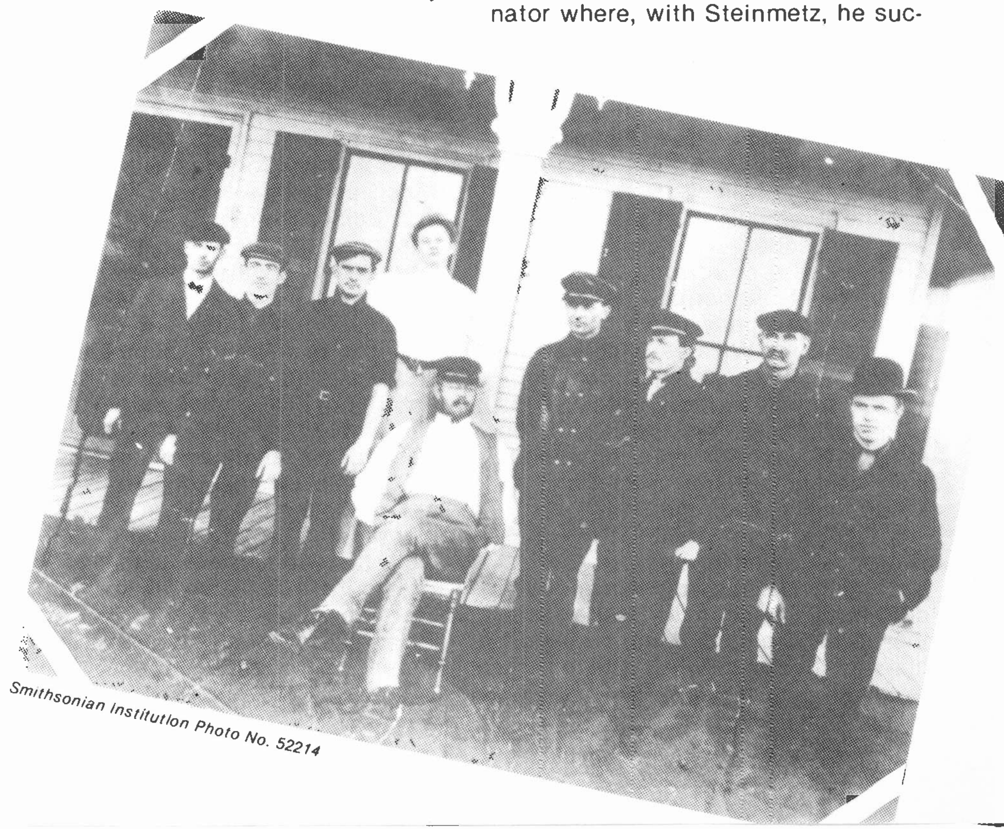
Fessenden already had made great strides in American industry, which was what brought him to Beck's attention in the first place, and one of these was his success working with Edison. He even educated himself in chemistry, later becoming Edison's chief chemist. However, his love was electricity and he never gave up his intent to transmit the human voice over radio waves.

James Clark Maxwell already had enunciated his famous field-force theory in 1873 using mathematics. Heinrich Hertz in Germany proved it in 1887 using what he called "ether waves" to go right through walls. With a stream of credits after his name, Fessenden, just 21, now determined to use this medium to serve his ends.

It was perhaps coincidental that Marconi already had begun experiments with this phenomenon, being awarded a grant by a grateful British Government in 1898 of nearly $100,000, who saw in this medium opportunity to communicate with her far-flung colonies. Fessenden, who had already actually succeeded in sending Morse's transmissions overland for the U.S. weather service, failed to equal Marconi's more spectacular spanning of the Atlantic in December 1901, when he transmitted merely three dots; the letter "S".

His obsession with "sound" made Fessenden overlook his many achievements now massing around him. His failure to gain the electrical engineering chair at McGill University, in his home country, was ballooned far out of proportion to his real desire. Ever since Alexander Graham Bell demonstrated that voice could be sent over wire during experiments in nearby Brantford, this dream of going Bell one better remained paramount.

Perhaps it explains, in part at least, the perils building around him in failing to protect himself. And his obsession, linked with a deep sense of patriotism for his country, was to multiply the difficulties ahead. For example, while he assembled the top brains of the day to help build an alternator which he was convinced would generate the high frequency needed for his continuous waves, he was careless about patents. The fight over the Poulsen arc patents, between the embryo International Telegraph company and RCA, were good examples of the "arc" versus the "Alexanderson Alternator", a direct outcome of Fessenden's alternator where, with Steinmetz, he suc-



Smithsonian Institution Photo No. 52214

ceeded in achieving 50kHz. (Later assisted by a relative newcomer from Sweden, E.F.W. Alexanderson and working under the aegis of General Electric, this was pushed to 100,00 kHz, the frequency used eventually at Brant Rock).

Fessenden's mounting success in out-distancing even Marconi while working with the U.S. Weather Bureau in 1901 brought jaundiced eyes his way and now the Bureau itself wanted a piece of the action. Fessenden fought these encroachments on his method of sending a "clean" Morse signal, losing valuable time in advancing his dream to transmit voice via radio. In need of work after leaving the Bureau in an understandable huff, he fell in with two financiers inPittsburgh.The fact it came at the same time as a position with the university there seemed to be propitious, for the research opportunities would be tremendous. The financiers, Given and Walker, however insisted all patents become the property of their company, called the National Electric Signalling Company, and Fessenden was to receive $300 per month in salary. There are two views to this arrangement; one that the employers were selfless, generous men putting up their hard-earned money to support a dubious enterprise with apparently no compensation and the other, that the company bled Fessenden of any hope for essential control of his own work. In fact it took Fessenden the rest of his life to unravel all the claims and counter claims associated with his subsequent work.

Construction at Brant Rock accelerated and the small yet significant success of the first words uttered in that long ago Christmas Eve of 1906 have since reverberated around the world. But, thinking he had the communication's world at his feet, Fessenden understandably had already approached Canadian Government authorities to form a Canadian company under the name "Fessenden Wireless Telegraph Company of Canada". The deal hinged not on his subsequent success with voice transmission, but on reliable Morse with a station already built at Machrihanish, Scotland to Fessenden's specifications.

Oddly, the 1906 Christmas Broadcast failed to impress the National Signal Company heads, even denying Fessenden its fruits while they threw one hurdle after another in his way, finally denying it to others. When Fessenden proposed he carry on his work in Canada, a testy relationship broke into open hostility, resulting in a court settlement which gave Fessenden financial redress but forced the company into bankruptcy. The bulk of his patents went to satisfy creditors.

Brant Rock station was closed down and Fessenden and his wife (who he'd met and married while on a teaching stint in Bermuda earlier) were driven from the premises much as another little known inventor named DeForest, struggling with the vacuum tube "audion", was labelled a criminal for so-called patent infringements.

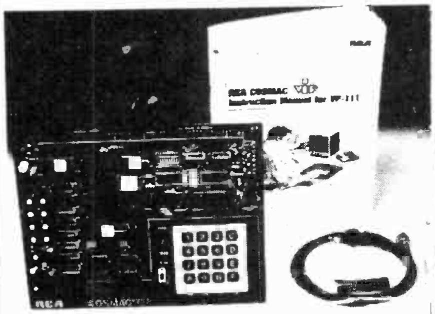
Fessenden's Alternator
Smithsonian Institution
Photo No. 52218

Thus, Fessenden's allegiance to Canada back-fired with his own country disavowing earlier arrangements, and he was without a job at the peak of his career. Morse code continued into ascendancy while his miracle of transmitting the human voice via the same radio waves was forgotten. Broadcasting was eclipsed, still born, while Morse flourished.

Morse offered a permanent record by which messages could later by used, ideal for the business world which as yet hadn't tumbled to the fact Edison's embryo invention, the phonograph, could do as well. (Instant recording with tape was not even envisaged). Morse served not only the business community, but proved invaluable in nabbing criminals. (The first recorded use in Canada of this occured in 1910 when, at a pilot station at Father Point near Rimouske, Quebec, an American doctor, escaping by ship, was apprehended for one of London's most grisly murders and four months later hanged for murdering his wife.) The sinking of the Titanic in 1912, two years later, proved radio Morse invaluable in saving life and radio became standard equipment not just on land, but on all ships. Fessenden's dream wasn't resurrected until 14 years later, in 1920, when, in the same town that he received his first honor, as head of that city's University, Pittsburgh went "on the air" with KDKA, broadcasting election returns of the Harding-Cox Presidential race. This also signalled the race for broadcast licences in North America and broadcasting was born.

Fessenden seldom returned to his native land following his second rebuff, although he did offer his services to Canada at the outbreak of war in August 1914. He later returned to the relative quiet of his adopted home in Bermuda. Ironically, his one redeeming memory of Canada was not radio, where he'd earlier first conceived the idea, but the Niagara project and the 6 million horsepower he'd help tame. He died on foreign soil trying to recover patent rights long lost. The New York Herald Tribune at the time of Fessenden's death in Bermuda said "It sometimes happens, even in science, that one man can be right against the world. Professor Fessenden was that man. He fought bitterly and alone to prove his theories. It was he who insisted, against the stormy protests of every recognized authority that what we now call radio was worked by continuous waves sent through the ether by the transmitting station as light waves are sent out by a flame. Marconi and others insisted that what was happening was a whiplash effect. The progress of radio was retarded a decade by this error. The whiplash theory passed gradually from the minds of men and was replaced by the continuous wave one with all too little credit to the man who had been right.".

He was buried in St. Mark's Church Cemetery July 22, 1932. ETI



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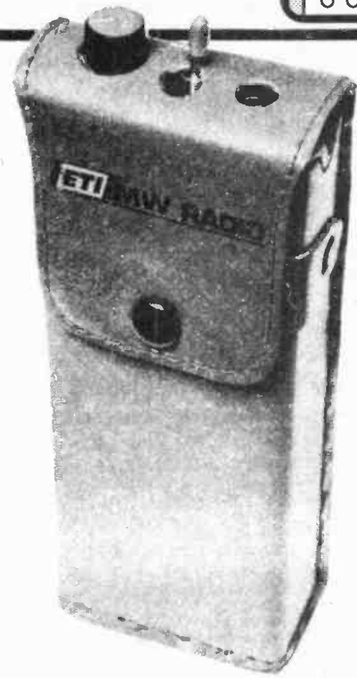


THERE HAS BEEN no shortage of designs for simple AM personal radios over the past few years, and these almost invariably seem to be based on the Ferranti ZN414 device. One could be forgiven for thinking that there is no viable alternative to the use of this IC, but it is in fact possible to produce a simple medium wave receiver circuit that will give good results using just a couple of transistors as the active devices. Just for a change then, we decided to use transistors in the present design.

The set provides good reception of reasonably strong signals, and by adding a couple of leads to purposely introduce positive feedback the sensitivity can be boosted to the point where numerous stations can be received at a good volume. The output is for a crystal earpiece — magnetic types are not suitable for use with the set.

Construction

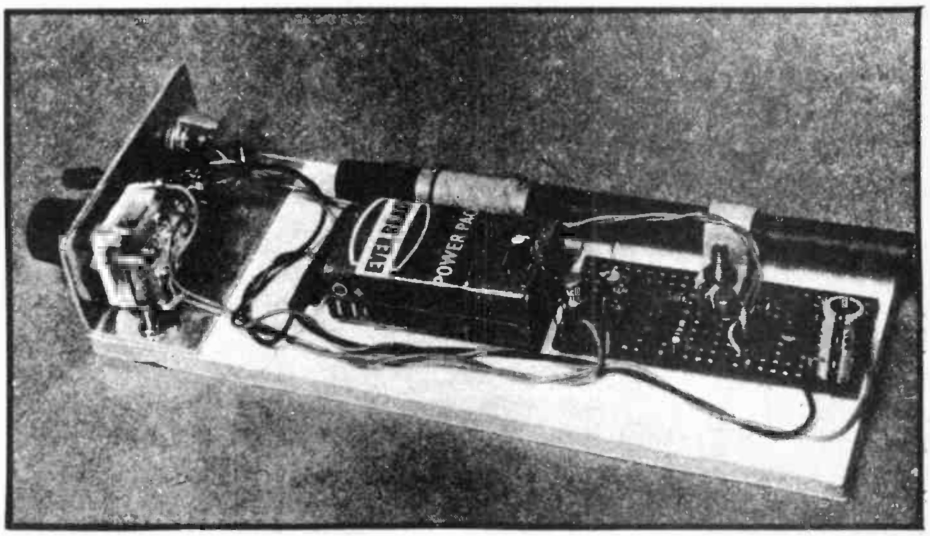
Most of the components, including the ferite aerial, are mounted on one of our standard size (24 holes by 10 strips) 0.1" matrix Veroboards. Details of the components layout and wiring of the receiver are shown in Fig. 2.

A P-style cable grip is used to mount the ferrite aerial on the component panel, and apart from this the board is assembled in the usual manner. Be careful that you do not overlook the single break in the copper strips, and it is advisable to make this before fitting the components into place. The leadout wires of T1 are made of a special type of wire called Litz wire (which has a very low resistance at radio frequencies) and have ready-prepared ends. It is recommended that these leads should be left full length as Litz wire can be difficult to tin with solder, and you may find it difficult to connect these leads if you trim off the prepared ends!

There are a number of plastic cases available which will comfortably accommodate the set, but be careful not to underestimate the size of the case required. The ferrite rod is about 125 mm long and the case must obviously have an internal dimension of at least this figure. A metal case is not suitable as it would screen the ferrite aerial and no stations would be received!

The set should cover the entire AM band if the aerial coil is positioned almost right at the end of the ferrite rod, and it should be glued or taped in place here. The set has a slight excess of coverage and so the position of the coil on the rod is not too critical.

It should be possible to receive a few stations quite well when the set is first tested, but improved results can be obtained by adding the two single-strand insulated leads, as shown in Fig. 2. These will increase the feedback applied over the RF amplifier and, up to a point, the closer together the wires are brought, the better the performance of the set. However, bringing them too close will result in the set oscillating and blocking proper reception. The two wires should therefore be positioned as close together as possible without this occurring at any setting of CV1. Once the optimum position has been found, the leads should be secured with insulating tape. If moving the two leads closer together results in reduced performance the phasing of T1 is incorrect, and the two leads from the small winding of T1 should be transposed.



By mounting the project on a suitable board it can be carefully inserted into a case.

HOW IT WORKS

Fig. 1 shows the circuit diagram of the radio, and the circuit breaks down into three basic stages: an RF (radio frequency) amplifier, a detector, and a single audio amplifier stage.

The RF amplifier uses Q1 as a straightforward common-emitter amplifier which gives high gain. T1 is the ferrite aerial, with tuning capacitor CV1 giving coverage of slightly more than the whole of the standard medium wave broadcast band. The tuned winding of T1 has quite a high impedance, and signals from this winding cannot be fed directly to the relatively low-input impedance of Q1 as this would give a very inefficient signal transfer and unacceptable results. A low-impedance coupling winding on T1 is therefore used to match the output of the aerial to the input of Q1.

Coil T1 is connected so that a phase inversion of the signal is produced, and a further phase inversion takes place through Q1. This brings the collector of Q1 and the hot end of T1's main winding in phase, and there is inevitably a certain amount of stray feedback between these two points. This feedback results in some of the output of Q1 being fed back to the input where it is amplified once again. This boosts the sensitivity and selectivity of the receiver. By purposely encouraging this feedback it is possible to obtain a very substantial increase in performance, although excessive feedback (or 'regeneration' as it is often called in this application) must be avoided. Otherwise the circuit will break into oscillation and the set will not function properly.

The output of Q1 is fed to a simple detector circuit which uses diode D1 to provide rectification and C2 to give RF filtering. Resistor R3 gives D1 a slight forward bias which gives improved detection efficiency.

Capacitor C3 couples the audio output of the detector to a second common-emitter stage which uses Q1 and directly feeds the crystal earphone. The current consumption of the circuit is only about 2.5 mA, and a 9V battery is sufficient to give many hours of use.

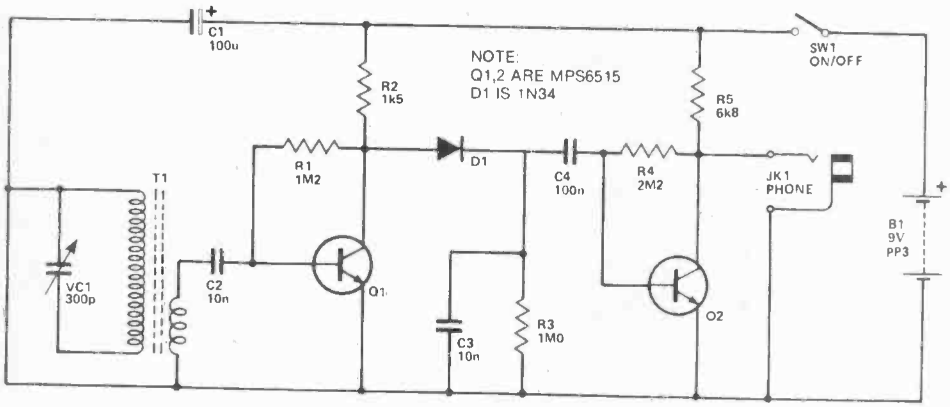


Fig. 1. The circuit diagram of the ETI Miniature AM Radio.

PARTS LIST

RESISTORS (All ¼ W, 5%)

R1	1M2
R2	1k5
R3	1M0
R4	2M2
R5	6k8

CAPACITORS

C1	100u, 10V electrolytic
C2,C3	10n polyester
C4	100n polyester
CV1	226p polyvaricon variable capacitor

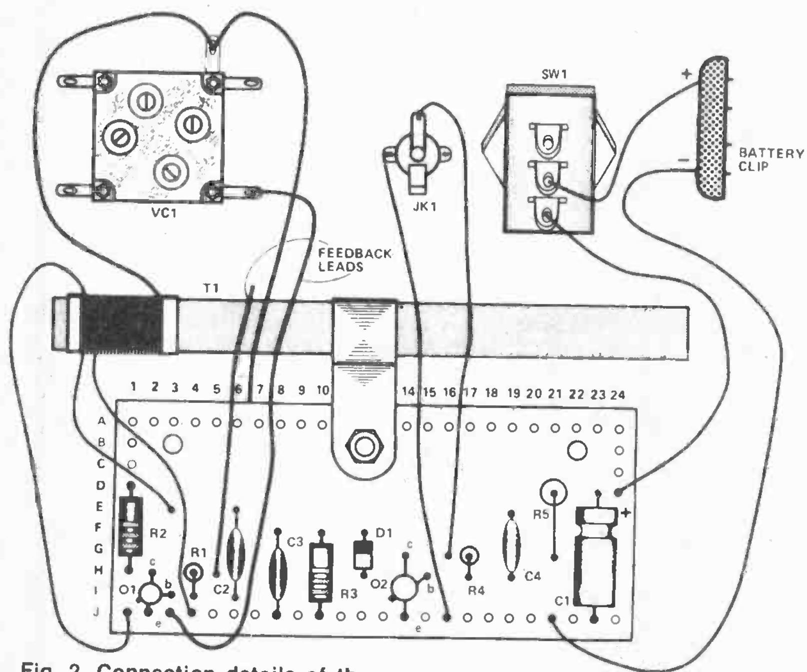
SEMICONDUCTORS

Q1, Q2	MPS6515
D1	1N34

MISCELLANEOUS

SW1	single-pole, single-throw toggle
T1	ferrite aerial
JK1	3.5 mm jack socket

10 strip x 24 hole Veroboard
Crystal earphone
Case to suit
Battery and clip
Knob to suit.



