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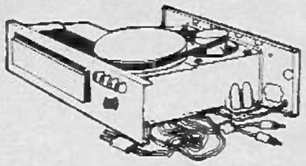

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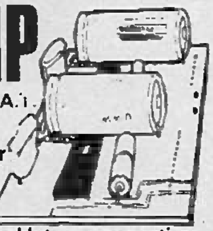

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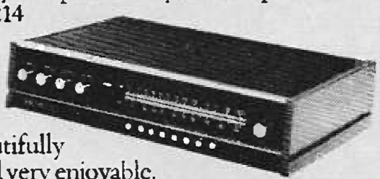

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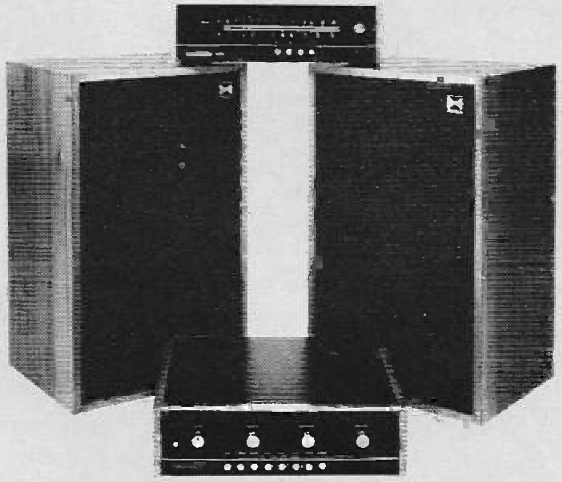

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NOVEMBER 1974 Vol. 3, No. 11.

main features

projects

product tests

news & information

Cover: Artist's impression of the Mariner Venus/Mercury fly-by probe which gave successful results earlier this year. Photo courtesy of NASA — see page 10. Also our Add-on SQ decoder amplifier — see page 54.

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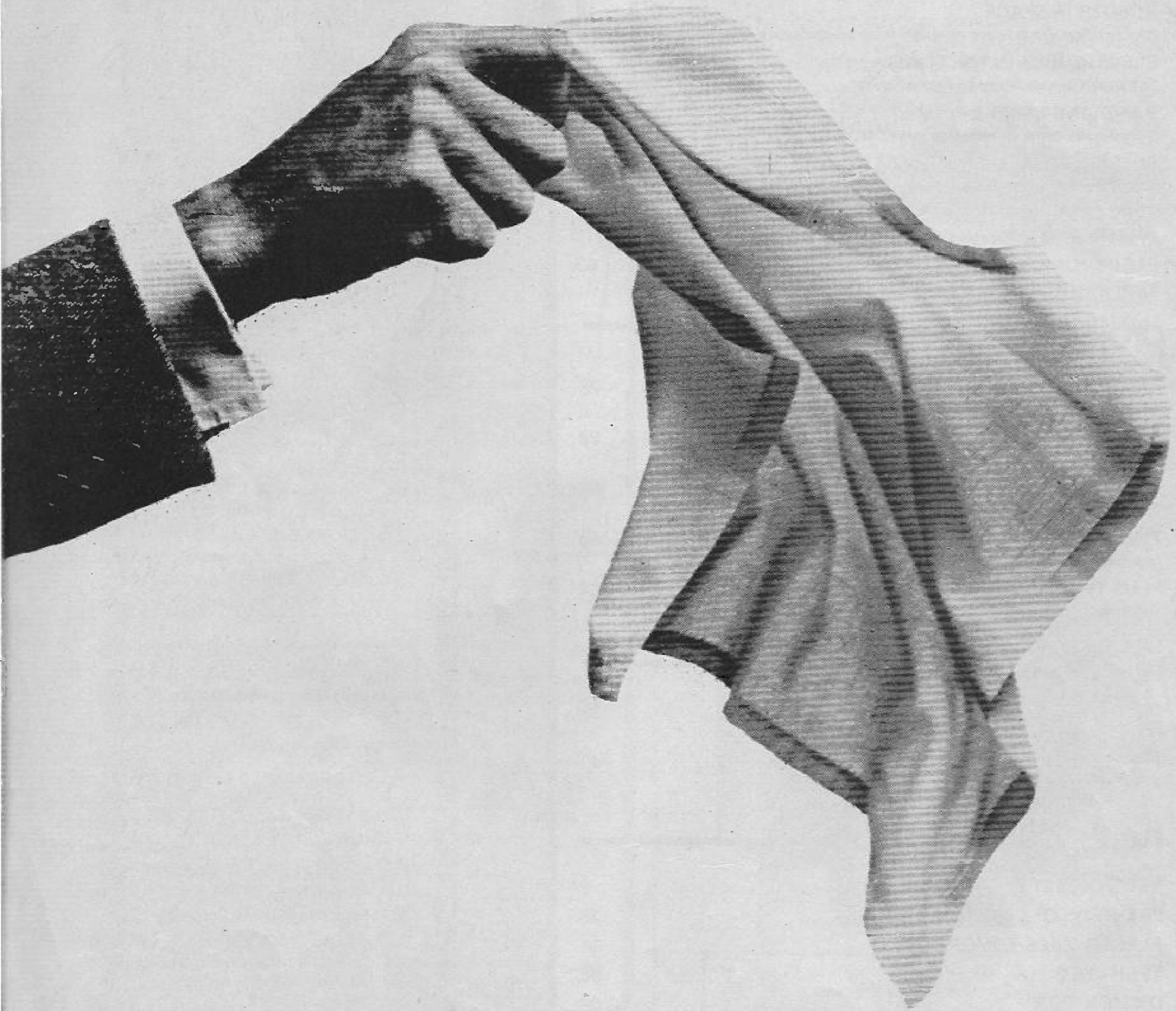
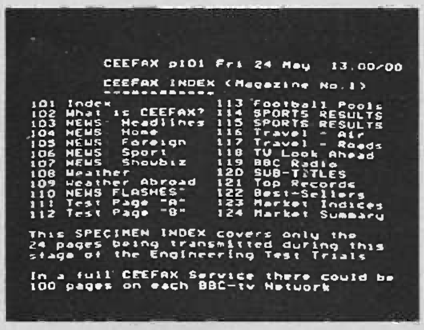
DETAILS OF THE ETI TOP PROJECTS BOOK ON PAGE 34

Goodbye to the long wait



news digest

CEEFAX



"UNIFIED SYSTEM" ON THE AIR (CEEFAX AND ORACLE)

Regular transmissions of live broadcasts as part of the BBC's Ceefax Service experiments started on 23rd September.

The IBA have applied for permission for their Oracle service.

In July's News Digest we described how the two systems, the BBC's Ceefax and the IBA's Oracle were amalgamated to give a "Unified System", the names Ceefax and Oracle now refer to the services.

Ceefax (from seeing facts) is an information service whereby a television receiver can display screen-size pages at the touch of a button. The viewer can switch quickly from his normal programme to any of up to 100 different pages in a 'magazine', with each page providing about as much information as a paragraph in a newspaper.

The viewer will have a small push button unit with which to select their number: Page 1 the index page, Page 2 news headlines, maybe, Page 6 weather and so on.

The coded information is hidden on two television lines which are not used in the picture, lines 17,18,330 and 331. The extra receiving circuits can pick out the information, decode it and then display the complete Ceefax pages.

Ceefax can also be used to superimpose sub-titles on the normal programmes. This could be useful for the deaf or could give an alternative language version of the programme sound. In a similar way the viewer could choose to have news-flashes automatically displayed as soon as they were transmitted.

Receiver designers will be able to choose to display the information in either capital letters or capital and lower case letters while other refinements can allow simple maps and diagrams to be shown and different parts of the display to use different colours.

Every page can have up to 24 rows of information with up to 40 characters in each row. The shape of the characters will depend on the receiver design but the system is tailored to a 7x5 shape, that is where each letter, number or symbol is made by lighting up groups of dots in a rectangle 7 dots high and 5 dots wide.

The first row of every page is a special row called the 'page header'. The page header will show the page number, the date and the time to the second. The Ceefax receiver will recognise signals transmitted at the beginning of the header row so that it can tell when a page is beginning and what page it is. When the signals match the orders given by the viewer through his page selector the receiver will display the header row and the text which follows it.

The pulses are added to two lines in the field blanking period of the TV waveform (lines 17 and 18 in one field and 330 and 331 in the next). Each of these lines carries the coded information for one row of the display. Thus with two lines available from each TV field it will take 0.24 seconds to transmit a full page with 24 rows. So a magazine of, say, 60 pages will take around 15 seconds to transmit. Because complete pages are transmitted one after the other, it may take some 15 seconds after pushing the selector buttons before the required page appears on the screen. In order to limit the waiting time the length of a magazine will probably be limited to 60 full pages rather than the 99 which are possible. However if some of the pages have several blank rows, then it will still be possible to have more than 60 pages but still remain within the 14 or 15 seconds needed to complete a magazine.

Good Ceefax reception will be possible wherever good uhf 625-line pictures can be received but one difference between receiving Ceefax and ordinary TV is that where effects like ghosts or interference each have a characteristics appearance on ordinary TV with Ceefax these effects may cause errors in the display.

PROGRAMMABLE CALCULATOR KIT

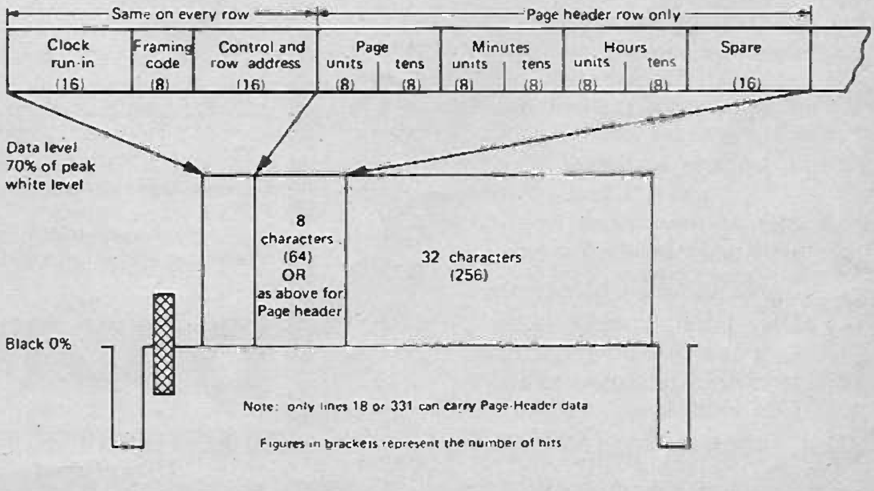
The world's first kit for a fully programmable calculator is being offered by Advance Electronics. Limited for £99 (plus VAT). The kit, which can be assembled in a matter of minutes without any special tools, is based on the established Advance 162P desktop calculator.

This calculator has an advanced specification including the facility to enter and obtain answers to 16 digits, two-key 'rollover' permitting very fast sequential entry of data, two independent accumulating memories, square-root and percentage keys, algebraic logic, and key-sequence entry of up to 40 program steps for carrying out routine repetitive calculations.

BIG NUMBERS

Two or so years ago the US Unicon company announced production of a trillion-bit laser memory. This extraordinary device operated by burning tiny holes in a thin metal film. At $US1.7 million it was something of a bargain but nobody seemed to need that many bits.

A smaller version of this device has now been announced by Precision Instrument Co. (Santa Clara.). The new



The organization of CEEFAX data on lines 17, 18, 330 and 331 device is available with capacities as 'low' as 200 megabytes. Prices begin at US$400,000.

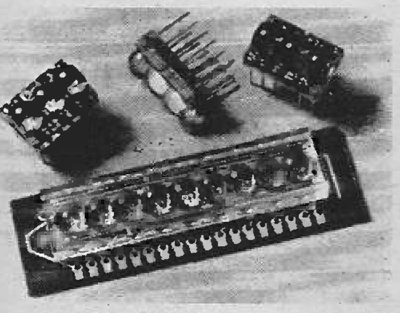
BUBBLE MEMORIES

Japan's Ministry of International Trade and Industry are subsidizing a number of Japanese companies in their quest to produce bubble memories.

Hitachi have developed a 17 k memory on a 6.5 by 4.4 mm chip and NEC-Tohoku Metals have produced a 2400 bit chip.

Ultimate aim of the project is to produce a chip suitable for a mass filing system with 10 megabit capacity and 0.1 ms access time. To do this successfully chip size will need to be about 100 000 bits.

CALCULATOR DISPLAY



Litronix have a new pre-aligned PCB - mounted numeric display. Intended primarily for hand-held calculator applications, the DL-95 can be supplied either as an 8-digit display with a left-hand minus sign, or as a 9-digit display without polarity indication. The digits, which are slanted at 10°, have a magnified height of 0.1in. on 0.2in. centres, and include a decimal point.

The DL-95 features an integral moulded lens with good off-angle viewing, low profile and low power consumption, and has been designed to meet current industry standards. To an amateur constructor the display would cost £6.90, but the large quantity price is of course much less.

DOPPLER RADAR MODULE

A small doppler radar module for use in systems designed to detect movement manufacturerd by Mullard is available from Edmundson Electronic Components. The CL8960 is a little bigger than a matchbox although containing an antenna with a beam angle of 140° in the horizontal and vertical planes. An intruder detector is formed by adding an a.f. amplifier, signal-processing circuits to prevent false alarms, and a relay to sound an alarm or operate a warning light.

The module has two cavities so that an improved signal-to-noise ratio can be achieved, one being the microwave generator which gives an output of typically 8mW; the other cavity is the mixer. With a return signal 100dB below that transmitted, and a signal-to-noise ratio of 18dB, the mixer gives an output of 40μV. This enables a man to be detected fifty feet away. With the wide beam angle, intruder detectors using the module give protection over an extensive area and in a large volume.

The CL8960 has many other applications besides detecting intruders (including speed measuring equipment and counting systems). The module operates with a d.c. power supply of 7V. The price is £20.00.

FARADAY LECTURES

This year is the 50th anniversary of the foundation of the Faraday Lectures, organised by the Institution of Electrical Engineers. Desmond H. Pitcher, FIEE, is to give the 1974/75 series on the subject 'The Social Computer'.

Mr. Pitcher will outline the basic workings of computers with live demonstrations and automated displays, but rather than go into depth on computer technology, will discuss how computers affect our everyday life and save time right across a man's life span.

He says, "The impact of computers on almost every aspect of life today means they attract widespread interest - but are not always fully understood. They are therefore a very suitable theme for the Faraday Lectures which have a tradition, established over half a century, of projecting electrical technology to the layman in comprehensible terms. We hope to dispel any mystery which still surrounds the computer and to show how it has already improved man's living standards and will continue to do so in the future".

This year's Faraday Lecture will be presented in fourteen diffrent cities throughout England, Scotland and Wales, during the period November 1974 to March 1975, to an invited audience. In all, thirty four lectures will be given.

CLOCK CHIP

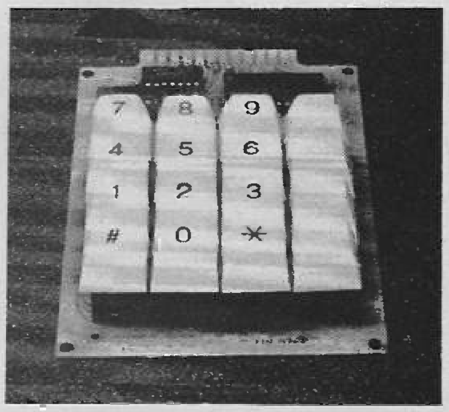
A new 4-digit clock circuit is available from Semicomps Ltd. Designated the AY0501224, the IC contains all the logic necessary to make a 4-digit, 12/24hr clock operating from 50 or 60Hz.