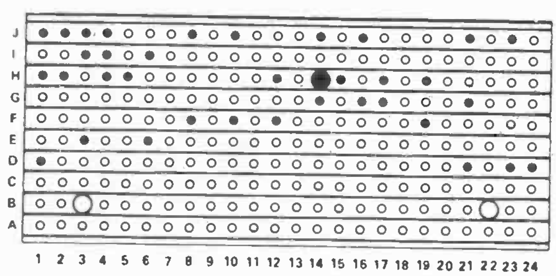
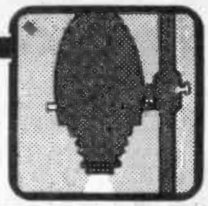


Fig. 2. Connection details of the project along with Veroboard overlay and underside track break.

Photo Timer



You won't get caught in the dark with this one — time your photographs to perfection with this cheap-to-build, simple project.

WE COULD NOT BE accused of overcomplication with this simple photographic timer project, which uses only about half a dozen components. The unit has a LED indicator which flashes regularly at one second intervals, and it can be employed as a simple enlarger timer or to time exposures lasting several seconds with the camera set to 'B' or 'T'. There are many other uses for this timer.

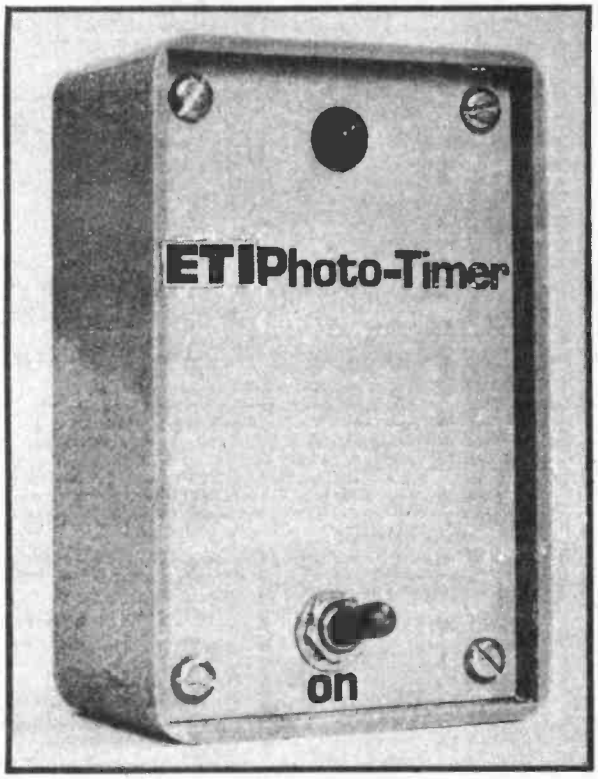
It is inexpensive and extremely simple to construct, being well within the capabilities of even a complete beginner: it makes an ideal first project.

Construction

The few components fit easily onto one of our standard size (24 holes by 10 strips) 0.1" pitch Veroboards, as shown in Fig. 2. Building the component panel could not be easier, but be careful to connect LED1, Q1 and C1 the correct way round, and be sure to connect the battery clip with the right polarity.

Practically any small metal or plastic case should be adequate to house the timer. Indicator LED1 is mounted on the front panel using one of the special panel holders available for the device. This panel holder can provide the mounting for the component board.

Potentiometer RV1 is given the correct setting by trial and èrror, comparing the flash rate of LED1 against a clock or watch which gives seconds' indication. In use the unit is started by closing SW1. The shutter is opened or the enlarging lamp is switched on at the first flash, and then the appropriate number of flashes are counted. On the last count, the shutter is closed or the enlarging lamp switched off. The period from switch-on to the first flash is slightly more than one second, and should not be used as part of the timing period.



The ETI Photographic Timer will fit into any suitable-sized small case and when finished will be a valuable addition to the darkroom.

HOW IT WORKS

A unijunction relaxation oscillator makes a good basis for a project of this type since it gives the necessary short pulses of current required to give brief flashes of a LED indicator, and it does not need a stabilised supply to give good frequency stability. A circuit of this type is also simple, as can be seen from the circuit diagram (Fig. 1).

There is normally a resistance of a few thousands of ohms between the base 1 and base 2 terminals of a unijunction transistor, and a potential divider circuit is therefore formed by the unijunction device Q1 and resistor R2. Because of the comparitively low resistance of R2 the voltage appearing across this component is well below the threshold voltage of LED1, and the latter will not light up. The input impedance at the emitter of a unijunction is very high under normal operating conditions, and at switch-on C1 charges by way of R1 and RV1.

Capacitor C1 continues to charge until it reaches a charge voltage of about 80% of the supply voltage, and Q1 then triggers. This results in the emitter-to-base 1 impedance of the device dropping to a level of just a few ohms. A rapid discharge takes place through Q1 and the parallel impedance of R2 and LED1, the latter being brought into the state of conduction by the current flow through R2 and the consequent rise in the voltage across this resistor. Because of the low impedance of C1's discharge path its charge diminishes very rapidly to the point where Q1 is no longer maintained in the 'triggered state', and Q1 quickly reverts to its original state. Thus there is only a brief pulse of current through LED1, and it produces only a brief flash.

With Q1 back in its original state C1 is free to charge up once again, but the charge on this component soon reaches the trigger potential of Q1 once again, causing the device to trigger and discharge C1. This cycle is repeated indefinitely, giving a regular series of flashes from LED1. Potentiometer RV1 controls the charge rate of C1 and in practice it is adjusted to give the required flash rate of one per second.

The current consumption of the circuit is only about 1 to 2 mA, and each 9V battery gives many hours of use.

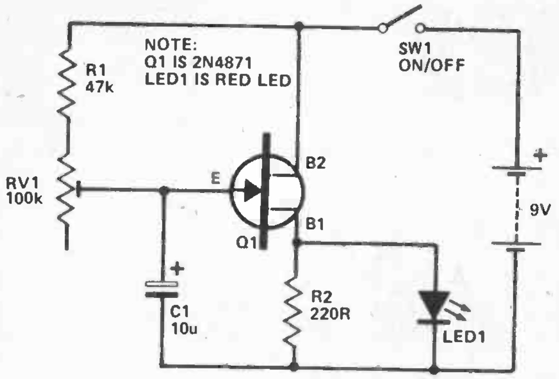


Fig. 1. Circuit diagram of this simple project.

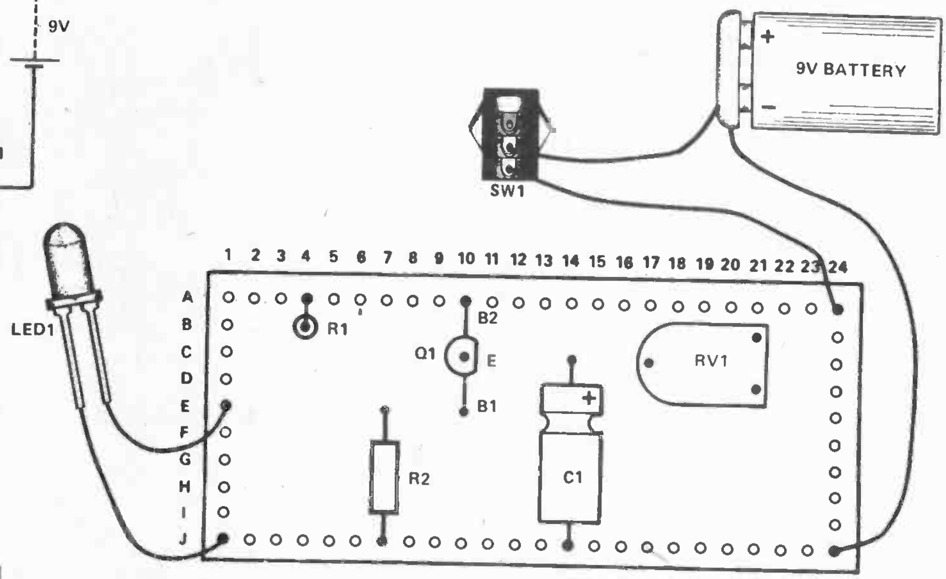


Fig. 2. Veroboard layout, underside view and connection details. Note there are no track breaks.

PARTS LIST

RESISTORS (All ¼ W, 5%)
R1 47k
R2 220R

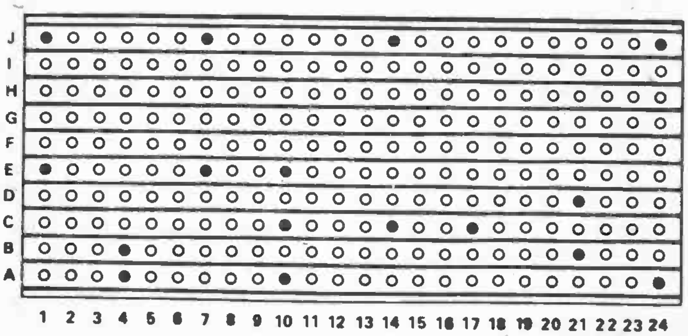
POTENTIOMETER
RV1 100k miniature horizontal preset

CAPACITORS
C1 10u, 25V electrolytic

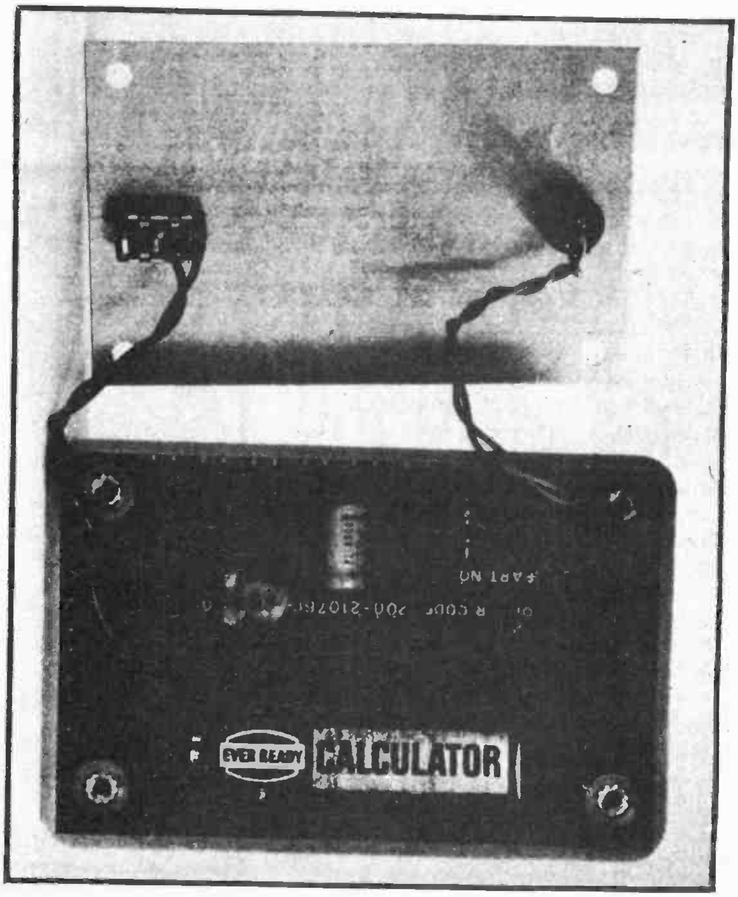
SEMICONDUCTORS
Q1 2N4871 unjunction transistor
LED1 0.2" red LED

MISCELLANEOUS
SW1 single-pole, double-throw toggle switch

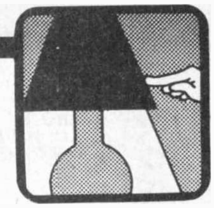
Case to suit
10 strip x 24 hole 0.1" Veroboard, battery and clip.



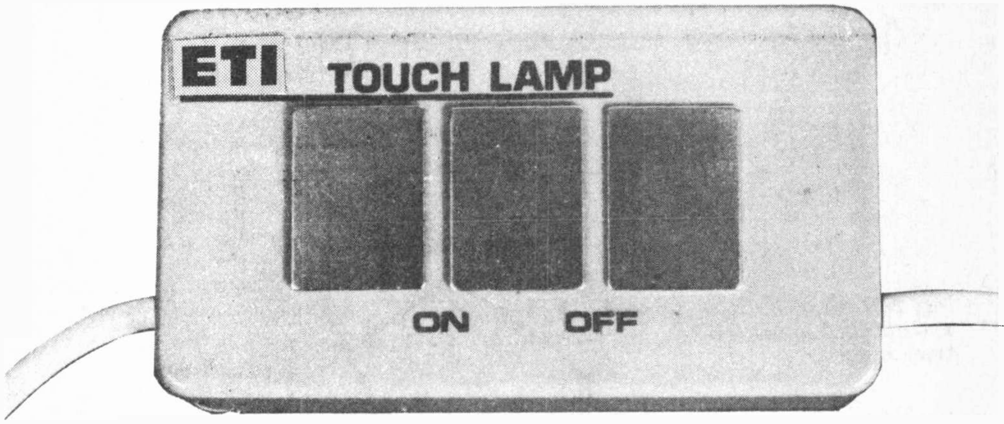
Inside the ETI photo timer



Touch Lamp



Left in the dark? This project gives simple on/off touch control of your battery or AC powered bedside light.



IF YOU'RE TIRED of fumbling around in the dark in search of the lamp switch, and then fumbling around trying to actually operate the switch, our touch-operated bedside lamp is just what you need. It is a very simple and economic battery operated design which has a neglible stand-by current. The use of a touch switch makes the lamp extremely easy to operate even in the dark, since once you have found the touch contacts the unit virtually operates itself!

You can use this project to either turn a small 6V bulb on and off or alternatively to operate a relay (which can be used to switch a line-powered bulb on and off). The amount of light available from a 6V bulb, such as a flashlight bulb, is not very much, of course, but is adequate for its purpose and has the advantage of making a completely self-contained project with no trailing wires. If you choose to build in a relay to the project (as in our prototype) then AC input and output leads will be necessary.

A point worthy of note is that, wired for line control purposes, the project will not only turn a lamp on and off, but in fact most line powered equipment. The project may find other uses, therfore, particularly as an aid for handicapped persons.

Construction

Build up the project using one of our standard sized (24 hole by 10 strip) pieces of Veroboard, carefully following the overlay details in Fig. 2. Make sure the transistors are inserted correctly.

Drill the case lid to fit the three touch contacts, which can be specially bought contacts, or simply three pan head bolts. Mount the contacts using soldertags (to provide connection points) and nuts.

You must now decide whether you want the project to operate a small bulb or a relay. If you choose the small bulb, then mount it in a holder fitted to the top of the case. Drill a hold near the holder to enable the two leads from the lamp to pass through to the interior of the case.

Some sort of shade can be placed over the lamp to give a neater finish and a more diffuse light. Some food containers and aerosol caps are made of a suitable thin white plastic material, and a little ingenuity must be used here.

Fit the battery and circuit board inside the case and wire up the project as in Fig. 3.

If you choose to operate a relay and thus control a separate AC powered lamp (such as a bedside or overhead lamp) then drill the sides of the case to fit rubber grommets. Push the two grommets into position — they will protect the cable from being damaged.

Fasten the relay to the bottom of the case (double-sided, self-adhesive pads are ideal for this purpose) and connect the project as shown in Fig. 4.

Use cable ties on the AC input and output leads to prevent them from being accidentally pulled out.

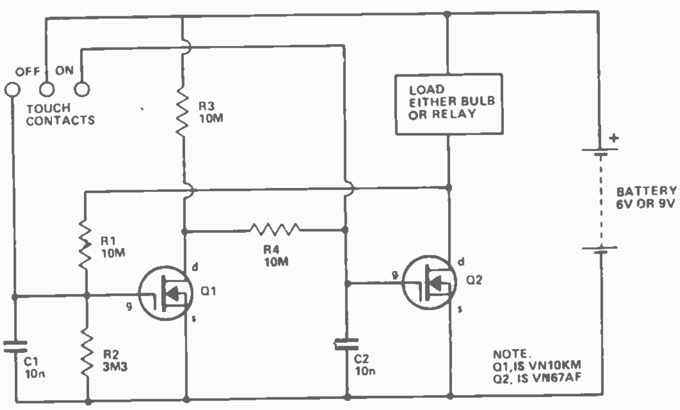


Fig. 1 Circuit of the ETI Touch Lamp.

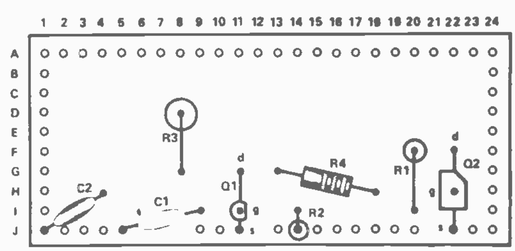
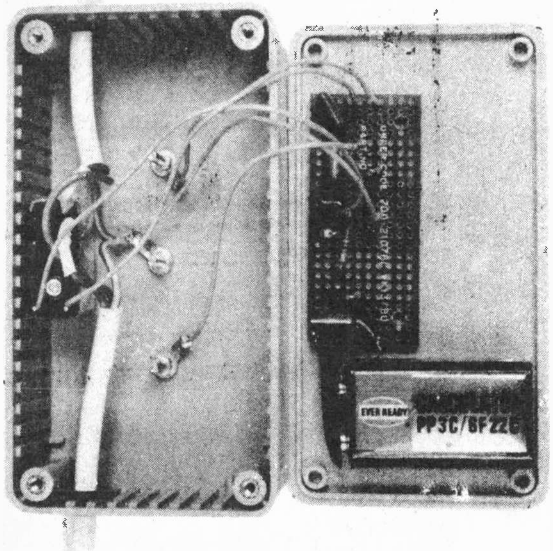


Fig. 2 Veroboard layout of the project. Note that there are no track breaks to make underneath the circuit board.