The clock is in a 16 pin package. Outputs can be selected to be BCD or 7-segment. The latter will directly drive an LED display. There is an on-chip multiplex oscillator (one external 650pF capacitor sets the operating frequency). A single half-wave rectified supply of 15V is all that is required for the whole system.

Leading zero suppression is incorporated for the 12hr mode as well as interdigit blanking for ¼ of the digit time, enabling gas discharge displays to be used. A complement pin allows polarity inversion of the BCD and segment outputs. The 100-up price is £3.20.

ENCODED KEYBOARDS

Tekdata Ltd are newly offering a family of fifteen American manufactured small encoded keyboards. Ten, twelve or sixteen keys are avilable and three ME switch patterns: Type LM Gold V-bar switches, with low profiles and close mounting centres for hand-held keyboards; Type LFW Gold V-bar full-stroke switches that have mechanical spring-on-spring action, available either in push-button version or with moulded keytops; or Mercutron full-stroke mercury switches with sealed contacts giving more than 50 million operations.



Each keyboard has a Harris HD-1065 keyboard encoder, giving a 4-bit parallel output and 2-key roll-over. All outputs are bounce-free and TTL-compatible. The keyboards are initially coded in BCD, but the coding can be altered in the field, if desired. In addition these keyboards are available with single line (uncoded) outputs.

VIDEO DEVICES

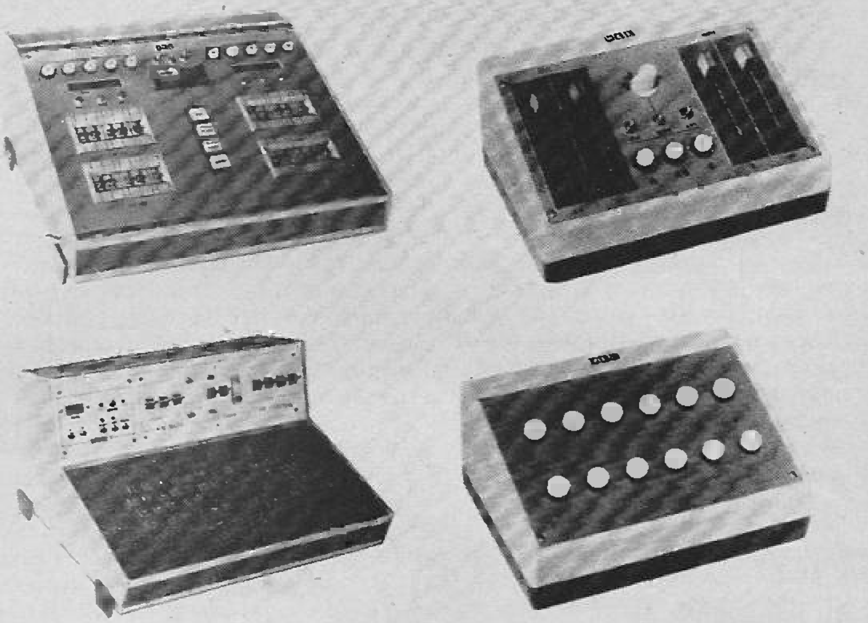
Four new items of video equipment have been introduced by Video Electronics Limited.

Videotape editing can be achieved with the ESI timecode editing system. This mini-computer has direct plug-in interface to remote control a pair of helical scan 1 inch editing VTRs (such as the IVC 800 series), and is used with two standard VEL TC1 5 digit timecode units.

The operator can select, insert, assemble or live editing modes and the built-in rehearsal facility allows him to preview the edit before recording. When the timecodes have been entered, the ESI takes over all time calculations and sequence controls to achieve a fully automated edit. It costs £1100.00 (+ VAT).

The VEL Minimixer is a low-cost A/B mixing and special effects generator built to broadcast colour specifications. It offers extremely flexible facilities for cross-mixing, fades to black, superimposing, horizontal/vertical and corner wipes, internal and external keying, and all possible combinations of these processes covering all TV production needs. Vertical interval switching and black level clamped inputs are standard features, and the unique built-in pulse regenerator has outputs available to slave remote cameras so that captions, split screens, mixes etc. can be added to existing videotape material without the use of other studio facilities. The Minimixer costs £330.00 (+ VAT).

Thirdly, there is the KCG1 keyboard caption generator, an advanced, self-contained unit offering instant interface with existing television systems and monitors. The built-in microcircuit pulse generator allows the unit to be used alone or genlocked to any normal composite video signal.



Top left: The Videotape editing unit. Top right: The VEL Minimixer. Bottom left: The caption generator. Bottom right: The VEL Miniswitcher.

Its two-page facility permits full-page messages or singlerow "titles" to be prepared, edited, stored and transmitted in conventional TV signal form. Alphanumeric characters are shown against a dark ground or superimposed on to external monochrome or colour signals. A single row of characters may be selected at random and positioned anywhere on the picture with a switchable choice of character size. Individual characters may be flashed or underlined. The KCG1 costs £760.00 (+VAT).

The quartet is completed by the VEL Miniswitcher, a miniature vision switch unit designed to colour specifications. Completely self-contained, it has six video inputs and two switch banks each with momentary-actions, electronically interlocked and illuminated switches operating during the vertical interval. It costs £270.00 (+ VAT).

TEPIGEN

Tepigen, a computer-controlled television picture generation system developed by Marconi at Leicester, made its first public appearance at the Farnborough International Air Show. The equipment, initially designed for training television-guided-weapon aimers, has many applications in the simulator field. Tepigen dispenses with the television models or film used in conventional simulators and represents a major advance in simulator design techniques.

Tepigen synthesises television pictures directly from a computer. The objects in the picture are defined three-dimensionally and can be shown in any attitude or size. They can move independently, relative to each other and relative to the background. Three main elements comprise the Tepigen system - a scenaric computer, a television picture generator and a television display.

The scenaric computer, as its name implies, lists all the elements of the scene to be depicted, each element being listed together with its location and orientation. This list is passed to the picture generator which converts the digital words into video signals for display in black and white or colour. The picture generator obtains the dimensions and shapes of the objects in the scene from its backing store and 'visualizes' these in their appropriate relationship with closer objects obscuring those behind.

The entire picture is updated at an animation rate selected for the particular application between the limits of 10 and 50 frames per second.

MARTIAN MEADOW

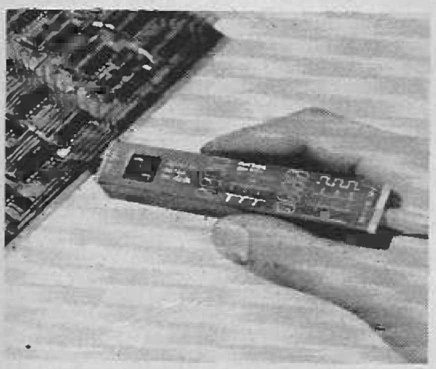
This eerie landscape is actually the surface of a tungsten electrode, magnified 2,500 times by a scanning electron microscope. The photomicrograph was taken at the G.E (U.S.A) R & D centre as part of research into improved ways of making high intensity lamps.

LOGIC PROBE

For determining which switched state exists in 12V or CMOS circuitry during development, testing and servicing work, a new digital logic probe with quasi-oscilloscope display has been introduced by Wandel & Goltermann Ltd.

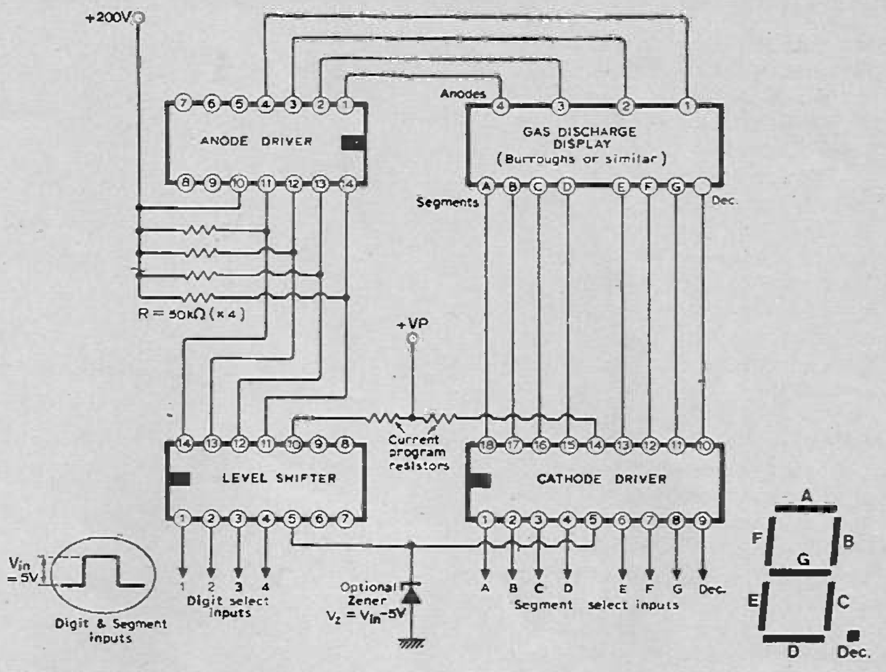
The same general layout and size of the TKL-5, introduced in 1972, the new instrument, the TKL-12, fits easily into the hand and produces at a glance an indication of results. Level "high" and "low" are indicated and threshold values are adjusted to be less than 0.3 supply voltage for "low" and more than 0.7 supply voltage for "high". If necessary, these values can be readjusted.

A checkpoint in the indication field is illuminated as soon as the probe is ready for operation. Additionally this point serves as a reference for level indication. No indication means an open input or that the potential being sampled is in the "forbidden range" or that the input has not been taken from the correct measuring point. Protection is provided against reverse polarity.



By means of the quasi-oscilloscope display, pulses can be easily verified. Differences can be observed between pulses at high and low levels, pulses at a duty cycle of 1:1 and pulses at duty cycles both >1 and <1. This estimation of duty cycles provides unambiguous results up to a frequency of approximately 0.5MHz.

By resetting the threshold values, 18V logic can also be tested, since the threshold voltage of this logic is 13V.



HIGH VOLTAGE 4-DIGIT DISPLAYS

Walmore Electronics have a series of circuits for driving 4-digit displays. The circuits, which employ a dielectric isolation technology are manufactured in America.

To drive a display, three ICs are required: cathode driver, anode driver and level shifter, as shown in the diagram. The cathode driver has eight outputs: one of each segment of the 7-segment display and one for the decimal point. Two resistors are employed to program the display constant current sources to any value between 0.2 and 2mA per segment.

When MOS devices are employed to drive the display circuitry at drive levels greater than 5V, the zener diode shown in the circuit should be employed to clip the input voltages to the proper level.

Walmore have available three versions of the three ICs for use at different voltage levels. All these ICs are pin compatible and can be used in the circuit given without any other changes. The code numbers for the nine devices are as follows:- **Cathode driver**, D1298N (125V), D1288N (150V), D1278 (175V); **Anode driver**, D1404P (100V), D1403P (125V), D1402P (150V); **Level shifter**, D1264N (200V), D1254N (225V), D1244N (250V).

UK 5

UK 5, the latest scientific satellite in the British collaborative programme with N.A.S.A., is ready for launch in September. This very advanced X-Ray satellite carries experiments provided by British and American researchers and is designed to carry out the most comprehensive investigation yet initiated into X-Ray sources in deep space including phenomena which might shed light on the existence of 'black holes' in space.

The all-British satellite will be launched by a US 'Scout' rocket from the Italian 'San Marco' oil rig type platform situated off the coast of Kenya. It will be the first British satellite to carry a core store system for processing experimental data before it is transmitted to the ground. It will also be the first British scientific satellite to use pulse code modulation for the telemetry link, and to use a system of propane gas jets for the attitude control.

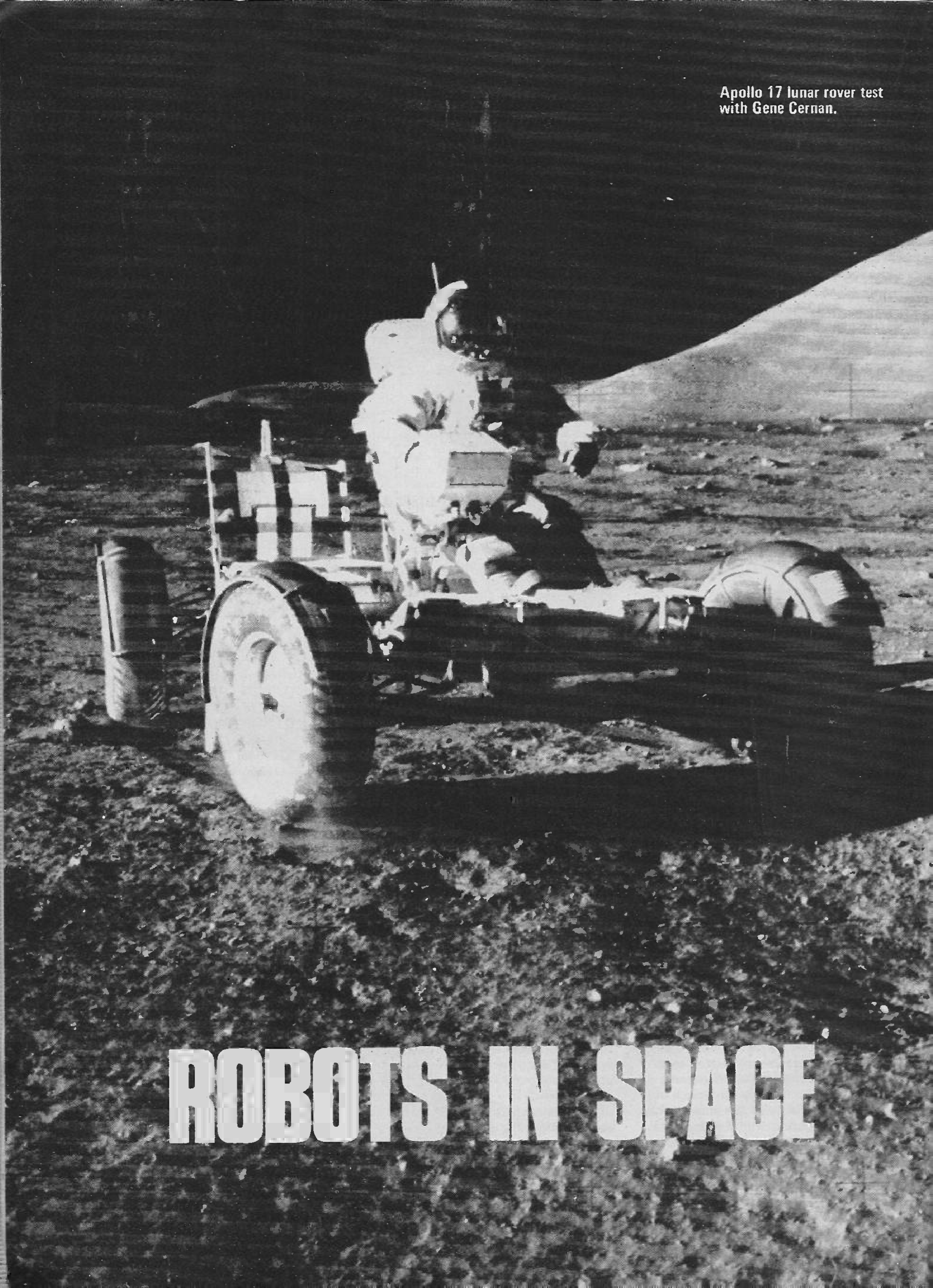
UK 5 will carry a scientific payload of six X-ray experiments into a near equatorial orbit and should remain operational for at least one year. The experiments aboard the satellite are designed to locate cosmic X-ray sources, including pulsars, and to measure their spectra, time, variation and polarization

UK 5 is in the form of a cylinder weighing 300lbs with a diameter of about 38" and a length of 34". Solar cells, mounted around most of the curved surface, will provide power when the satellite is in the earth's shadow. All on-board experiments will be switched off while the satellite is in shadow during each orbit to conserve battery power.