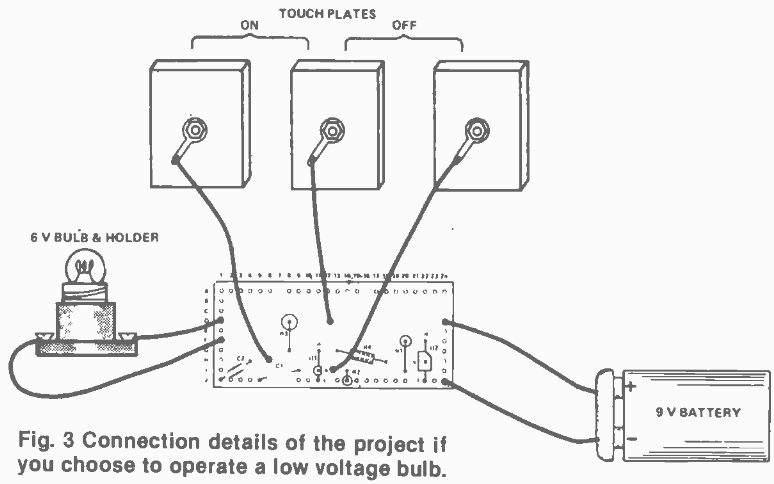


Fig. 3 Connection details of the project if you choose to operate a low voltage bulb.

PARTS LIST

Resistors (All ¼ W, 5 or 10%)

R1	10M
R2	3M3

Capacitors

C1,2	10n polyester

Semiconductors

Q1	VN10KM VMOS transistor
Q2	VN67AF or VN66AF VMOS power transistor

Miscellaneous

Suitable plastic case
Veroboard, 24 hole x 10 strip
Touch contacts.
9V type battery clip

Either: Bulb holder and a 6V 100 mA bulb for AA-sized cells and a plastic holder

Or: 6-12V operated relay (100R coil, or greater)
9V battery

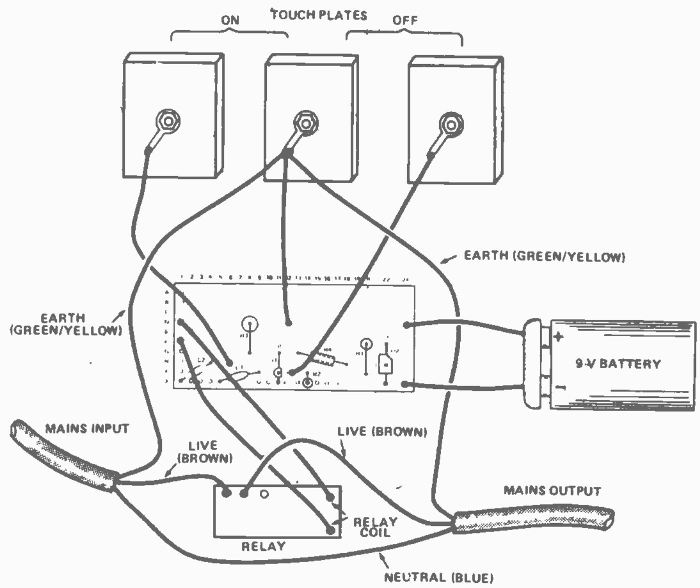
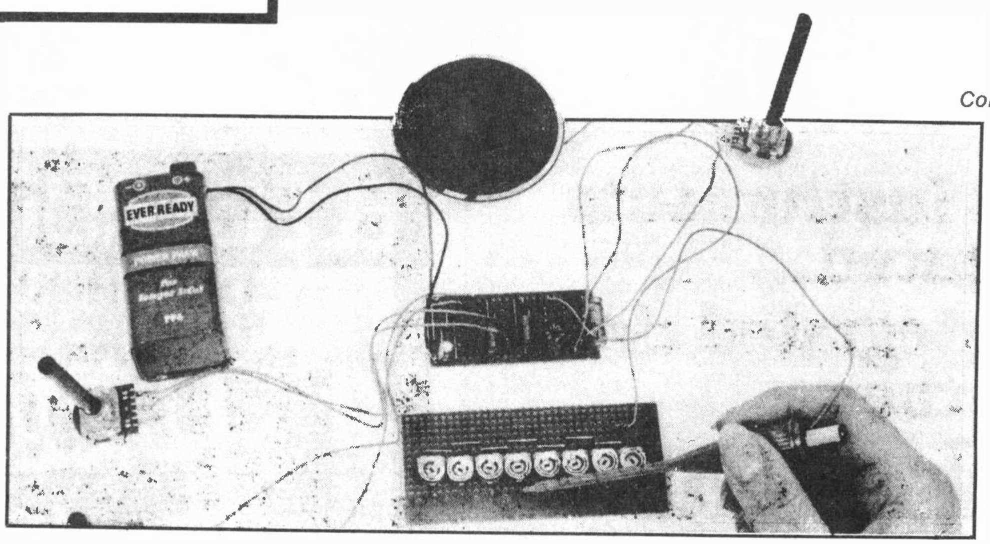


Fig. 4 Project connection details to control line powered equipment.



Continued on page 78

Electronic Thermometer

Convert your meter to read temperature with this simple add-on unit.

USING THIS CIRCUIT you can convert any voltmeter capable of reading 0-1V to a 0-100°C temperature probe. The device that makes this possible is National Semiconductor's LM335. This is a temperature-sensing integrated circuit housed in a T0-92 transistor type package which acts as a shunt regulator giving an output voltage of 10 mV per degree. The chip gives a 0V output, not at 0°C as you might expect but at absolute zero, minus 273°C. This means that an output voltage of 2.73 V is obtained at freezing point. To get a 0 V output from the circuit at 0°C, all we need to do is compare the output of the chip with a reference voltage of 2.73 V, which we obtain from a second integrated circuit, the TL430C.

Construction

Begin by mounting resistors R1,2,3,4,5, integrated circuit IC1 and variable resistor RV1 into the printed circuit board (PCB), as shown in Fig. 2. As IC1 and IC2 look alike make sure you've picked up the right device, the TL430C. Check its orientation against the overlay diagram.

Now connect a voltmeter with its negative lead to 0 V and its positive lead to the junction of R4 and R5. With the unit connected to a 9V battery you should be able to adjust RV1 to obtain disconnect the meter and battery and a reading of -2.73 V. If all is well, solder R6, RV2 and IC2 into the PCB, taking care with IC2's orientation.

Reapply power and connect the meter this time with its negative lead to the junction of R4 and R5, and its positive lead to the junction of R6, IC2 and RV2.

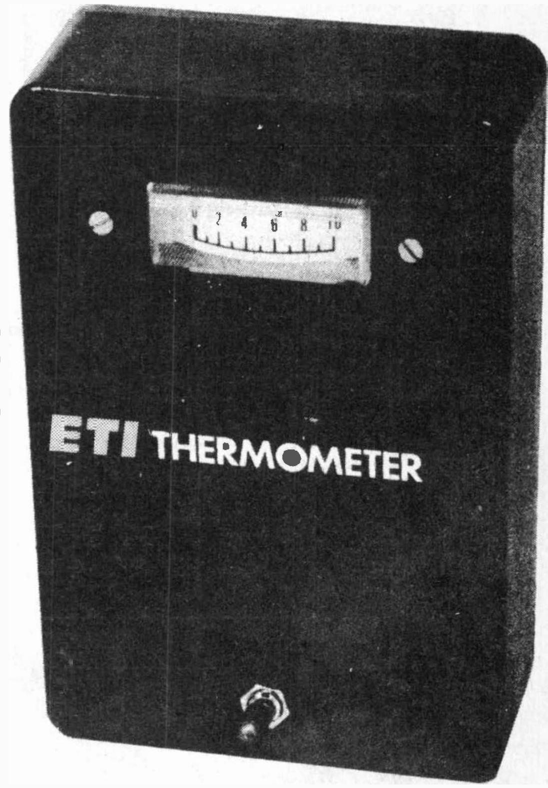
By adjusting RV2 you should obtain a reading corresponding to the ambient temperature. If the temperature is 25°C adjust RV2 for a reading of 0.25 V.

Only one calibration is needed as this sets the chip accurate to within 1°C over a range of -10°C to -100°C.

Now, mark and drill the case to fit the panel meter and on/off switch. Mount the PCB, battery, switch and meter into the case and wire up the project as shown in Fig. 2.

If you wish to make a temperature probe, you can mount IC2 remotely from the PCB. Choose a mounting to suit your application, taking care that the leads cannot be bridged or short-circuited if measuring water temperature, for example. In fact, it is a good idea to encapsulate the complete IC in epoxy resin or similar, if you intend to use the probe to measure water temperature.

And there you have it. With just two comparatively cheap chips and a handful of components, you have a complete linear temperature measurement system.



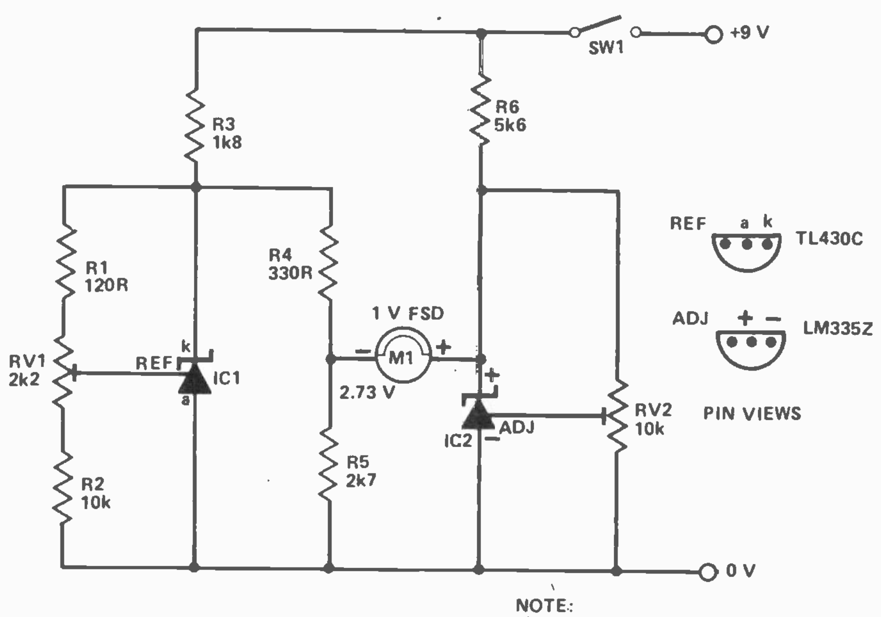


Fig. 1. Circuit of the ETI Thermometer.

PARTS LIST

RESISTORS (All ¼ W, 5%)

R1	120R
R2	10k
R3	1k8
R4	330R
R5	2k7
R6	5k6

POTENTIOMETERS

RV1	2k2 miniature horizontal preset
RV2	10k miniature horizontal preset

SEMICONDUCTORS

IC1	TL430C adjustable zener
IC2	LM335Z temperature sensor

MISCELLANEOUS

M1	any meter capable of indicating 0-1 V (for 0-100°C measurement range)

Case to suit.

HOW IT WORKS

The heart of the circuit is the LM 335Z solid state temperature sensor. When a current of 400 uA to 5 mA is passed through this device, a voltage of 10 mV per degree is developed across it. At 25°C (room temperature) a voltage of 2.98 V will be produced, not the 0.25 V (0.01 x 25) that you might expect. This is because the output is proportional to absolute temperature and 0°C is 273K so 25°C is (273 + 25 ÷ 100) V, ie, 2.98 V. So that the meter will read zero for 0°C, we generate a reference voltage of 2.73 V corresponding to 0°C, 273 K (the 'K' is for Kelvin — Lord Kelvin, a physicist).

The reference voltage is produced using a special integrated circuit, the TL430C. This chip is connected just like the LM335Z and has a terminal which monitors the output voltage via potential divider R1, RV1, R2. The TL430C will regulate the voltage at its output until a voltage of about 2.7V appears at its reference input. This occurs for an output voltage of about 3V. Unlike the LM335Z whose output will change with temperature, the TL430C is designed to be temperature independent and its output will drift by less than 50 parts per million, per degree Centigrade (ie, not more than 150 uV/°C). The required reference voltage of 2.73 V is obtained from the 3V output via potential divider R4, 5. This network is required because the reference voltage (and so the minimum output voltage) may range between 2.5V and 3V for different samples of the device. Preset RV1 accommodates this variation, enabling a 3 V output to be obtained from any sample. To obtain a temperature measurement, a 1V FSD meter is simply connected between the reference voltage from IC1 and the output of IC2.

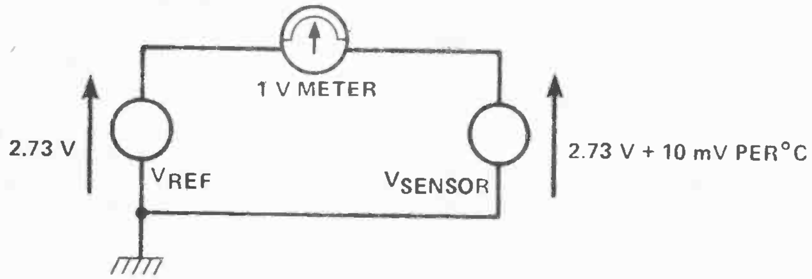
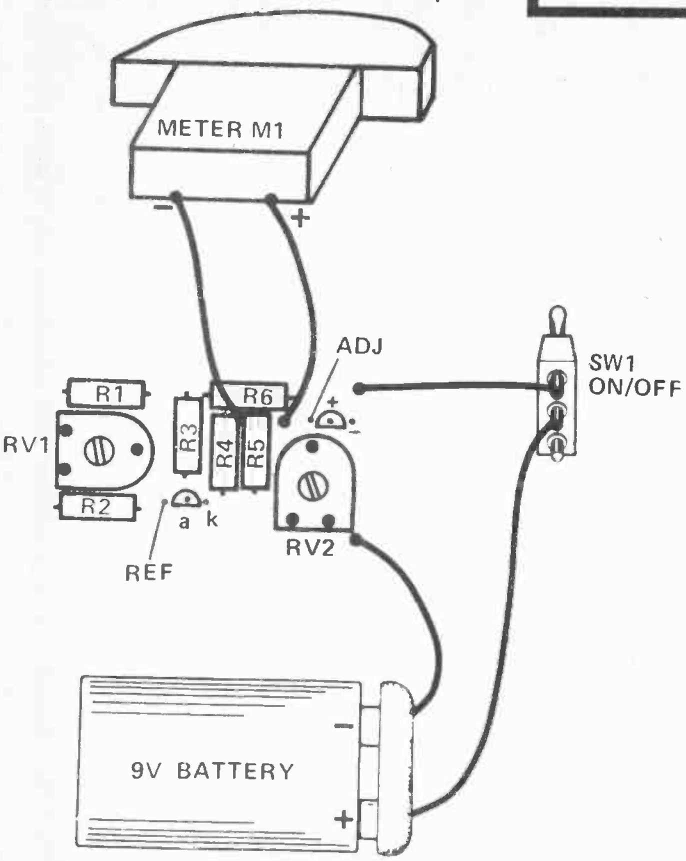


Fig. 2. Printed circuit board overlay of the Thermometer and connection details. Make sure you don't confuse IC1 with IC2 as they are similar both in size and shape.



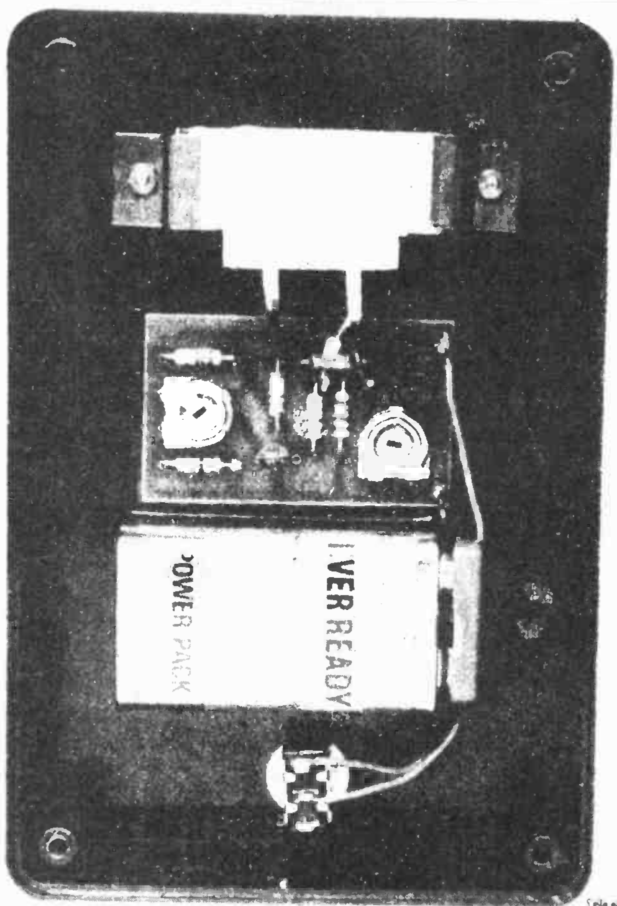
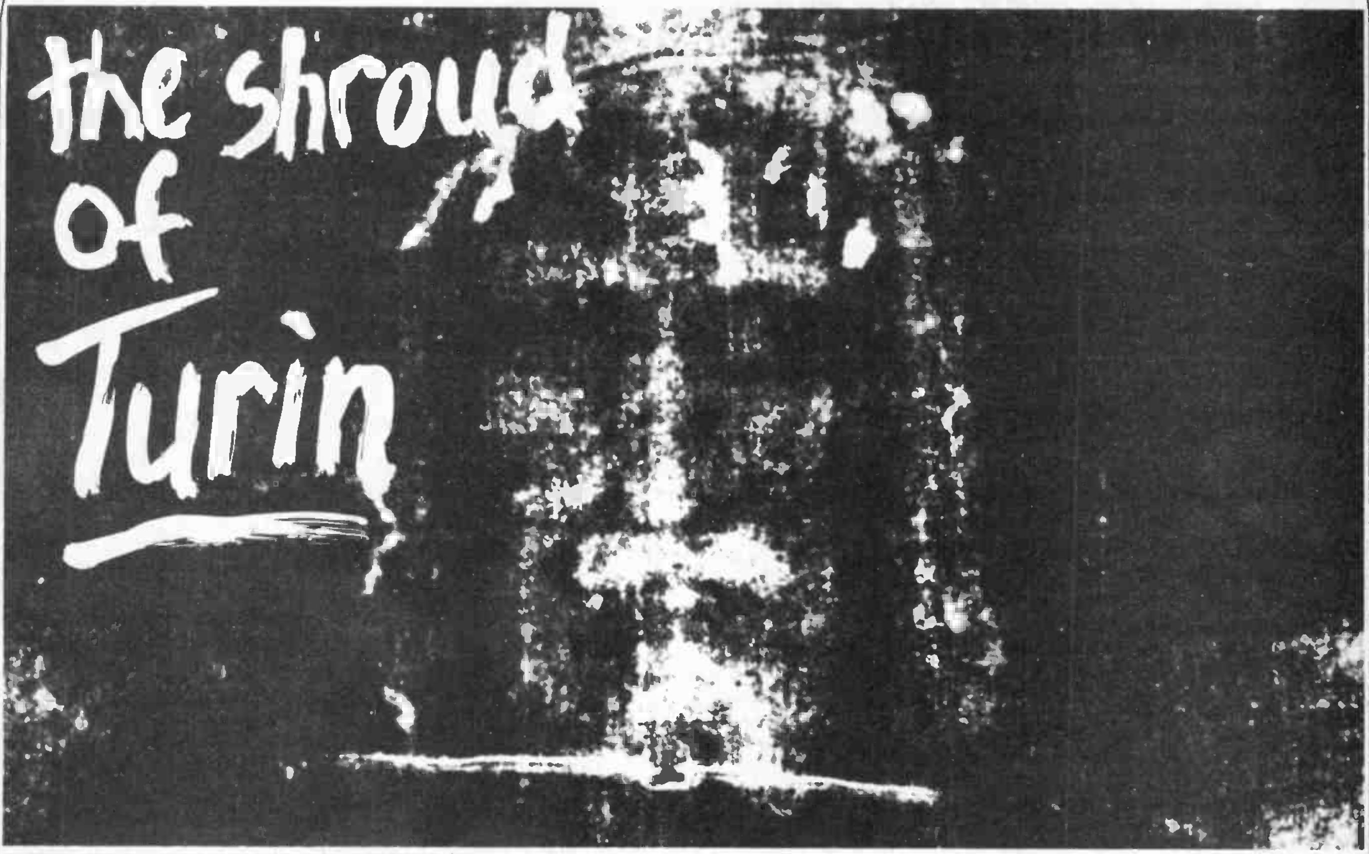


Fig.3. Internal view of the Thermometer. Keep all leads short and neat.

next month



Believed by many to be the burial shroud of Christ, this artifact was recently the subject of an intensive scientific examination. A look at the techniques used, next month.

Modems

Modems provide the computer user with a way to communicate with the outside world via the phone, and access an increasing variety of data and services. The mysteries of these useful little trolls unveiled, next issue.

LED Level Meter

Oh, yes, you say. . . another LM3914 bar graph. Hardly. Featuring 20 steps of resolution plus peak and averaging display, this may just be the most insanely complex LED level meter ever presented. For LED Level meter fanatics.

AF Signal Generator

A handy project, this, whether you're designing a 30kW car booster amp, or just experimenting with a chip. The whole story, including a wide selection of relevant words, next month.

Super Dice

Originally sent to Earth from the planet Krypton, these dice are faster than a speeding bullet, more powerful than a locomotive and will shortly be made into a full length feature film. They're also good for craps and Monopoly.

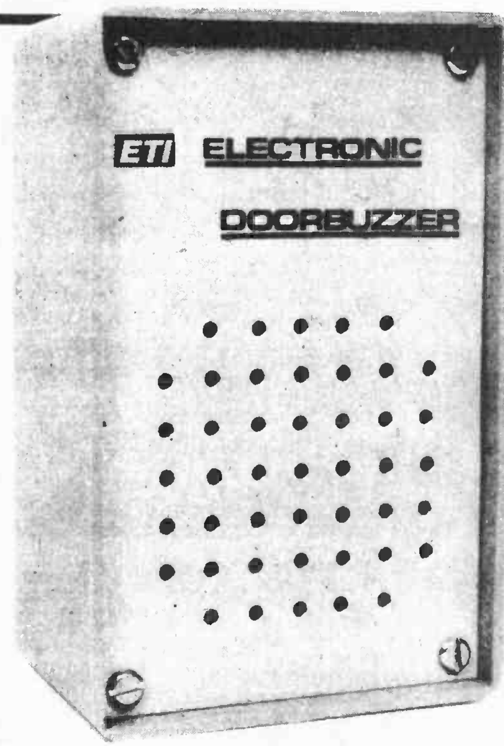
Faster Than Light Travel

A. S. Lipton, our ever inquiring science writer, probes the complexities of faster than light travel, and experiences a visitation by Einstein's ghost.

COMING TO ETI

At the time of going to press, the articles mentioned are in an advanced stage of preparation. However, circumstances may result in changes to the final contents of the magazine.

Electronic Doorbuzzer



This easily-built project for the home is an ideal alternative to the more expensive, commercially available door chimes.

ALTHOUGH AT FIRST sight an electronic doorbuzzer may seem to have no advantages over electro-magnetic types, it will probably be more reliable and longer lasting. A further advantage is that you can build it yourself at low cost. Our electronic doorbuzzer produces a warbling tone that is quite attention-catching, but should not prove to be objectionable to other members of the household. For simplicity of construction and installation, the ETI Electronic Doorbuzzer is battery-powered, and a 9V battery should have virtually its shelf life (typically about six months or more) within the project.

Construction

Start construction with the Veroboard by cutting the tracks underneath the board, where shown in Fig. 2. Use a cutting-tool or a small (1/8") hand-held drill bit for this job. Hold the cutting edge onto the hole in question. Press gently and then rotate the tool or bit clockwise, until the copper track has broken in a clean-edged circle. Make sure no loose pieces of copper swarf bridge across to adjacent tracks.

Insert and solder all resistors and capacitors in the positions indicated in Fig. 2. Now solder in the IC socket, if you intend to use one, and transistor Q1. Push fit the IC into its socket (or solder it into the board).

Following the connection details of the project, wire-up the board into its box.

Glue the speaker to the rear of the front panel of the box, behind a grill of some kind. This can be a cutout with a piece of speaker cloth fitted behind it, or a simpler solution is to drill a neat matrix of small holes. Make sure you don't get any glue on the speaker cone itself — only on the outside rim.

The hole for the lead to the bell button must be made in the casing, and it is a good idea to fit this with a small grommet which gives a neat finish and protects the lead.

Finally, mount the case securely to the wall where it is required, and wire it to the bell button.

HOW IT WORKS

Integrated circuit IC1 is used as the basis of the tone generator, and it is a standard 555 used as a free-running oscillator. Capacitor C4 charges to about ⅔ of the supply voltage via R5 and R6, and then discharges down to approximately ⅓ supply be way of R6 and IC1. This process repeats indefinitely, with the main output at pin 3 of IC1 going high while C4 is charging, and low while it is discharging. The waveform produced here is fed to a loudspeaker which consequently emits an audio tone.

The ⅔ supply voltage threshold at which C4 starts to discharge is modified by applying a control voltage to pin 5 of IC1. When this voltage increases the charge and discharge times of C4 are lengthened, giving decreased operating frequency. As the voltage reduces the charge and discharge times of C4 also reduce, so that a higher operating frequency results. The tone produced by the second generator is therefore frequency-modulated by means of a control voltage applied to IC1 pin 5.

The warbling effect is obtained by using a control voltage that rises and falls a few times per second. The character of the output signal depends to a large extent on the waveshape of the modulating signal, and a waveform similar to a sawtooth is used in this circuit. This is of the type that rises fairly steadily in voltage and then suddenly falls back to its minimum level. This actually gives a steady decline in output frequency followed by a rapid return to the initial frequency although this action occurs too rapidly to be clearly heard, and a pleasant warbling effect is produced.

A unijunction relaxation oscillator is used to generate the modulating signal. Capacitor C2 charges through resistor R3 until a charge voltage of about 7V is achieved, whereupon C2 rapidly discharges through Q1 and R2. Transistor Q1 then switches off, C2 commences to charge once again, and so on. R4 couples the output of Q1 to pin 5 of IC1.

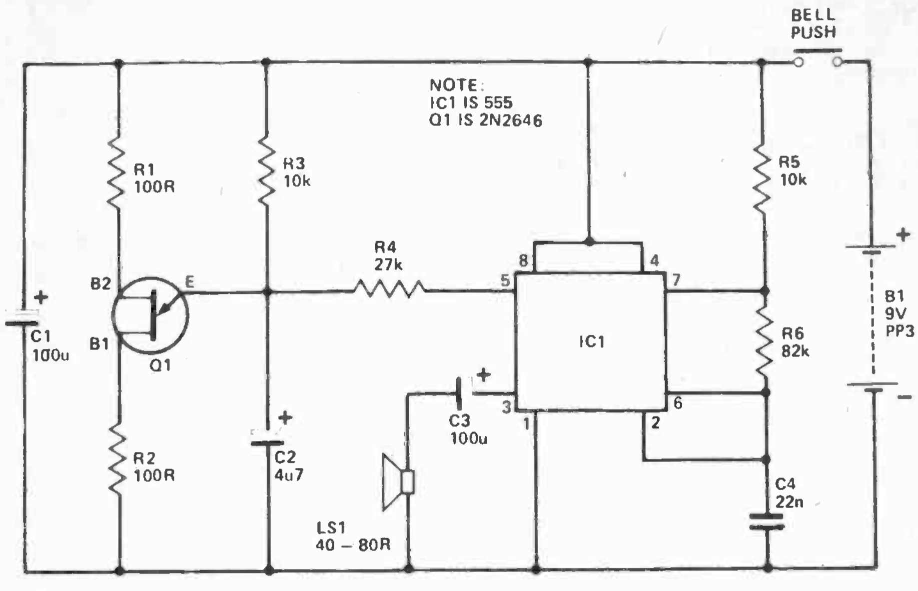


Fig. 1 Circuit of the ETI Electronic Doorbuzzer.

PARTS LIST

Resistors (All ¼ W, 5%)

R1, R2	100R
R3, R5	10k
R4	27k
R6	82k

Capacitors

C1,3	100u, 10V electrolytic
C2	4u7, 25V electrolytic
C4	22n polyester

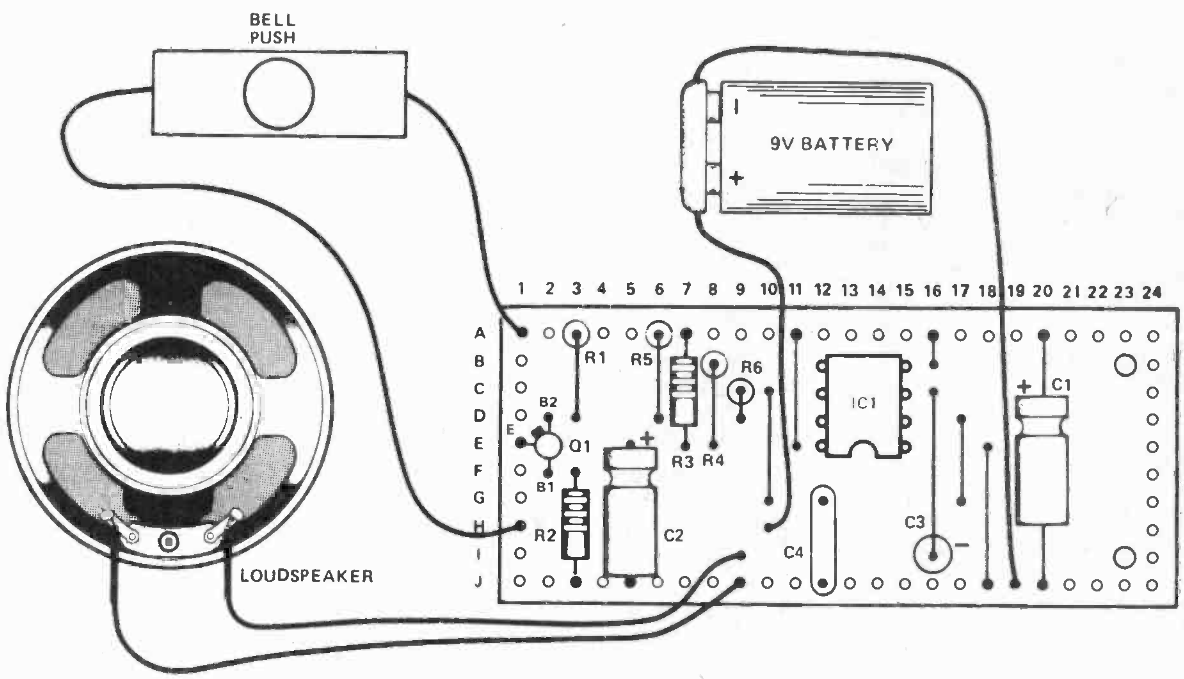
Semiconductors

IC1	555 timer
Q1	2N2646 unijumction transistor

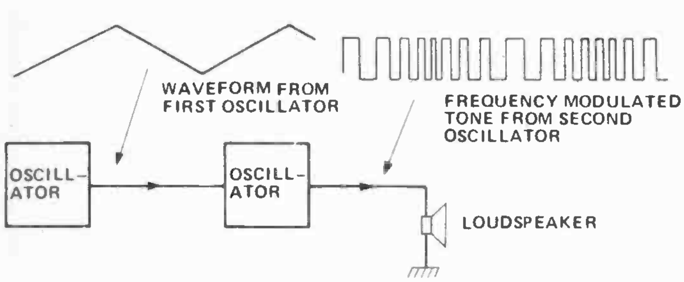
Miscellaneous

LS1	miniature 40-80R loudspeaker
Veroboard	24 hole x 10 strip, 0.1" matrix

Case to suit
9V battery and clip
Doorbell button and connecting cable



HOW IT WORKS



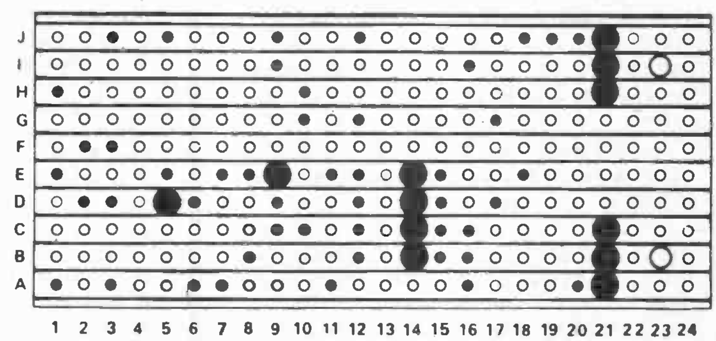


Fig. 2 Veroboard overlay, underside track breaks and component locations, and connection details.

ETI BACK ISSUES

February 1977

Features: CN Tower, Biorythm Calculator, VCT, 555 Timer Applications, Yamaha B1 Review, Scope Test Your Car.
Projects: 5W Stereo Amp, Philips Speaker System, Reaction Tester, Patch Detector, Heads or Tail, SCR Tester.

August 1978

Features: Getting into Shortwave, Using a 'Scope, Semiconductor Guide, Intro to Amateur Radio 2.
Projects: Sound Level Meter, 2 Chip Siren, Induction Balance Metal Locator, Porch Light.

November 1978

Features: Bally Arcade, PCM Explained, Danger of Lightning, Easy PCB Making.
Projects: Hi-Fi Amp with CMOS Switching, Capacitance Meter, Stars-n-Dots Game.

January 1979

Features: Robots: some Facts, Robots: Brain Power, Robots: Building Guide, VCT, Getting into Video.
Projects: Digital Tacho, Log-Exponential Converter, FM Broadcaster.

February 1979

Features: Quarks, Op-Amps, Binary to Decimal and Back.
Projects: SW Radio, Phasemeter, Light Chaser.

August 1979

Features: Casing Survey, Smoke Detectors, TV Antennas, Reed Switches, Magnetic Field Audio Amp, Industrial Electronics.
Projects: Audio Power Meter, Shoot-out, ETI-Wet Plant Waterer.

September 1979

Features: OSI Superboard Review, Solar Power from Satellites, Reed Switches.
Projects: Field Strength Meter, Digital Wind Meter, Up/Down Counter.

October 1979

Features: SW Receiver Survey, Ultra Fidelity, Computer Speech.
Projects: Simple Graphic Equaliser, Digital Dial, Variable Windscreen Wiper, Cable Tester.

January 1980

Features: LM10 Applications, Guide to Triac's, History of Car Ignition.
Projects: Guitar Effects Unit, Series 4000 Stereo Amplifier, Logic Probe.

February 1980

Features: Simple Radio Control, Gain Control, Guide to Triac's.
Projects: Series 4000 Moving Coil Preamp, Egg Timer, Power Supply.

The Back Issues shown here are available from ETI. Back issues are not just unsold issues; each month about 500 copies are held in reserve for later interest. The order form in this issue gives a complete list of issues still available.

Price is $3.00 each, any five for $10

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March 1980

Features: Biofeedback, Gain Control, Power Supplies, Self Resonant Capacitors.
Projects: Electromyogram (pr.1), Battery Condition Indicator, Wire Tracer.

May 1980

Features: Delay Lines, Standing Waves, Microwave Cooking, Artificial Intelligence.
Projects: Click Eliminator, Soil Moisture Indicator, Fuel Level Monitor, 16k RAM Card.

June 1980

Features: Electronic Warfare, PLL Synthesis, CA3130 Circuits, Canadian Sound Archives, Magnetic Power Control, CLIP.
Projects: Function Generator, Dynamic Noise Filter, Overspeed Alarm.

July 1980

Features: CMOS 555 Circuits, Capacitors, Electronics in the Studio, Tesla Controversy.
Projects: Hebot Robot (pt.1), Photographic Timer, Analogue Frequency Meter, Accentuated Beat Metronome.

August 1980

Features: S100 Bus System, Introduction to Test Gear, Designer Circuits, FET Special, Life Out There?
Projects: 300W Amp, Hebot (pt.2), Transistor Tester, Passionmeter.

November 1980

Features: Designer Circuits Special, Cassette Decks and Tapes, Attenuators, Project Daedalus, Thermistors.
Projects: Guitar Practice Amplifier, 6W Siren, Infra-Red Remote Control.

March 1981

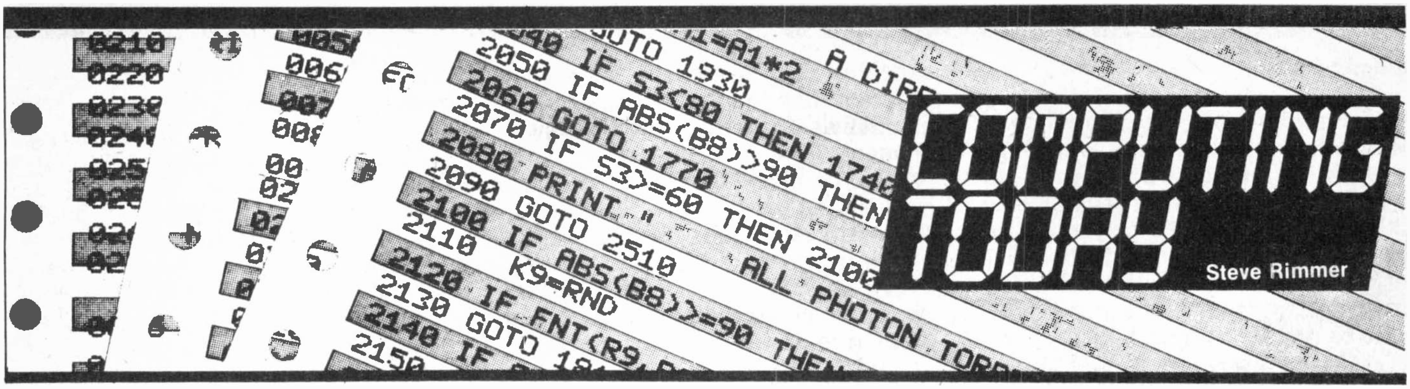
Features: The Ubiquitous Oscilloscope, VFET Applications, Photocells, Test Gear.
Projects: Hum Filter, Drum Sythesiser, Shark Game.