The 'San Marco' launch platform was selected because of its near equatorial location which will enable the rocket to place the satellite in a 500km altitude circular orbit inclined at 3 degrees to the equator.

The satellite will carry a total of six experiments, five designed by British Universities and one by NASA at the Goddard Space Flight Centre.

Continued on Page 69

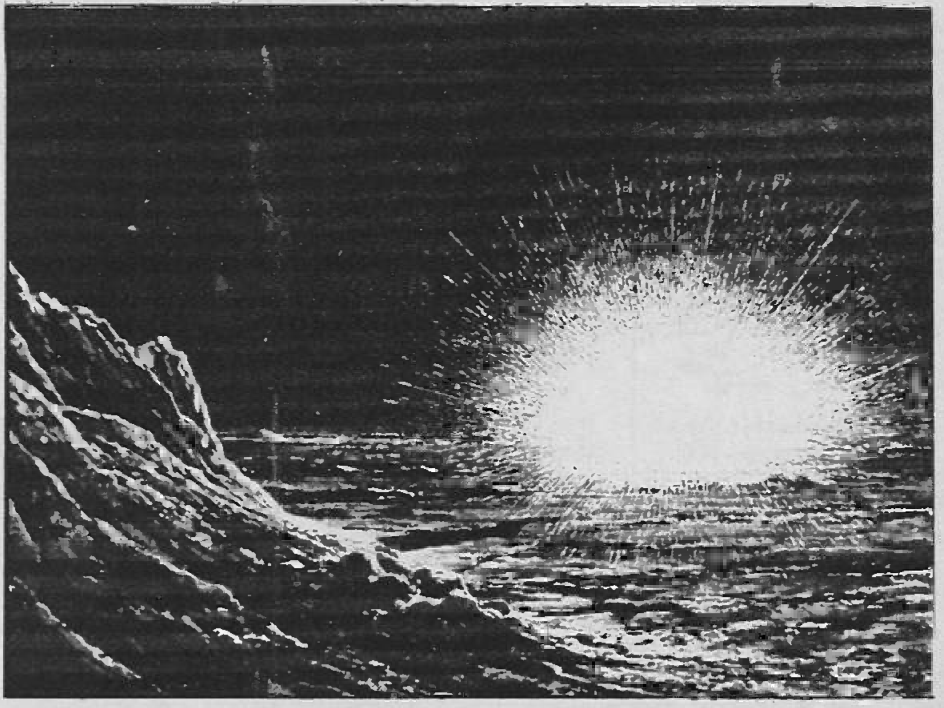


Apollo 17 lunar rover test with Gene Cernan.

ROBOTS IN SPACE

Why send man into space — thinking machines may be better and cheaper.

Sunrise as seen from Mercury's terminator. (Artist's impression).



THE placing of man on the Moon, and the follow-up exploratory trips, including the use of an auxiliary man-carrying lunar vehicle, were magnificent demonstrations of what technology can achieve.

But superb as the achievements were, it is questionable whether *manned* landings at those early exploratory stages were justified for other than chauvinistic reasons.

The addition of the crew and their intricate life-support systems added immensely to the already complex vehicle and instrumentation payloads and necessitated larger boosters for the rocket systems.

Apart from that there was the hazard to the crew during a mission — and the necessity to abort a mission in the event of a life-support malfunction or other similar accident.

Because of these factors NASA commissioned the Martin Marietta Aerospace Division to study the application of adaptive systems for the exploration of the solar system.

The development of adaptive systems is an exciting new technology aimed at simulating human intelligence using machines that can learn, think and make decisions.

NASA's interest has been to examine this field of artificial intelligence, and to identify practical applications for unmanned spacecraft which will be used for solar system exploration in the 1980s.

The study was in two parts.

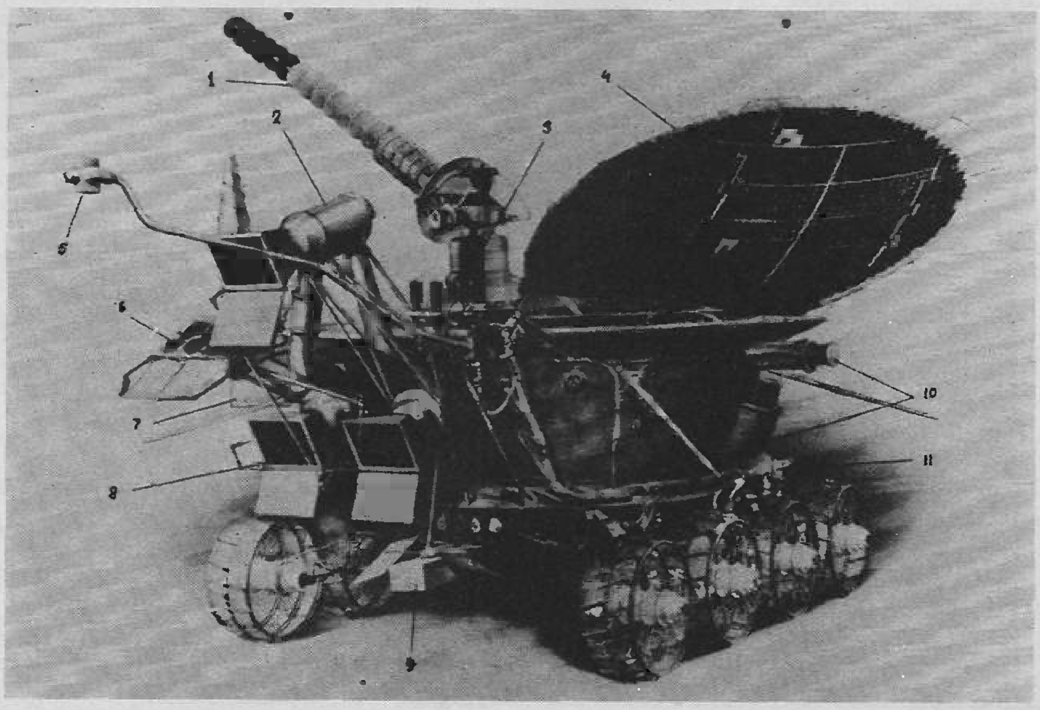
The first was a quick look at a large number of possible solar system missions extending to 1990. The objective was to examine the benefits and feasibilities of adaptive features on these missions, and to determine which missions would benefit the most from further study of adaptibility.

The second, and larger part of the project was directed to three Mars missions. The first an improved version of the Viking lander. The others adding respectively, a small tethered rover and a medium-sized rover with a range of one kilometre.