April 1981

Features: Introduction to Lasers, Test Meter Circuits, Eddy Currents, Modern Turntable Technology, Honeycomb Speakers.
Projects: Stereo Image Coordinator, Ultrasonic Switch, Autoprobe.

June 1981

Features: Project Galileo, Story Behind Stereo, Solder, Computerese.
Projects: 1573A VCA, High Speed Cassette Interface, Double Dice, Bicycle Speedometer.



ONE OF THE REAL NICETIES of the Acorn ATOM system is its on-board high resolution graphics. In the highest resolution mode, you can plot in a 256 by 192 point matrix, which is pretty dense, and a good deal better than trying to create shapes using the blocky, PET type graphics characters with which we are all fairly familiar. Not quite a Tektronix terminal, but pretty cool none the less.

When one is first turned loose on a machine with high resolution graphics, there is only one thing to do;

```
5 CLEAR 4; MOVE 128,96
10 X=ABS(RND%256)
20 Y=ABS(RND%192)
30 DRAW X,Y
40 GOTO 10
```

This produces an abstract string sculpture thing which is really fun to watch. Enhancements, such as using the PLOT command to erase some of the lines such that the screen does not completely fill up after a few seconds, a few wait loops to slow down the action, and so forth. . . all these make it a much more mystical experience, and one that's sure to keep you amused for many fun filled seconds.

To all things there is a season, though.

More sophisticated high resolution graphics applications, i.e., those without RND functions, are numerous, and much less likely to provoke sneers from your sober friends. We're going to have a look at one here, just to give you an idea as to what can be accomplished with all this wonderful hardware.

Of course, if you like the string sculpture. . .

ATOM and Eve

Program 1 is actually not a program; 'tis a subroutine, with a bit of stuff at the beginning to drive it. It is designed to be incorporated into a larger game program. What it does is to handle the drawing of segments of a maze, in 3D, from the eye of a viewer in the maze. The resulting game is usually one in which you go wandering around the maze looking for the holy grail, the sacred sword or the snack bar and john. It is a kind of classic thing, actually; a lot of these have been written for Apples.

The maze, as seen by the viewer, is a hallway which ends in a blank wall. There are up to five segments in the hallway before you hit the wall. Some of these are walls too, but some are corridors leading to other bits of the maze. The parameters held in the matrix AA decide which of the segments will be walls, and which openings. The variable Q determines how many segments there will be before the wall is encountered.

The AA segments are arranged as follows. All the AA elements are initially set to zero, which means that all the segments will come up as walls. Line 20 changes some of them to 1's, and, as such, the segments relating to these elements will become openings instead of walls. Try fooling with these for different effects. The segments are arranged such that AA(0) is the left hand segment furthest from the viewer, and AA(4) is the nearest. AA(5) is the right segment furthest from the viewer, and AA(9) the nearest.

If Q=0 the hallway will be five segments long; if it equals 3, it will be one segment long.

The subroutine consists of two sections, the filter, at e, driving the parameter setting stuff at s,t,u,v and w, and the actual segment drawer at b. The thing is all pretty uncomplex, as there are really very few parameters to take into consideration. All the lines fall in essentially the same places every time.

The filter, first off, sets the parameters for d, which draws the wall at the end of the hallway; the size of this is dependent upon the length of the hall; it gets bigger as the hall gets shorter. After this is drawn, the filters drops into the driver beginning with s. Notice that there are no RETURNS prior to the callable statements of this thing; if you jump in at the beginning, it draws all the segments, but you can also jump in further on, in which case it will draw proportionately fewer. Each segment is drawn by the routine at b, as per the parameters set by this driver.

The only slightly tricky bit is getting the walls to become corridores. However, what is actually happening in this case is that the lines which would link one vertical segment line to the next, i.e., these lines at angles, must be flipped so as to be horizontal, thus giving the illusion that they specify additional wall segments sitting at right angles to the hallway. As such, the only actual changes needed are the shifting of the end point parameters on these line segments, and, as you'll notice, these are such that the Y value will be the same as that of the start point of the line, and the X value the same as that of the vertical line of the next segment. The setting of these parameters is handled by the IF statements in the callable lines.

Devising a game to use this routine shouldn't be too complex; you'll need a maze, of course, probably randomly generated, and something to quest after and/or run away from, and finally, a plot!

You have been banished to the nether caves of the lost planet Thandor in the fourth dimension. It's where the overlords have send heretic worm pickers for centuries. As you pick your way over the skeletons of the poor wretched souls who have died in these murky caverns, waiting for the slime bats to devour you, you recall an ancient legend about the sacred Sapphire of Salvation, supposedly ensconced somewhere in the catacombs. If only you can find it in time. . .

Atomic Fission

Peter Headland, of Torch Computers, the Canadian incarnation of Acorn, recently returned from Acorn in England with a bunch of genuine new stuff. Yes, if you have played *Green Things* to death, and don't want anything more to do with the PEEKO computer, here is some more software to run. What fun, Billy!

All the software is $29.00 per cassette, unless they decide it isn't.

First off, there's *Desk Diary*, which will keep track of your life if you have an ATOM on your desk. It has an address book, a diary and a planner, and will do things like remind you of appointments, flag you when you try to schedule an important golf game and meaningless brain surgury into the same time slot, and so on.

And, to follow the first eight games packs, we have. . . *Games Pack 9.* Clever title, very symbolic. In it, you get *Minotaur, Snapper* and something really splendidly warped called *Babies*, in which babies are leaping from a burning building and you have position your net under them. . . . or else. (I swear I didn't make this up.)

Games Pack 10. . . it was to be expected. . . is actually somewhat different than the first nine packs, inasmuch as it's designed for the unexpanded ATOM, and, as such, all of its games run in low resolution graphics modes and using very little RAM. There are ten games on this one, including *Breakout, Mastermind, Snake, Lunar Lander* and *Squash*. Squash is played with a ball, and has nothing to do with babies.

ATOM *Adventure* is not quite the same as the usual adventure, but it's highly close, having been spawned from a Cambridge program called *Fantasy*. The way these things work is that you load up the Adventure meta-program, and then load in a set of parameters, which makes the game into a dungeon, a space war, and so on. Presumably, the user can create his or her own scenarios. The tape has the meta-program and three data bases, for *Dungeon, Haunted House* and *Intergalactic* something.

ATOM *Synthesizer* is a rudimentary tone generator thing which is more advanced than the Harpsichord program in the book, but not quite up to a Synclavier. It plays four voice music through the ATOM's internal squeaker-speaker, stores tunes played on the keyboard, allows editing thereof, and presents a medium resolution basic score display on the tube.

Life is. . . well, what can be said about this classic bit of computerized absurdity. However, as Peter said, if you're going to buy a Life, you might as well get a really wild one. ATOM *Life* does a cycle in .2 seconds in graphics mode 3, or in 2 seconds in mode 4. The user can draw shapes, save and call up up to seven shapes, and store shapes on tape. User modifications include using D/A converters on the ATOM's I/O ports to control the mixing of some amino acids to reproduce the game in a more biological sense. Torch does not claim any copyright over any organisms thus created, and the user is responsible for their disposal if they start eating cities.

A *FORTH* compiler and dictionary is now available, plus a book on *FORTH* ($20.00 extra). Become bilingual.

There is, also . . .eureka! . . . an ATOM Printer now available. In actuality, it's a Centronics 739, which does up to 132 columns and graphics, at 100 cps. In fact, it did the listing for Program 1. It is backed up by Centronics service, and is quite nice looking. Makes a dandy paperweight when not in use. $875.00. Ouch.

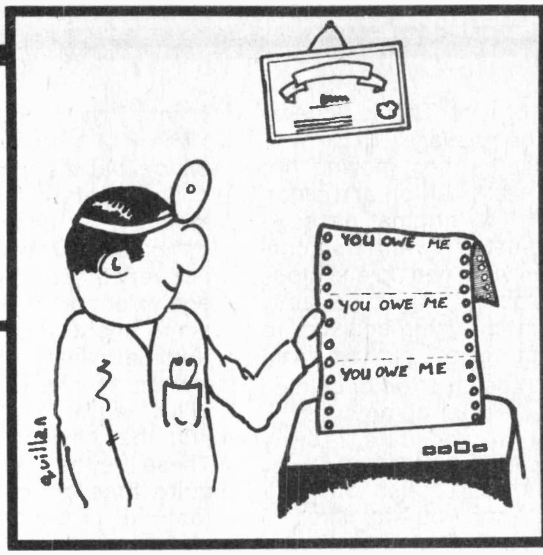
```
>>L.
    5 REM **MAZE DRAWING ROUTINE**      (C) 1982 STEVE RIMMER
   10 DIMAA(10);FORX=0TO9;AA(X)=0;NEXTX
   20 AA(3)=1;AA(9)=1;AA(5)=1
   30 Q=0
   40 CLEAR4
   50 GOS.e
   60 END
   70aREM DRAW MAZE
   80sX=115;T=90;B=75;N=105;U=97;L=69;IFAA(0)=1T.U=T;L=B
   90 GOS.b
  100 X=141;T=90;B=75;N=151;U=97;L=69;IFAA(5)=1T.U=T;L=B
  110 GOS.b
  120tX=105;T=97;B=69;N=90;U=108;L=60;IFAA(1)=1T.U=T;L=B
  130 GOS.b
  140 X=151;T=97;B=69;N=166;U=108;L=60;IFAA(6)=1T.U=T;L=B
  150 GOS.b
  160uX=90;T=108;B=60;N=70;U=122;L=48;IFAA(2)=1T.U=T;L=B
  170 GOS.b
  180 X=166;T=108;B=60;N=186;U=122;L=48;IFAA(7)=1T.U=T;L=B
  190 GOS.b
  200vX=70;T=123;B=48;N=43;U=143;L=32;IFAA(3)=1T.U=T;L=B
  210 GOS.b
  220 X=186;T=123;B=48;N=213;U=143;L=32;IFAA(8)=1T.U=T;L=B
  230 GOS.b
  240wX=43;T=143;B=32;N=0;;U=176;L=8;IFAA(4)=1T.U=T;L=B
  250 GOS.b
  260 X=213;T=143;B=32;N=256;;U=176;L=8;IFAA(9)=1T.U=T;L=B
  270 GOS.b
  280 R.
  290bREM DRAW SEGMENT
  300 MOVEX,T;DRAWX,B;MOVEX,T;DRAWN,U;MOVEX,B;DRAWN,L;R.
  310dMOVER,H;DRAWL,H;MOVER,B;DRAWL,B;R.
  330eIFQ=0T.R=115;L=141;H=90;B=75;GOS.d;G.s
  340 IFQ=1T.R=105;L=151;H=97;B=69;GOS.d;G.t
  350 IFQ=2T.R=90;L=166;H=108;B=60;GOS.d;G.u
  360 IFQ=3T.R=70;L=186;H=123;B=48;GOS.d;G.v
  370 R=43;L=213;H=143;B=32;GOS.d;G.w
  380 --------END-------
>RUNP.$3.
```

Send Us Stuff!!!

This is the part at the end of *Computing Today* where we invite you to send us your favourite computer program, hardware mod or other related regalia. Out of the goodness of our hearts, we will send you undisclosed amounts of money in return, which will permit you to purchase the finer things in life.

What good is a memory that only stores 8 K's? What if you have to store some L's or M's as well?

Electric Pencil



Whether you're a businessman or just have a lot of essays to write, a word processor is very useful to have. Bruce Evans describes one such package.

ONE OF THE first questions friends always ask when first shown your new microcomputer is, "Well, what does it do?" They never appreciate that just building and having it is enough. However, the question becomes embarrassing when posed by one's spouse. This word processing package is enough to answer even the most practical minded inquisitor — besides, it's even useful as well!

A word processing program allows you to type and compose on a video screen and then saves it for later use or prints it immediately or later. I like to justify my computer by telling those who will listen that I save enough paper by not having to retype to pay for my equipment. This may be an exaggeration but it indicates one advantage of such a system. Much more practical is the ability to edit your material by shifting it around, rewriting and correcting spelling and grammatical errors right on the screen. As an added bonus most word processing systems can format the type and print multiple copies — imagine having 100 original typed resumes when you are sending out job applications! Also, these programs allow you to store passages of material so that you can add it to form letters. You need only to type a bare bones draft and save it on disc or tape. Then when you are writing the letters you can read it into the program and either add to or subtract from the information presented. This would be useful to anyone such as a physician or lawyer sending out many nearly identical letters. Even if you do not own a printer, such a system is useful as it lets you format your letters and then type the final draft from the video screen. The ease of rewriting encourages you to redraft your material and should greatly improve the quality of your finished work.

The drawback of such a system was that usually it costs about ten thousand dollars to put into practice. Here is where the Electric Pencil comes into the picture. It varies in price from $120 to $250 depending on the version. Naturally this does not include the price of the hardware but it can be run even on an inexpensive TRS-80. There seems to be a tailor-made version for every imaginable combination of microcomputer, monitor, printer, video display and mass storage. I suspect the only system missed would be a Chinese abacus linked to a stone chisel — but I am not sure that version is not in the planning stage!

The software package comes with comprehensive documentation. The hardware requirements are listed. Patches with source listings are included to enable you to write I/O routines for a system that varies slightly. All the terms used are defined in detail including Shrayer's conventions for differentiating between control characters which are widely used and upper case characters. The I shall go into these later.

After the program is loaded into your machine and executed, the title appears on the display. You then enter a carriage return and the cursor appears at the top of the screen. From here you merely type as on any ordinary typewriter. However, as you reach the end of a line the carriage return is inserted automatically and if a word is too long it is moved to the next line intact. There is no hyphenation. The file that you type will automatically scroll down your monitor and you can continue typing as long as your memory storage area holds out. If you exceed memory, a message will appear on the screen advising you of this. Then it will be necessary to either print the material or store it on tape or disc. Unfortunately, there is no command to tell you how much memory space remains. This would be very convenient. There is no provision for appending two tape programs but most disc systems have such a function. I would like to point out that the Electric Pencil uses all the available contiguous memory above itself for file storage. If you have another program above it, be careful or you will overwrite it. This factor is taken into account on the North Star disc version since the disc operating system is located at 2000 Hex. The Electric Pencil writes over this area but when you leave the program by typing control 0, the program causes the system to dump the disc operating system back in. The Electric Pencil uses its own disc access routines so overwriting the DOS is of no consequence. However, be sure your system does this before taking it for granted.

The first group of commands allow you to edit the material that you have typed on the screen. If you are familiar with the usual editing functions found in most BASIC's you will be familiar with this. However, the Electric Pencil has the Rolls-Royce of editors. The cursor can be moved up, down or sideways. This is accomplished with control characters or, in the SOL-20, by using the standard keyboard cursor controls. It is possible to scroll through the entire work either forward or backward at variable speeds. The cursor can be homed to the beginning of the work, to the end of it or even to the top of the CRT screen. This last feature is a delight to those of us who dislike typing at the bottom of the screen where the lines are subject to distortion.

It is possible to move, insert and

delete blocks of type. This is done by surrounding the passages to be moved with brackets, then moving the cursor to the new position and entering control H. The original passage can then be deleted by entering control U. The type will open up and close around the blocks. This is certainly much simpler than using scissors to edit a manuscript. Lines and characters can be inserted or deleted with simple one-letter commands.

The search procedure is very helpful in locating a string in the body of the file. To accomplish this you enter control V and you are asked to enter the string desired. (See Figure 1.) Then the video display moves so that the cursor is at the first occurrence of this. The search can then be continued by entering control C. A useful variation of this is the ability to replace the sought after string with another. This can be done either a set number of times or throughout the entire file. This feature is very useful if you are typing data that is likely to be changed or is unknown at the time of typing. You can simply type in XX in the original and then search for and replace it with the new values at a later data. However, you must be precise in defining the strings to be replaced as you may find the string you get may not be the string you want but rather part of another. The search function is very useful if you use the Electric Pencil to keep lists such as Christmas card lists.

Once the material is edited to your satisfaction you enter a storage subsystem by entering control K. The video display associated with this is shown in Figure 2. This will give you the total number of words and paragraphs beyond the cursor in your file. This is very useful to a writer. The file can then be stored on tape or disc and later retrieved for further modification or printing. The program includes a verification routine for the Tarbel cassette format but unfortunately not for the CUTS format that I use. This command allows you to check that the file has been correctly copied before you erase it from memory. As cassette interfaces are not known for their dependability this is a very thoughtful touch. There is no equivalent command for disc storage since most disc systems do this automatically. There are three commands to clear memory and these allow you to clear all the memory or just that before or after the cursor. These are the only commands that require three letters each. This is important in preventing the accidental erasure of files.

```
WORD NUMBER X
RCRD NUMBER Y
DISK DRCTRY DI
SAVE DSKFIL DS
LOAD DSKFIL DL
CLER AA CUR CAA
CLER AB CUR CAB
CLER SYSTEM CLR
RGHT JUSTIFY J0-1
LINE SPACING S1-5
PAGE SPACING A2-20
PAGE LENGTH G1-72
LEFT MARGIN M0-100
PAGE NUMBER N1-255
PRINT LENGTH P0-255
LINE LENGTH L25-160
```

Fig. 2 This is the subsystem CRT display. The user has asked the number of words in the file by typing "X" and has received the answer 1666. He has asked the number of paragraphs by entering "Y" and received the answer 15. The command "W PENCIL" has caused the program to save the file with the header name "PENCIL". The reply "WRITTEN" indicates that it has been done. The command "DI" asks for a catalogue of the disc. As I have no disc system, the headings in the lower left corner are empty. The list on the right side indicates most of the subsystem commands and stays on the CRT screen for the user's convenience.

The rest of the subsystem allows you to format your print. This means that you can determine the line length, the line spacing (eg. double or single spacing and the page lengths. furthermore, you can "justify" the right margin which means that spaces are inserted into the line to make all the final letters end at the same spot. This is common practice with printed matter such as this magazine page and it is a very nice feature to have in your letters. The position of the left margin can be set. Pages can be automatically numbered. You may define these features or let the default values be applied at the time of printing.

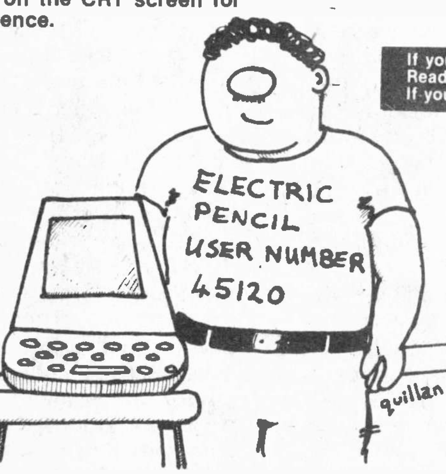
Once the printing information has been determined, you merely press control P and the file is output to your printer. There are several commands to allow underlining at this stage and pages can be titled automatically. If you are one of those lucky souls who owns a Diablo printer, there are further refinements. I assume they work as well as everything else.

Finally, Mr. Shrayer will send you any information about updates or bugs if you register with his company. He has a most commendable policy of allowing you to update or change your version for a nominal fee and the difference in price. Thus your version should never be obsolete. However, be warned that only original tapes can be exchanged — copiers beware!

In summary, the Electric Pencil delivers all it promises. It is a relatively inexpensive way to get the advantages or word processing for your micro without the expenses of the "big boys". Moreover, you will not have to trade off performance for price.

```
Search String? ABC/abc/23
SEARCH STRING? ABC/abc/23
```

Fig. 1 The phrase "SEARCH STRING?" has been displayed on the CRT and the user then entered "ABC/abc/23" which would indicate that the routine is to search for the string "ABC and replace it with "abc". It will do this only up to 23 times. If there are less than 23 occurrence of "ABC" the routine would display the number of times that the string occurred. Therefore, to be sure of getting all occurrences of a string, you can enter a number far in excess of the frequency expected.



Voice Mailbox

Another use for your telephone has just been launched. Known as the Voice Message Service it has the backing of no less a company than Shell Canada.

If you liked this article, please circle Reader Service Card number 53. If you didn't, circle number 54.

Take a number of recent, but well tried, technologies: the Touch-tone phone, Analogue-to-Digital and Digital to Analogue converters, a hard disk storage system and a high speed computer and mix well — you come up with Voice Message Service which has just been launched, initially in the Toronto area.

To make use of the system you have to be a subscriber. If you're unable to reach the someone on the phone, dial VMS followed by the 'code' of the person you want to reach (they also have to be a subscriber) and say your message. Your voice is fed to an A-D Converter and dumped onto a hard disk.

The idea is for you to dial into your 'mailbox' every now and then and any messages for you will be played out. This time the digital signals on the disk go via a D-A converter so what you hear is a facsimile of the original voice, though the quality change is not noticeable.

The computer control lets you do a lot more than the basic system: using your push-button dial you can for instance skip from message 1 to message 2, go back 10 seconds, forward 10 seconds etc. You may also add your own comments to the message and have it passed to a third person's 'mailbox'. "The primary value of the VMS system is its ability to save time," says VMS general manager John Rutherford. "Sending and receiving information, carrying on day-to-day business by telephone can be done much more effectively when the caller is not dependent on his party actually being on the other end of the line at the time of the call."

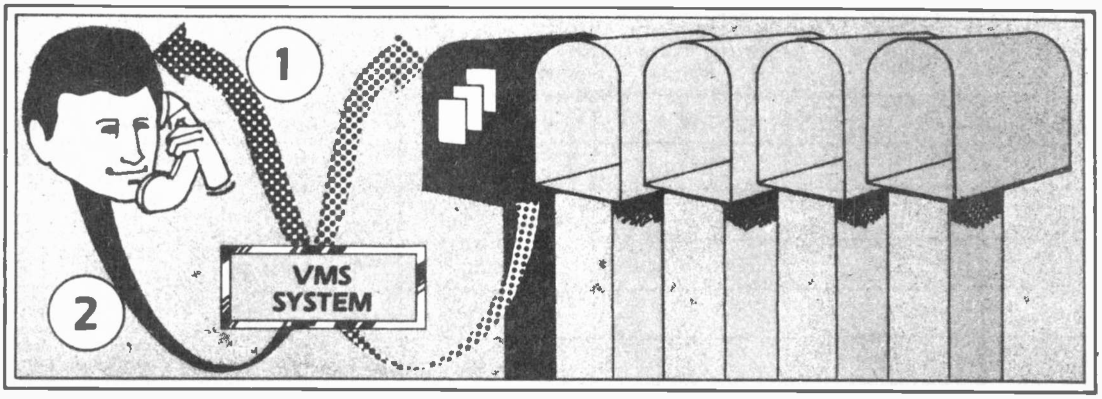
VMS is already in use between 400 people — over half of them within the Shell organisation but only now is it being opened up generally.

The existing facility has a capacity for 3,000 subscribers — each of whom can have up to 35 messages of up to 3 minutes each on the system at any one time.

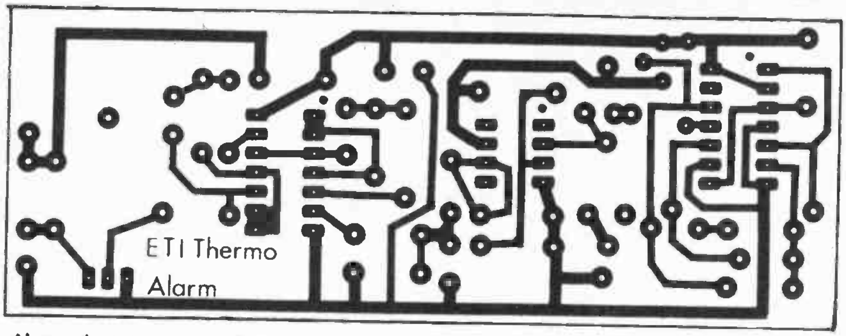
The cost is a nominal $10 for hookup and 'training' and then $40 a month — a cost that VMS find easy to justify. "Just two messages a day or four memos a month, for instance to your sales reps, come to $40 a month" claims John Rutherford "the saving in long distance calls or using discount period phone rates could be massive but isn't easy to compute".

The small size of the initial facility — just 3,000 subscribers, and the fact that both sender and receiver need to be subscribers seems rather limited to ETI. Large corporations will find a lot of use but largely for internal purposes making it an extension of their PABX. Other companies will be very lucky to find their business contacts on the system without prior agreement of a group to subscribe.

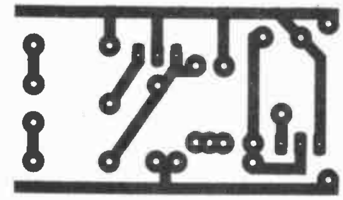
Still, VMS is a brave new venture in the field of communications and if it catches on at all it could become massive.



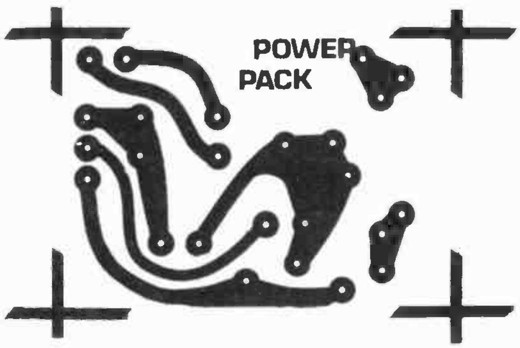
Each user is assigned a confidential "Voice Mailbox" in the computer. This works something like a conventional mail drop-off point. VMS users periodically call (1) into their "Voice Mailbox" to "pick up" information "dropped off" in the callers' own voices. If there is a message waiting for the user when he calls in, he or she can receive (2) the message; reply immediately, retain the message for future handling or re-direct it, with his own comments added, to one person or many — simultaneously.



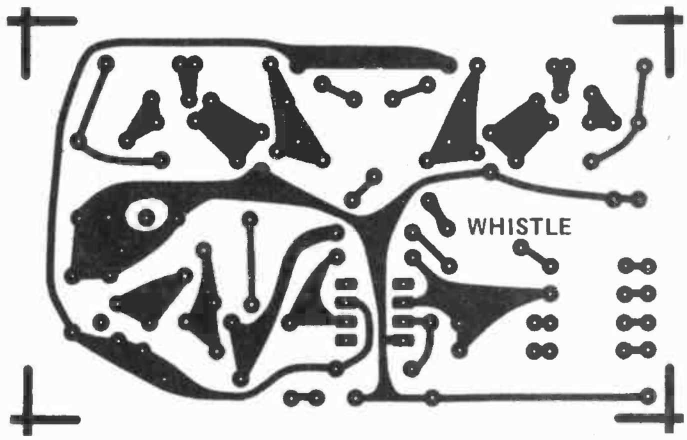
Above: the Micropower Thermal Alarm PCB.



Thermometer PCB foil pattern



PCB pattern for HE Power Pack



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April 1982

ETI Helmet Visor!

Ah, those gallant days of old, when knights were proud and fierce, women soft and yielding and horses everywhere had curved spines. What a time it was! 'Twas the stuff of legends, or, at least, fairly good hallucinations late at night.

If you pine for those days gone by, dream of sallying forth into the fray once more (even though you live in a one room bachelor apartment instead of a castle) well, we have just the thing for you. For just $8.00 plus PST for Ontario residents, you can have the ETI Helmet Visor Kit/Magazine Binder. Made of impermeable cardboard and vinyl, it will repel the sword of any foe, providing he doesn't actually unsheath it. It's durable, and each and every ETI Helmet Visor converts into a perfectly useable magazine binder for when they let you out.

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Into Linear ICs Part 5

Having dealt with all of the 'ins and outs' of the 741 Ian Sinclair turns his attention to the very popular 555 timer IC.

HARKING BACK TO PART 1, do you remember all that spiel about having to make ICs in immense quantities if they're to be worth making? Our next chip is an example of just that — a very versatile IC which practically every IC manufacturer turns out in great quantities. We certainly can't ignore it, it's the 555 timer. Like the 741, this chip comes with different letter codes before the number, and in various different packages. We'll stick to the 8-pin DIL package.

The 555 timer contains a number of circuit components; two operational amplifiers which are used as comparators, one bistable (or flip-flop), one output stage and one switching transistor. You don't need to know what happens inside the 555 to be able to use the chip in the circuits which follows, but you can make much more effective use of it if you do know something about it, so here goes.

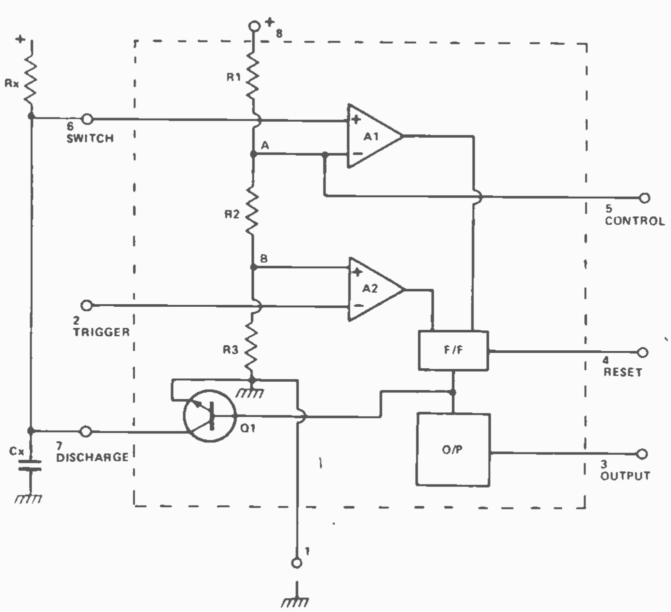

Fig. 1 The works — a block diagram of the circuits inside the 555 timer.

The arrangement inside the 555 is as sketched in Fig. 1. The resistors R1, R2 and R3 are all equal in value, so that the voltage at point B is one third of the supply voltage (V+), and the voltage at point A is two thirds of the supply voltage. At the time when the whole lot is switched on, Q1 is conducting so that any circuit which is connected to pin 7 is earthed — in many applications, this pin is connected to pin 6 and to a CR circuit which is shown dotted in the diagram. The output voltage is held low, and will stay low even is a current of up to 200 mA flows into the output pin, pin 3.

Timing is started by a negative-going trigger pulse at pin 2, and the action really begins when the voltage at pin 2 drops below the voltage at point B, which is one third of V+. When this happens, the comparator A2 switches over, its output voltage rises and so causes the flip-flop to switch over. The flip-flop is an electronic switch, turned on by a positive pulse from A2, and which can be turned off only by a positive pulse fro A1, or a reset voltage from pin 4. Ignoring the reset action, then, the flip-flop switches on with a positive pulse from A2, *off* with a positive pulse from A1.

The flip-flop controls both Q1 and the output stage — it switches Q1 off, and switches the output stage over so that the voltage on pin 3 goes high, almost to the level of V+. With the output high, up to 200 mA can be taken from pin 3 to feed any sort of load. The action now passes to the external components. In our example, with the external components shown dotted, Cx can now start to charge through Rx. As the capacitor charges, the voltage on pin 6 rises, and is compared with the voltage at point A, two thirds of V+. When the two are equal, the output voltage of comparator A1 switches high and turns off the flip-flop. This in turn causes the output at pin 3 to switch low, and Q1 to conduct again. With Q1 conducting, Cx is rapidly discharged to almost ground voltage, and the timer waits in this state for the next trigger pulse.

Skin Deep

Let's go back to the outside of the IC. The supply pins are No. 8 (V+) and No. 1 (negative), and a single supply of any voltage between 4.5 V and 16 V can be used. We'll run most of our circuits from a single 9 V battery. Pin 2 is the trigger input, which is normally connected through a resistor to supply positive. Connecting or pulsing this input momentarily to ground or to any voltage less than one third of V+ will cause one comparator (B) inside the 555 to switch over, causing in turn the output to go from LOW to HIGH, and pin 7 to become open circuit instead of connected to ground. This is the start of the timing action of the 555, as we have described.

The output of the 555 timer will deliver (source) or accept (sink) up to 200mA, so that load resistances can be connected either between pin 3 and ground or between pin 2 and supply +. The timing periods which are produced by the action of the timer are not noticably affected by changes in the supply voltage, so that the timer will continue to work well even with a battery which is near the end of its useful life.

Because pins 6 and 7 can be separated, however, rather than connected together, we can stop the action by a separate circuit, and we can also control the timer by using pins 4 and 5. Pin 4 is a reset pin whose voltage is normally set high. Connecting pin 4 to a low voltage will cause the flip-flop to reset, making the output go LOW and grounding pin 7, no matter what was going on previously. Pin 5 enables us to vary the control voltages, so that both triggering (on pin 2) and automatic resetting (on pin 6) can take place at higher or lower voltages. Lowering the voltage on pin 5, for example, makes the triggering and reset voltages lower; raising the voltage on pin 5 makes the triggering and reset voltages higher. In most applications pin 5 is not used and is simply connected through a capacitor to ground. The capacitor prevents voltage pulses which are radiated from other wiring from being picked up on pin 5.

Timely Circuits

Now for some circuits. Fig. 2 is a circuit of a 1 minute timer, which starts timing when the START button is pressed, and stops timing one minute later. The time can be set to exactly one minute by adjusting the value of RV1. When the circuit is first switched on, the output from pin 3 is LOW, so that the LED does not glow. When the push-button switch is pressed momentarily, the circuit triggers, because the trigger pin, pin 2, has been grounded. The output at pin 3 goes high, so that current can now flow through R3 and LED, causing the LED to glow. At the same time, because pin 7 is no longer grounded internally, C1 can start to charge through R2 and RV1. Since C1 is also connected to pin 6, the circuit will switch back when the voltage across C1 is equal to two thirds of the supply voltage. This switches the output LOW, extinguishing the LED. It's a useful little timer circuit, particularly for a photographic darkroom, because the red LED doesn't affect black/white papers (be careful with colour papers, though, you may need some shielding around the LED). To obtain different time ranges, just change the values of C1 and R2. Larger values give longer times, but don't exceed 100 μF for C1, nor 10M for R2.

Let's get a bit more ambitious now, and look at a control timer circuit. If we want to use the 555 timer IC for controlling equipment which works at higher voltages than the timer itself, the easiest and safest method is the use of a relay. Any relay which has a coil requiring low voltage (9 to 12 V) and an operating current of less than 200 mA is suitable, so that the resistance of the relay should be 60 ohms or more. The contacts of the relay should be adequate for the current which is to be controlled; that means that a circuit which needs 3 A should be controlled by a relay whose contacts are rated at 3 A or more. The insulation of the relay should be also adequate if the contacts are to be used for switching line voltages; it's usual to have a relay tested to 1,000 V between contacts and coil when it is to be used for 120 VAC. The relay contacts may be of three types — normally closed, normally open, or changeover according to the use which is to be made of it. The word 'normally', incidentally, means 'when no current is being passed through the relay coil'. The advantages of using a relay rather than an electronic device like a thyristor are that the relay contacts are completely isolated from the coil, and that a relay can deal with a much greater range of currents and voltages. In addition, relays can be obtained which will switch several circuits at the same time.

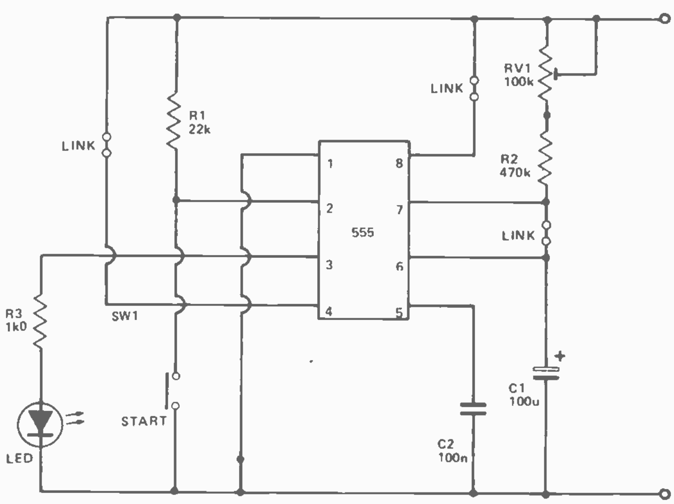

Fig. 2 A one-minute timer.

Latching On

When a relay or any other highly inductive load like a solenoid, is activated by the output of a 555 timer, protective diodes D1 and D2 must be connected as shown. D1 should be a high-voltage, high-current diode like the 1N4001, and D2 should be a germanium diode like the 1N38. These two suppress the high voltage which is otherwise generated when a relay coil, or any other large inductor, is switched off. In addition, D2 protects the 555 from 'latch-up', a condition which makes the output voltage stay high until the circuit is switched off. Latch-up occurs because the voltage pulse which occurs when a relay is switched off can be coupled through the wiring or by stray capacitance to the trigger input, so causing re-triggering. The trigger input is very sensitive, but a reasonably low resistance connected to pin 2, and the use of these diodes will completely prevent latch-up, which incidentally doesn't happen when the relay is connected as shown in Fig. 3b.

In our circuit, Fig. 5.4, the usual timing action is used, with timing capacitors C1 and C2 selected by

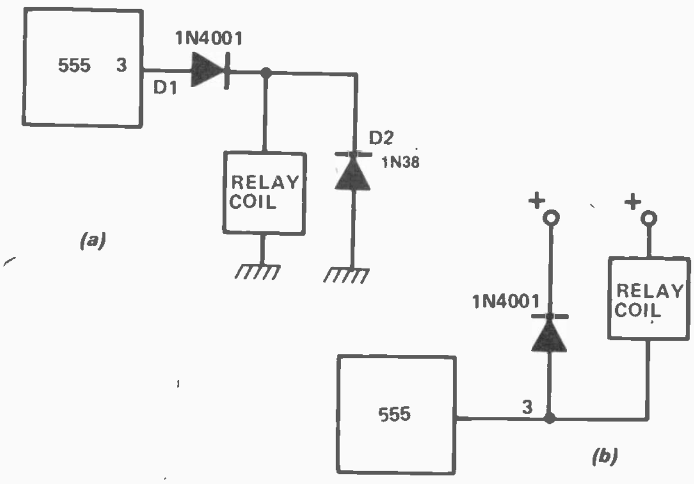

Fig. 3 Methods of connecting a relay to the 555. In method (a), the relay is activated when the output of the 555 goes high, latchup must be avoided by suitable choice of diode types for D1 and D2. In Method (b) there is no risk of latchup since the relay is activated when the output of the 555 goes low, but a protective diode is still needed.