ADAPTIVE SPACECRAFT AND SYSTEMS

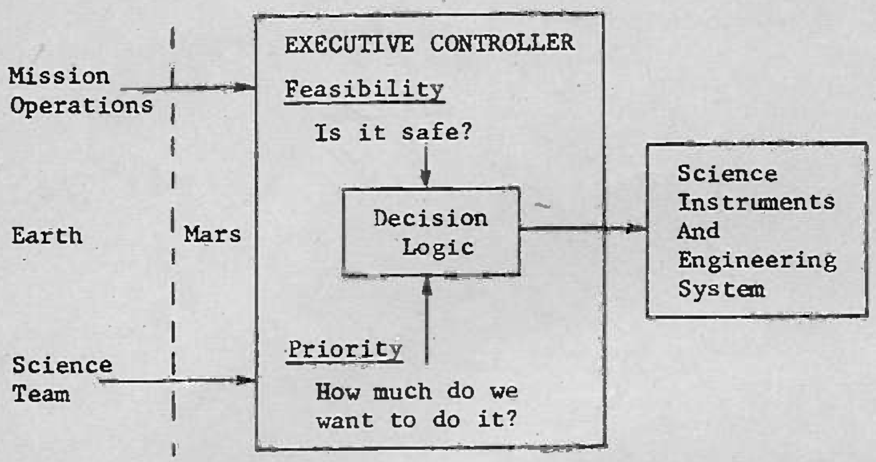
If an unmanned spacecraft can be made to adjust or *adapt* to the environment, to make decisions about what it measures and how it uses and reports the data, it can become a much more powerful tool for the science community in unlocking the secrets of the solar system.

In terms of sophistication, an adaptive system can be extremely simple or as complex as a chess playing machine that learns from its mistakes.



Soviet self-propelled vehicle Lunokhod—2.
1--directional antenna;
2--outboard TV cameras;
3--photoreceptor;
4--solar battery;
5--magnetometer;
6--angular reflector;
7--astrophotometer;
8--TV cameras;
9--outboard Rifma instrumentation pack;
10--telephotometers;
11--vehicle's roadability gauge.

ROBOTS IN SPACE



Typical control system. On-board executive controller monitors data relating to robot's environment, ie, internal and external temperatures, power availability, wind speed, terrain, instrumentation condition etc, it then compares this against stored data relating to mission priority and desirability and then decides whether or not mission should proceed. The robot's decisions can at any time be overridden or modified by earth-based mission operating centre.

At the bottom scale of sophistication are such devices as thermostats — "if the temperature is above X degrees, turn off heater" or "if the seismometer output exceeds Y, increase sampling rate".

In more complex situations, as for example cloud photography — "search sky with optical sensor, if patches of unusual brightness encountered, point camera in direction and make repeated pictures till clouds disappear or data banks are full".

A rock presents a more subtle problem as a target for taking pictures. It is generally neither uniformly darker nor lighter than the background.

The problem can be simplified if the photographing position can be chosen so that the sun strikes from the side, making a highlight and a shadow. For example the surface of the Moon yields much more optical detail when viewed from Earth during a period other than when the Moon is full. The shadows produced when the sunlight strikes the surface at an angle bring out crater detail not seen when light 'normal' to the surface illuminates the scene. On this basis a program for rock recognition has been written and tested. It requires about 200 words of computer memory.

These examples broadly define the function of an adaptive system. In effect the goal is for "thinking" machines to perform the many tasks hitherto achievable only by carrying the best computer-man.

It is accepted that landing man on any extra-terrestial body is the best way of obtaining optimum acquisition of data. However, the extended periods of time involved on such journeys, the necessity of carrying life support systems and the capability of ensuring safe return after such an excursion, require pre-research and proving exercises that are financially prohibitive and wasteful of time.

The "robot" as a primary explorer is a more generally satisfactory alternative.

Table 1 details twenty proposed space missions, commencing in 1979 and culminating in 1988. Listed are possible destinations, payloads, launch systems and propellant methods. Also suitable launch dates and trip durations.

The launching dates are particularly important as missions will also be used for observing comets passing close to our solar system (in the eighties). Correct timing would place vehicles at optimal observational positions at time of "fly-by" of the comets. Similarly the planetary exploration probes have launch "time windows" which allow for the shortest trajectory or for the "assist" of the gravitational pull of some other celestial body to deflect the spacecraft in the direction of its final goal.

It is also interesting to note that new propulsion systems including Nuclear Electric Propulsion (NEP) and Solar Electric Propulsion (SEP) are suggested.

	Science Payload kg	Launch/ Injection System	Spacecraft Propellant	Trajectory Type	Launch Date	Trip Time, Years
Mercury Orbiter	127	Shuttle/Centaur	Space Storable	Venus#	1980	1.83
Venus Orbiter	1036	Shuttle/Centaur	Space Storable	Direct	1983	0.43
Venus Probe	200	Shuttle/Centaur	Space Storable	Direct	1983	0.43
Venus Balloon	244	Shuttle/Centaur	Space Storable	Direct	1983	0.43
Venus Lander	180	Shuttle/Centaur	Space Storable	Direct	1983	0.43
Mars Orbiter	2771	Shuttle/Centaur	Space Storable	Direct	1988	0.58
Mars Lander	600	Shuttle/Centaur	Space Storable	Direct	1988	0.58
Mars Lander/Rover	300	Shuttle/Centaur	Space Storable	Direct	1988	0.58
Halley Flyby	458	Shuttle/Centaur/ HE Burner II	Monopropellant	Direct	1984	1.17
Encke Flyby	1287	Shuttle/Centaur	Monopropellant	Direct	1980	0.22
Encke Rendezvous	415	Shuttle/Centaur	NEP	Direct	1982	1.4
Vesta Rendezvous	111	Shuttle/Centaur	Space Storable	Mars#	1986	1.69
Jupiter Orbiter	248	Shuttle/Centaur HE Burner II	Space Storable	Direct	1980	3.33
Jupiter Probe/Flyby	76/371	Shuttle/Centaur HE Burner II	Monopropellant	Mars#	1982	3.56
Saturn Orbiter	97	Shuttle/Centaur HE Burner II	Space Storable	Direct	1986	4.90
Saturn Probe/Flyby	30/165	Shuttle/Centaur HE Burner II	Monopropellant	Jupiter#	1979	3.17
Uranus Orbiter	361	Shuttle/Centaur	NEP	Direct	1982	5.80
Uranus Probe/Flyby	342/97	Shuttle/Centaur SEP	Monopropellant	Saturn#	1982	7.23
Neptune Orbiter	341	Shuttle/Centaur NEP	NEP	Direct	1982	11.6
Neptune Probe/Flyby	342/51	Shuttle/Centaur SEP	Monopropellant	Saturn, Uranus#	1982	11.6

#Gravity Assist NEP = Nuclear Electric Propulsion SEP = Solar Electric Propulsion

Table 1. Table shows proposed missions for future solar system exploration. Note possible use of nuclear electric and solar electric propulsion in 1982.

MARS MISSION — ADVANCED LANDER — ROVER CONCEPTS

Three concepts for the Mars missions are envisaged: an advanced lander, advanced lander with small rover, advanced lander with medium rover. Each has a different impact on the Viking '75 lander design and different degrees of adaptability, versatility and sophistication. Engineering aspects of each concept were evaluated in sufficient detail to indicate their required adaptive functions and to work out suitable systems that would be reasonable extrapolations of the Viking '75 system.

Figure 1 shows a proposed model for the advanced lander concept.

Not shown on the drawing are a wet chemistry experiment that can detect optically active amino acids, and a life detection system that monitors the gas over a soil sample for changes in composition that indicate metabolism.

The added rover (tethered) will be carried in available space as shown. A wide range of capabilities can be incorporated into such a rover concept (Fig. 2). It can gather samples within a 100 metre radius of the lander and receives its commands and its power from the lander via an "umbillical" cable. It can pick up samples, make a preliminary analysis with its X-ray fluorescence spectrometer, reject samples that are like ones already collected and return interesting samples to the lander for detailed analysis.

A more advanced free-roaming rover with a range of 1 km is envisaged for following missions. Figure 3 shows various suggested configurations and the accompanying table outlines the science payload carried.

Stereo imagery would use facsimile cameras about half the size of those used on Viking '75.