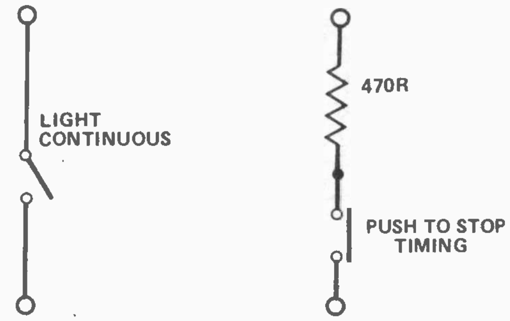

Fig. 5 Two modifications which are useful when the control timer is used for controlling a photographic enlarger.

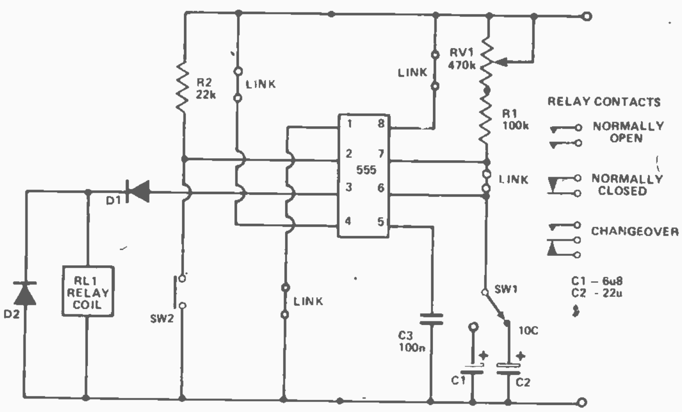

Fig. 4 The control timer-circuit.

SW1 and charging through R1 and RV1. Switch SW1 acts as a coarse time selector, with RV1 providing fine adjustment. Before the START button is pressed, the output at pin 3 is LOW, so that the relay is not activated. Pressing SW2 momentarily will start the timing cycle, so that the replay is activated, and C1 and C2 starts to charge through R1 and RV1. At the end of the timing cycle, the relay is switched off and the capacitor C1 or C2 discharges through the timer. This action is ideally suited to such applications as a photographic enlarger lamp; Fig. 5 shows two refinements, a 'continuous-light' switch, to allow setting-up, and a 'push-to-stop' button so that the timing can be interrupted if need be.

Fig. 6 shows a turn-off delay. The application for this circuit is to turn on the interior light of a car when the ignition is switched off, and then to turn the light off again after about 1½ minutes, so giving the driver time to gather up his/her keys and go. A 12 V relay is used to carry out the switching, since the circuit must operate from the 12 V car battery, and several interior or exterior lamps can be controlled if necessary. It may be useful, for example to switch on the reversing lights for this short time.

The main 12 V supply to the 555 circuit must be taken from a point in the wiring which is not switched off when the ignition switch is turned off—one obvious point is the wire which supplies the ignition switch, or the live lead to the interior light. There must also be a connection to the switched side of the ignition switch and from the relay contacts (open when the relay is not energised) across one of the door switches (Fig. 6).

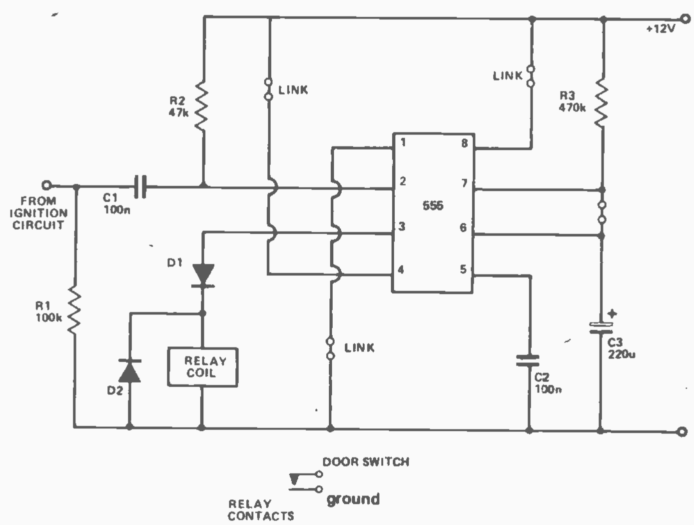

Fig. 6 A delay lamp circuit with a fixed delay of about 1½ minutes.

The action of the circuit is like this. When the ignition is switched off, the voltage across R1 drops to zero, and momentarily causes the voltage at pin 2 to drop to zero until C1 charges. This is enough to cause the 555 timer to trigger, so that the output on pin 3 goes high, activiating the relay and so turning on the interior light. After the timed interval, determined by the values of R3

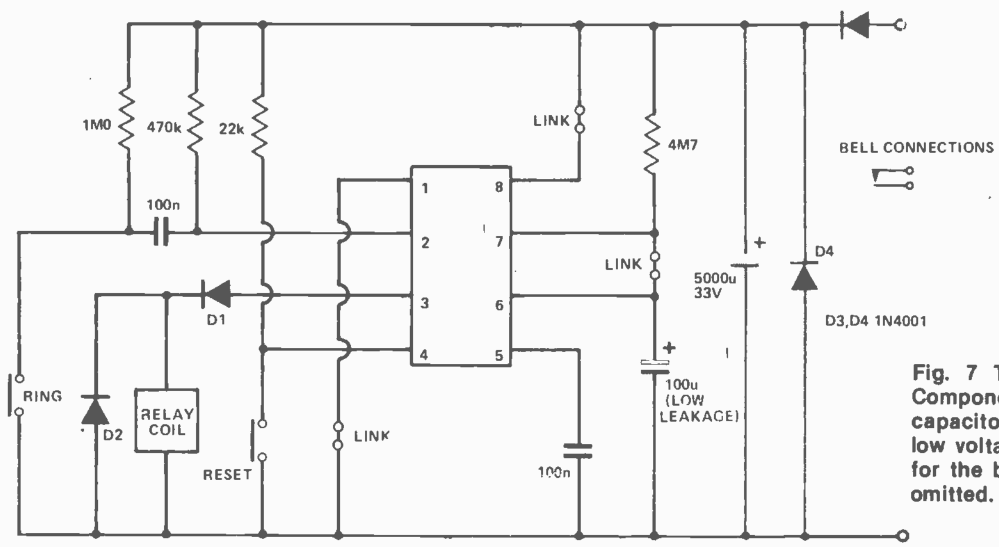

Fig. 7 The long-ring door-bell circuit Components D3, D4 and the 5,000 uF capacitor is needed if the bell supply is low voltage AC. If a DC supply is used for the bell, these components can be omitted.

and C3, the circuit switches back, the voltage at pin 3 goes low again, and the relay returns to open circuit, switching off the interior light.

RINGING THE CHANGES

Now for a different door-bell. This is a circuit (Fig. 5.7) which turns an ordinary door-bell into something that can't easily be ignored. When the bell-push is operated, the 555 timer is triggered, operating the relay and so ringing the bell. The bell will then ring for the time set by the timer, or until the reset switch is operated from inside the house. The circuit can be powered from the same supply as the bell if the bell is DC operated, otherwise a separate supply can be used for the timer. Once again, diodes D1 and D2 are used to protect the 555 from the effects of turning off the relay. If you're not too keen on your present doorbell, you might want to combine this circuit with one of the tone-generator circuits (later), so that the door-alarm becomes a purely electronic device.

These circuits should give you a pretty good idea of how the 555 timer can be used in timing circuits, but that is by no means all that we can do with this very versatile IC. Fig. 5.8 shows a pulse generator, a useful circuit for testing digital circuits or even for testing 555s themselves. The circuit generates pulses from any input wave whose amplitude is large enough to trigger the input. Souces such as a sinewave generator, a microphone and amplifier, or the secondary winding of a low-voltage transformer can be used.

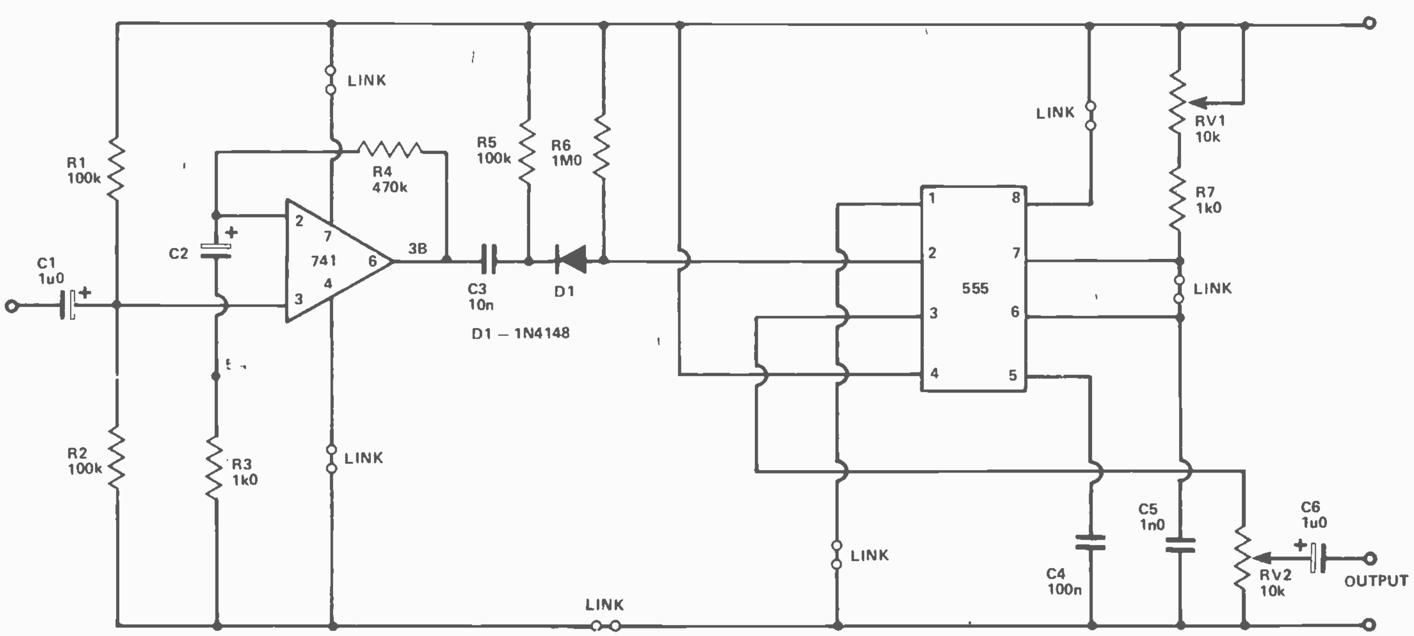

Fig. 5.8 The pulse generator. The imput is a signal which can be a sinewave or any other waveform. The output is a series of pulses at the same frequency as the input wave. RV1 controls the duration (width) of the pulse, and RV2 controls the amplitude of the output.

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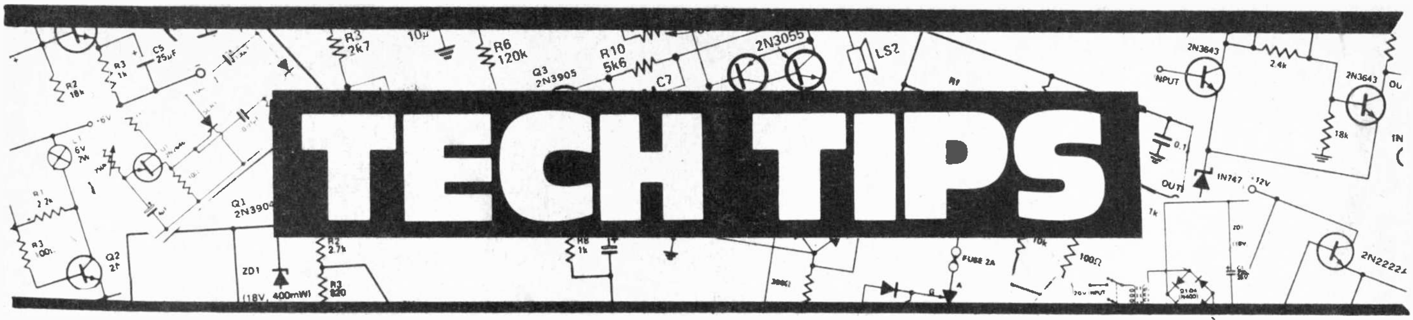


Fig. 1

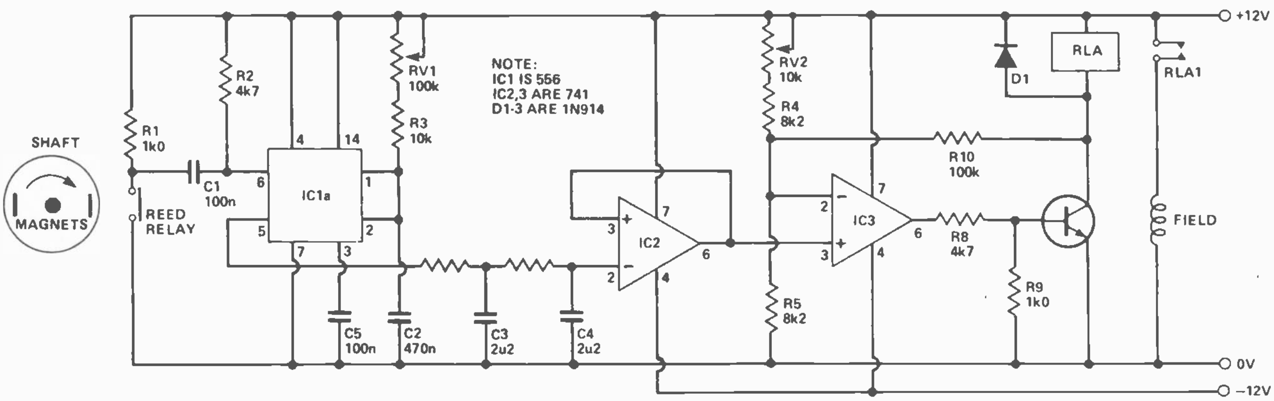


Fig. 2

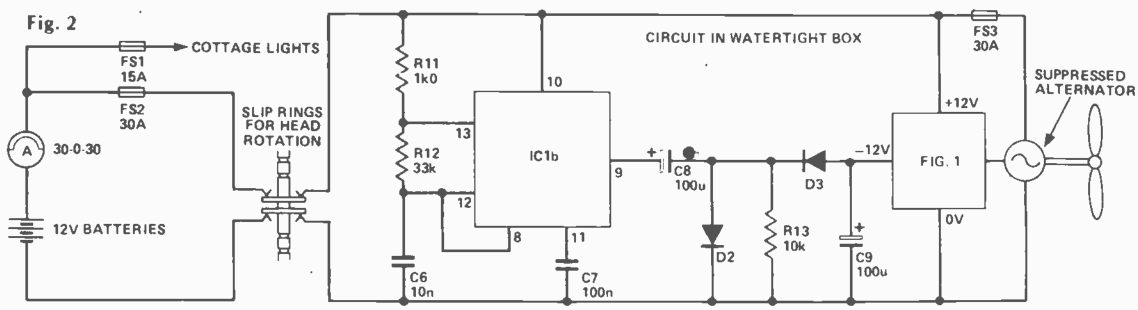
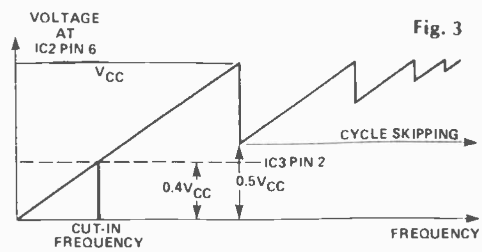


Fig. 3



Control Wind-power Circuit

E.A. Parr

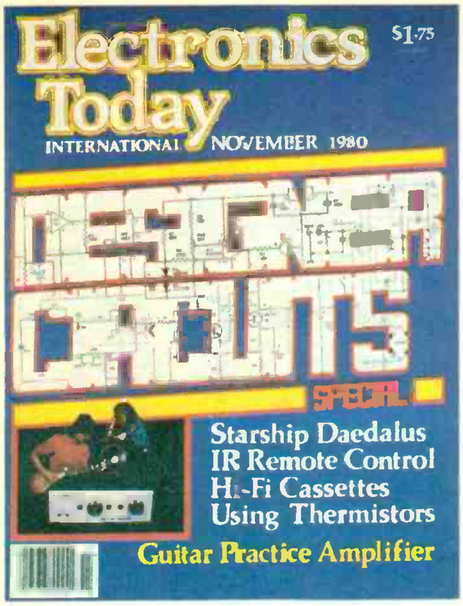
This circuit was designed to control a windmill at a remote holiday cottage. The cottage's electrical supply is derived from 12V batteries which are recharged by an alternator driven by the windmill. The field on an alternator draws about 1A when the battery is not being charged, and the circuit was designed to cut out the field when the windmill speed is too low to permit charging.

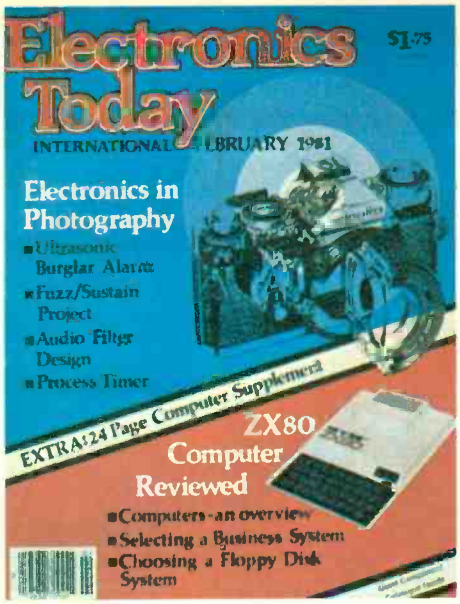
The windmill speed is measured by two magnets on the shaft which pulse a reed relay. This in turn fires the 556 monostable IC1 as shown in Fig. 1. The output from IC1 is thus a constant width pulse train whose frequency is determined by the windmill's rotational speed. This is smoothed by the two stage filter R6-C3-R7-C4 and buffered by IC2 to give a DC voltage at pin 6 of IC2 which is speed. This is compared with a preset voltage by IC3 and used to switch the field relay via Q1. R10 provides hysteresis, necessary because the windmill speed drops slightly as the alternator comes on load.