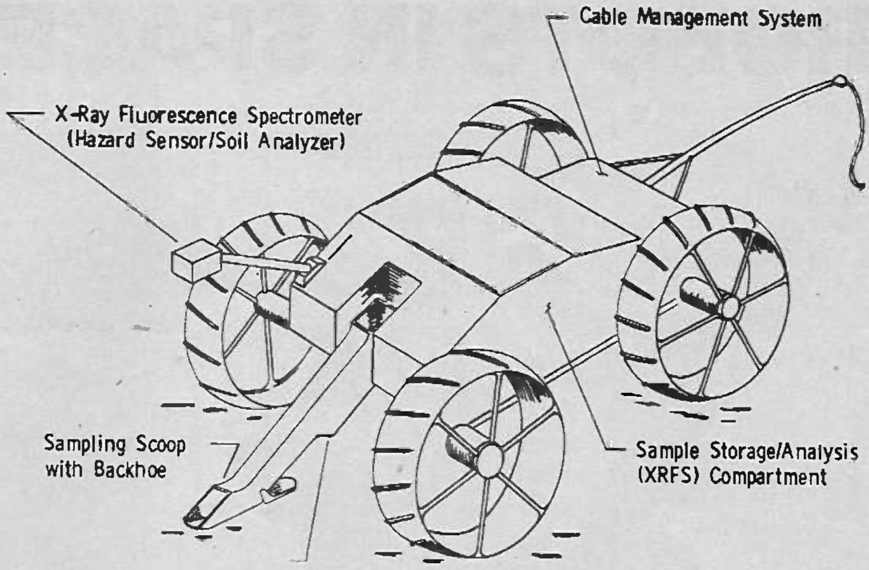


Fig.2. Tethered rover associated with advanced lander.

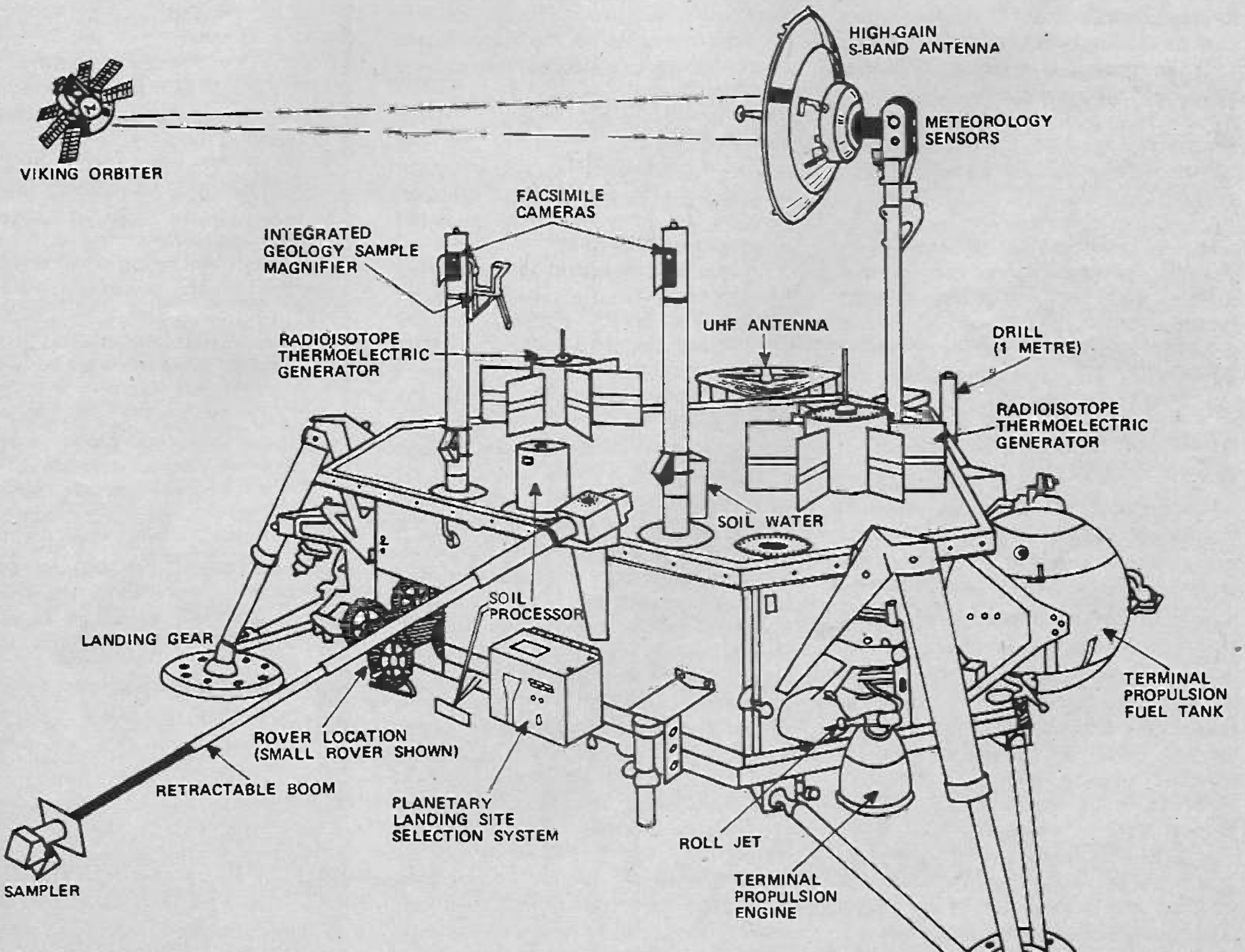


Fig. 1. Proposed Viking Lander (Artist's impression – by ETI staff artist Toni Modric is based on official drawings and sketches).

ROBOTS IN SPACE

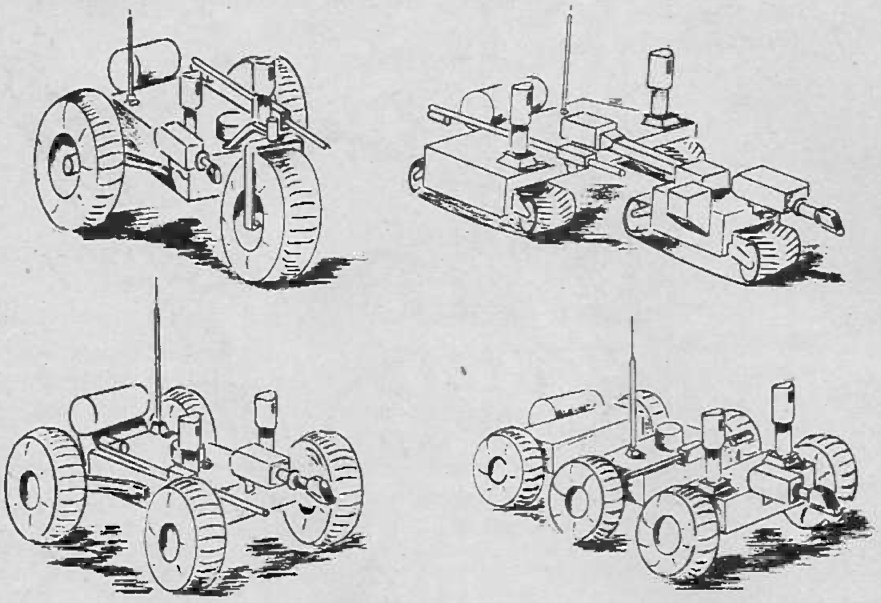


Fig. 3. Configurations proposed for NASA's advanced free-roaming rover.

"Sieves" would provide initial screening of samples for inorganic and organic content. Samplers would be half the size of the Viking '75 one, also a rotary-percussive 1 m drill would be carried. Mechanisms for storing samples and transferring them to the lander would complete this payload.

The major reason for the rover is to be able to manipulate the Martian surface and go part way toward bridging the gap between a passive observer and a geologist on the scene with hands, feet and hammer.

ADAPTIVE REACTIONS – THEIR PRIMARY GOALS

The purpose of this study has not been to put scientific judgment into a computer. Rather, it is to give the scientists a tool that enables them to automate some simple decisions so that they can be made on the lander or rover and carried out promptly enough to do some good. The fundamental philosophy is then to put the adaptive system under as direct control as possible of the scientific teams in order to make modifications quickly and easily.