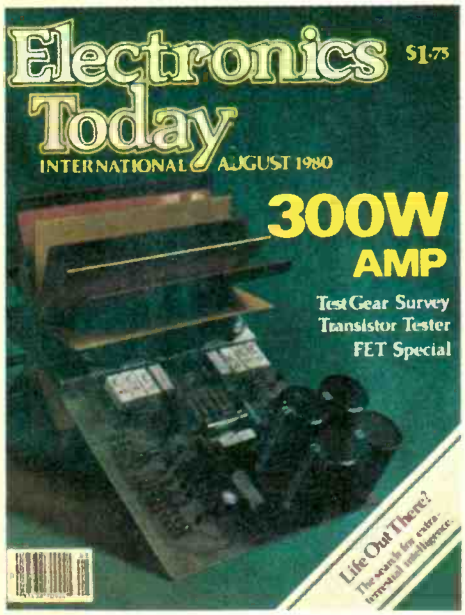
For IC2 and IC3 to work properly, a negative supply is needed. To provide this from the single 12V battery supply, the simple DC-to-DC inverter shown in Fig. 2 was necessary. This utilises the other half of the 556 and gives a low current -12 V supply.

The voltage at pin 6 of IC2 is proportional to speed until the period of the monostable is equal to the rate at which the reed relay is pulsed. At frequencies above this, the voltage falls due to cycle skipping, giving the output voltage versus frequency graph of Fig. 3. As a windmill operates over a wide frequency range, it was expected that cycle skipping would occur at high speed. This is, however, of no importance if the trigger voltage is set at 40% of V_{CC} giving a single, unambiguous cut-in point.

The coarse cut-in point is set by RV1, and the fine by RV2 (subject to the comments in the preceding paragraph). the circuit was designed for a cut-in speed of about 400 RPM which suited the windmill/alternator combination. The circuit draws minimal current from the battery, therefore allowing the windmill to be left to its own devices while the cottage is unattended.







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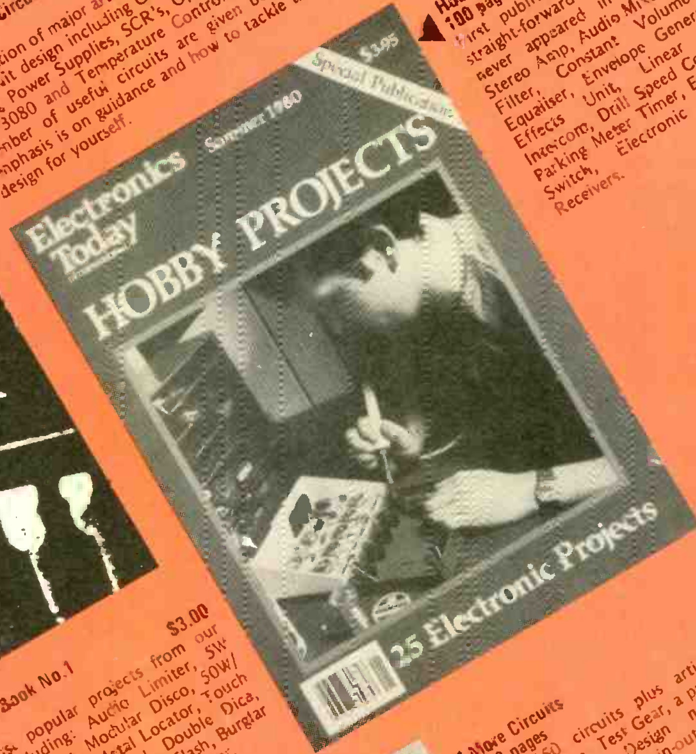

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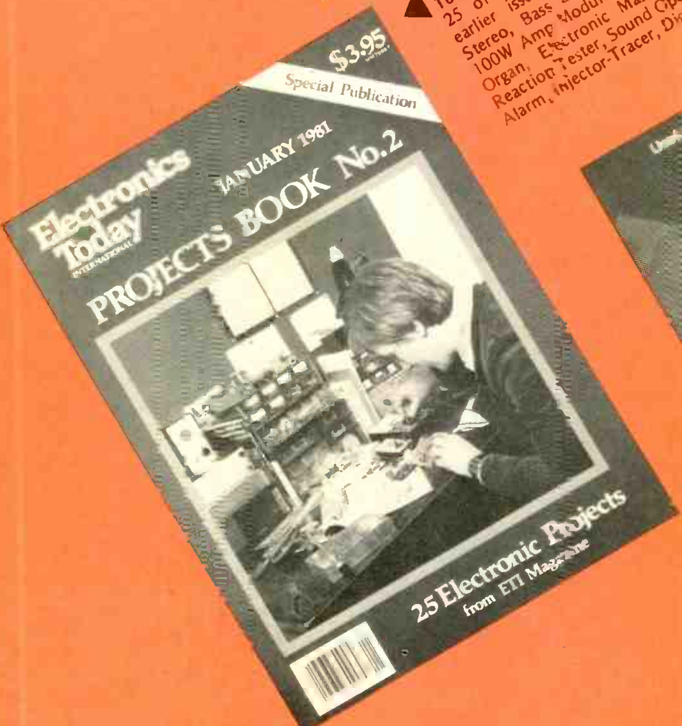

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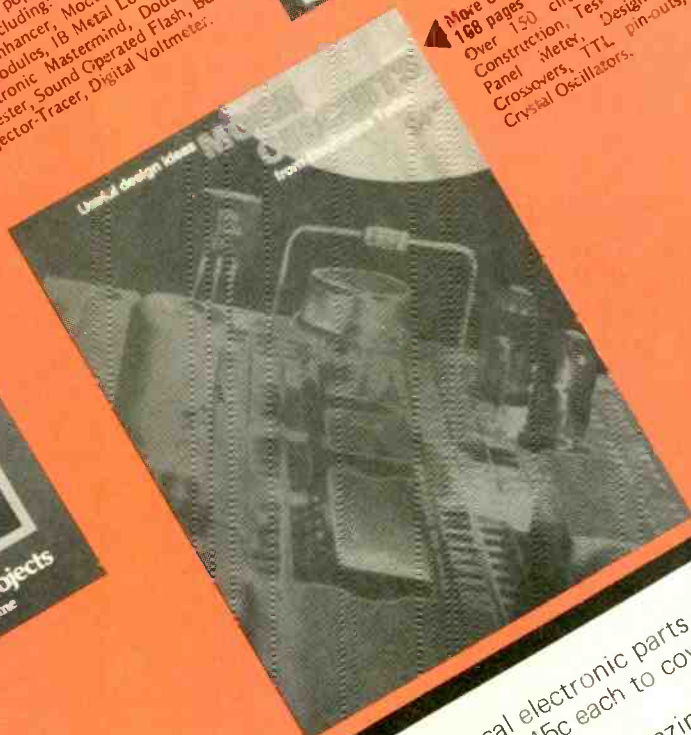

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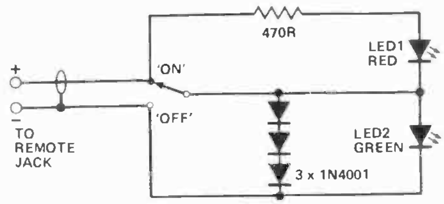
Indicating Remote Switch For Cassette Recorder

P.F. Taylor

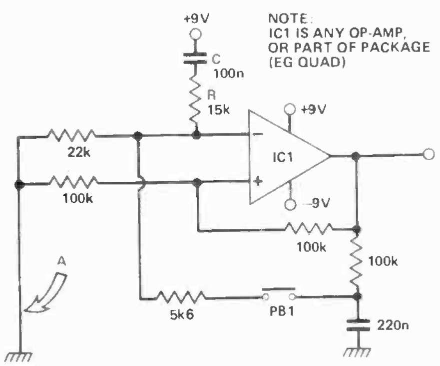
This circuit adds visual indication to a remote on/off switch for cassette recorders. When switched to 'off' the cassette motor will not turn, but provided the 'play' button on the recorder is depressed, a path exists for sufficient current to light the red LED1. If the LED will not light then warning is given that the recorder is not ready; if it lights, then the recorder is ready. When switched to 'on', motor current passes through the three 1N4001s, dropping sufficient volts to power LED2 (green), indicating that the cassette motor is turning. When the tape reaches the end and automatically shuts off, the green LED goes out.



The price paid for this indication is a reduction of about 1V5 in the effective cassette power supply, but on AC supply or with relatively new batteries this should cause no problems. The components can, with, care, be fitted into the spare room in the sort of remote cassette switch box available widely in stereo stores.

Single Push-button Op-amp Flip-flop

T.J. Hill



This circuit will be of use to constructors who find that while designing a circuit with quad op-amps, they have only one spare op-amp in their packages.

Upon switch-on, the CR combination at the inverting input takes the output to -9V, the non-inverting input causing the output to switch to 9V.

Even if the push-button is kept depressed, the circuit will not oscillate because the non-inverting input will now become 4V5, and the inverting input (22k/127k6)x9 = 1V55. When the push-button is released the 220n capacitor can then charge fully to the op-amp output of 9V and the non-inverting input falls to 0V.

The circuit will maintain this new state until the push-button is pressed once again, when the reverse will occur taking the op-amp output back to -9V.

There are two further points; the CR combination may be taken to the -9V terminal to allow the op-amp output to become 9V upon circuit switch-on. This circuit may also be powered from a single rail power supply if point A is connected to a voltage divider comprising two resistors of 4k7 between the battery positive and ground, giving approximately positive and ground alternating states.

Continued from page 31

HOW IT WORKS

The circuit comprises three main sections, these being a thermal switch (TH1-PR1-R1-R2 and IC1), a sample pulse generator (IC2 and Q1), and an alarm generator (IC3 and Q2). The thermal switch circuit is quite conventional: TH1-PR1-R1-R2 are wired as a simple bridge across the inputs of voltage comparator IC1. The action is such that the output of IC1 is normally low (at 0V) but switches high when the TH1 temperature falls below a value preset by PR1 (the circuit can be made to give over-temperature switching by transposing the TH1 and PR1 positions). If this conventional circuit were powered from a continuous DC source, it would draw several milliamps of quiescent current.

The sample pulse generator circuit is designed around IC2, which is configured as a special micropower oscillator and produces a 300 us pulse at pin 12 roughly once every second. This pulse is used to connect power to the IC1 thermal switch circuitry via emitter follower Q1, thus reducing its mean current consumption by a factor of 3000 relative to the 'normal' DC value. Thus, if the TH1 temperature is above the preset alarm level on the arrival of the sample pulse, the IC1 output (pin 6) will be low and no charge will be fed to C1 via D1, but if the temperature is below the preset level the output of IC1 will switch high for the duration of the sample pulse, rapidly charging C1, the C1 charge is used to activate the IC3 alarm generator circuitry.

IC3a-IC3b are connected as a gated 6Hz astable, with the output fed to the input of 1 kHz gated astable IC3C-IC3d; IC3d has its output fed to an external speaker via VFET power amplifier Q2. Thus, when the C1 voltage is zero, the two IC3 astables and Q2 are cut off and the alarm generator circuitry consumes zero quiescent current, but when the C1 voltage is high the 6 Hz astable is gated on and pulses the 1 kHz astable on and off, generating a powerful pulsed-tone alarm signal in the speaker. The supply to the major sections of the circuit is decoupled from LS1/Q2 transients by D3 and C3.

This over - or under-temperature alarm consumes a mere 3.5 uA of quiescent current, yet the alarm delivers 1W of peak audio power. ETI

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R1,2,11	100k
R3,8	33k
R4,13	10k
R5,6,7	10M
R9	220k
R10	1M0
R12	68k

Potentiometers

PR1	10k miniature horizontal preset

Capacitors

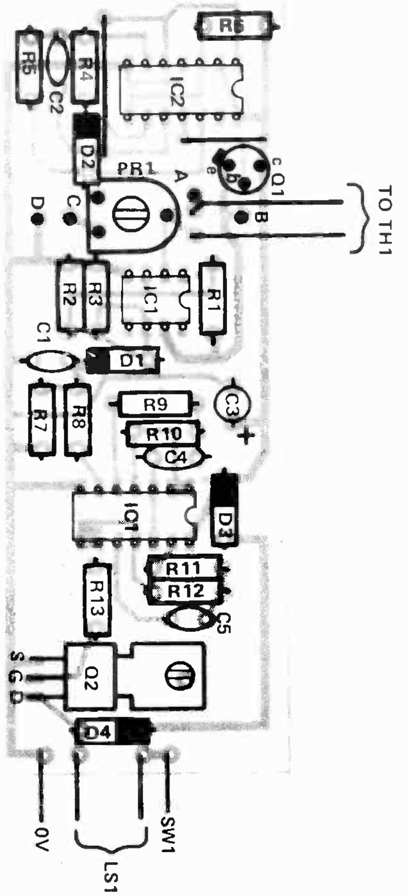
C1	470n 16V tantalum
C2	47n ceramic
C3	47u 16V tantalum
C4	100n ceramic
C5	10n ceramic

Semiconductors

IC1	CA3140
IC2	4007UB
IC3	4011B
Q1	MPS6515
Q2	VN66AF
D1,2	1N4148
D3,4	1N4001

Miscellaneous

TH1	VA1066S
SW1	SPST miniature toggle
LS1	64R loudspeaker
TX1	PB-2720 (optional)
PCB.	



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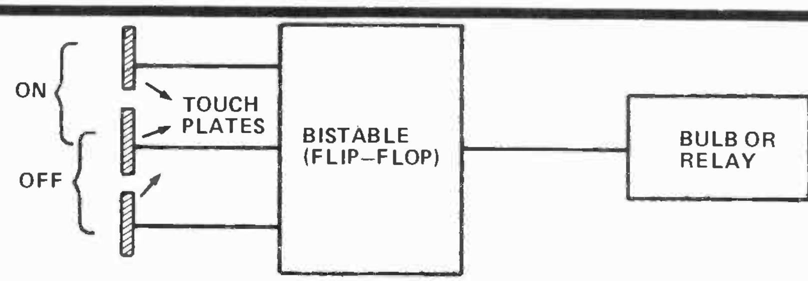
HOW IT WORKS



The Touch Lamp circuit consists of a simple bistable. A common name for a bistable is a flip-flop, and this helps to explain the action of the circuit.

When the top two touch plates (the ON plates) are touched, the bistable is turned on and its output voltage goes positive (i.e., it 'flips') and stays in this state.

When the lower two touch plates (the OFF plates) are touched, the bistable is turned on and its output voltage goes to zero (i.e., it 'flops').

The output of the flip-flop is used to turn a bulb or a relay on and off.

When power is first applied, the circuit takes up a state where transistor Q1 is biased into conduction by way of the load and resistor R1. This gives practically 0V at the drain terminal of Q1, and transistor Q2 is therefore cut off as it receives no significant bias voltage via resistor R4. Both transistors are VMOS types and are therefore voltage operated — unlike ordinary bipolar devices which are current operated.

If the two 'ON' touch contacts are activated, the skin resistance of the operator is placed between Q2's gate and the positive supply rail. Although this resistance is almost certain to be very high, the high input impedance of Q2's gate ensures that the gate of Q2 is taken a few volts positive so that Q2 is biased into conduction. The load is therfore switched on.

Transistor Q2's drain terminal is now at a very low potential, and is further reduced by the voltage divider action of resistors R1 and R2 so that Q1 now becomes switched off. The voltage at the drain terminal of Q1 thus rises to virtually the full positive rail voltage, and Q2 will be biased into conduction by way of R4 when the operator's finger is removed from the touch contacts. This latches the circuit in the 'ON' state.

The circuit can be returned to the 'OFF' condition by touching the two 'OFF' contacts. The places the skin resistance between the positive rail and Q1's gate so that Q1 is biased into conduction. Its drain voltage falls back to almost zero so that Q2 and the lamp are both switched off. Transistor Q2's drain voltage rises to almost the full positive supply voltage again so that Q1 is latched in the on state as a result of the bias voltage received via R1. Thus the circuit stays in this state with the lamp switched off when the touch contacts are no longer operated.

The circuit can obviously be triggered from one state to the other indefinitely by operating the appropriate pair of touch contacts, and capacitors C1 and C2 are used to filter out any electrical noise which could otherwise produce spurious operations.

VMOS devices require no significant input current and will work at very low drain currents. This makes possible a circuit having a low stand-by current: the quiescent current consumption of this circuit is typically only about 1 uA.

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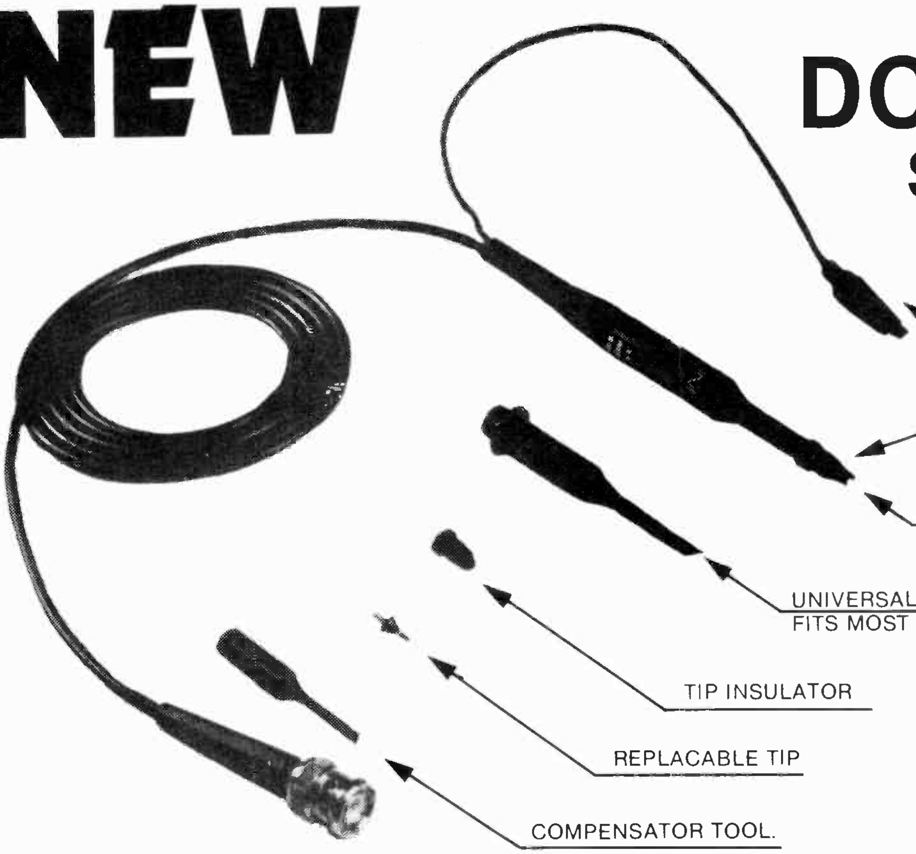

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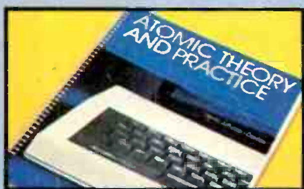

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