A further principle to be followed on any mission of long enough duration is to start with a minimum of autonomy and increase it as confidence is gained. The typical actions after a successful landing would be to initially exercise the systems to verify their conditions. The rover would be deployed and traction measured on the Martian soil. At this stage few decisions would be made on Mars.

As confidence increases, more decisions would be made by the on-board controller. Thus fixed action schedules and measurements would be reduced and more flexible ones, based on priorities, phased-in.

These priorities would be determined in part by "on-site" detections of transients and other unusual phenomena which would replace less valuable activities.

Finally when the region close to the lander will have been thoroughly explored, the rover can be sent on long excursions, even out of communications range, since the chance of finding something new will be worth the risk of losing the rover.

This by no means indicates that it is proposed to turn the lander and rover loose with a large bag of untried tricks, but rather to ease into adaptability and to tailor the criteria, thresholds, and logic according to experience gained and the actual conditions at the planet surface.

By applying the adaptive system in such a manner and exploiting the flexibility great advances in adaptability can be made in a single mission, which, if it had been attempted to *forsee* how the system would react, would have resulted in a long series of missions for the same progress. ●

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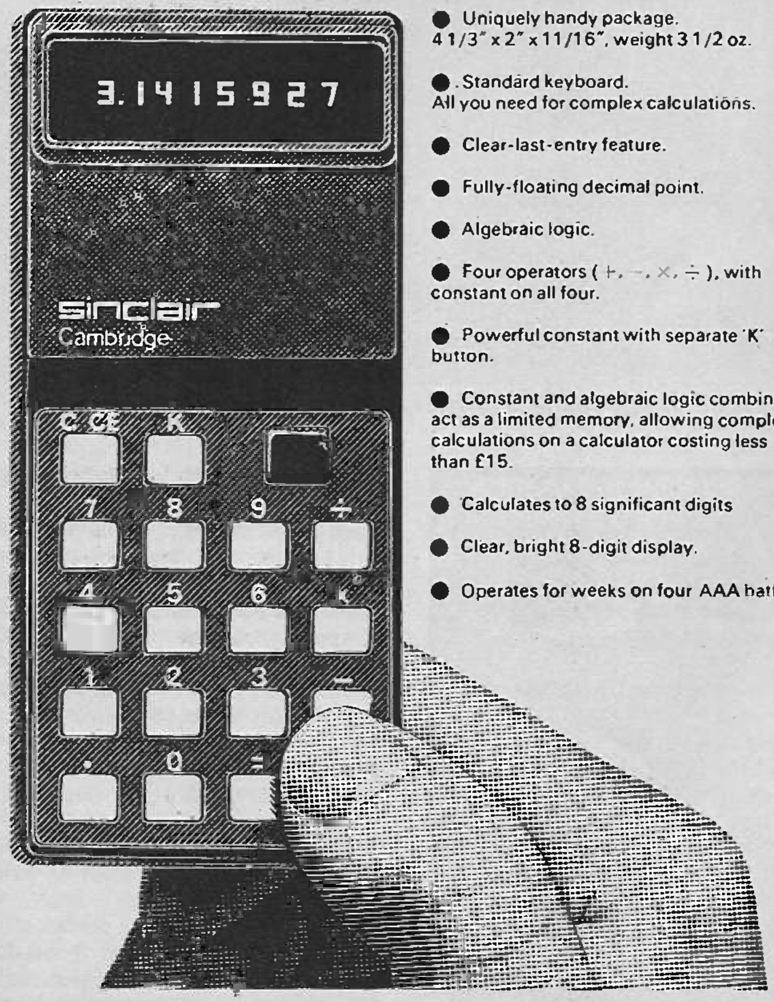

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KNITTING - 1974

The centuries-old knitting machine has been coupled to a mini-computer to gain versatile control over the production of complicated fabric patterns. Here Dr. Sydenham describes this latest step in the highly competitive textile trade.

This electronically-controlled knitting machine by Kirkland, represents the latest developments in machine design and philosophy.

The popularity of knitted stockings was probably the original reason for the invention of the knitting machine. As early as 1527, the French industrial community had formed a stocking-knitters' guild. In early times it was a woman's natural lot to be an accomplished knitter as this extract from an early poem portrays:

"She sayde, as herr whytte hondes whyte hosen were knyttinge, Whatte pleasure ytt ys to be married."

In 1497 a Professor at Aberdeen recorded that Scots often wore stockings from the knee upward to fill in the space between the then fashionable cloth hose and the short balloon-like breeches. History also tells us that Henry VIII appeared in new-fangled stockings in 1510: the garments were:—

"powdered with castels and sheafes of arrows of fine ducket gold."

Obviously, such fine silk stockings were only used for grand occasions in the 16th century for their manufacture took many hours of dainty hand knitting to produce.

KNITTING is a manufacturing method whereby a single continuous thread is used to gradually produce material or a garment. It differs from weaving which uses separate threads laid into each in a perpendicular manner. Both processes can be used to produce fabrics, ranging from delicate to heavy dense; each has its merits. Historically the two processes have developed side by side. Both originated many hundreds of years ago.

We do not usually give much thought to the production of knitteds by quantity manufacturers. When we watch the ladies knitting away, stitching plain after pearl into complicated ribbing patterns, the process looks as though it would be difficult to duplicate mechanically. The weaving machine seems simpler to design. But history records that automatic knitting machines are about as old as automatic weaving looms.

THE INCREDIBLE BUNDLE OF BITS AND PIECES – A KNITTING MACHINE

The first accredited automatic knitting machine – a very complicated mechanism that did away with hand knitting for bulk manufacture was in routine operation in 1589.

It seems that mention of such a device was made in a state of the art report made to Cromwell some fifty years after its invention. This report was presented by petitioners seeking to establish a guild. The knitting frame described in the petition was made by the reverend William Lee who came from a town near Nottingham (most of British commercial knitting is still produced here). Lee's machine could be used to knit at a rate at least one hundred times faster than an experienced hand knitter and it had: *"2000 pieces of smith, joiners and turners work . . . it far excels in the ingenuity, curiosity and subtility of the instruments of manufacture in use in any known part of the world".*

This may sound like a rather proud designer's idea of his own invention but the words were written many years later. Seeing is believing; a knitting frame, Fig. 1, still exists today in the Science Museum in London. Bearing in mind that the machine originated nearly four hundred years ago, one cannot fail to be impressed by the design and its execution.

A contemporary historian claimed Lee invented the knitter to allow his young country girl-friend to spend more time with him and less at her knitting. Suffering the setback many inventors experience he was despised in Britain. He subsequently went to France but his patron, Henry IV of France, was assassinated shortly after his arrival and Lee finally died in Paris . . . "in great distress".

Early in the 17th century the Venetians obtained (by devious means, for loom owners realised their potential worth) a stocking loom, but local pressure from traditionalists forced its demise because it was seriously upsetting the economics of the other knitters – an 'oh so familiar' story of progress.

The new looms spread, as was inevitable, and by 1696 they were in common use. In 1670 there were 700 looms in use in Britain. By 1714 the records show 9000 and by 1753 the number was up to 14 000.

Each year the designs became more sophisticated. In 1758 a patent was granted for the first ribbed stocking knitter. Many notable engineers of the time tried their hand at designs: Marc Isambard Brunel built a knitting machine in 1816; Whitworth lodged a patent for a straight material knitter in 1846. By this time textile machines were rapidly being converted to steam power and in 1835 stocking frames using a rotary motion were often steam driven. (This sounds somewhat incongruous today – a steam driven knitting machine!). Cotton and silken hosiery manufacture was big business by 1850 – 3 510 000 dozen stockings a year consumed 4 584 000 lbs of cotton, 140 000 lbs of silk and 6 318 000 lbs of wool: 73 000 people were employed in the British trade in mid-Victorian times.

Most of these early looms, however, generally produced a plain knit only. There were no coloured patterns and highly fancy stitching schemes to create interesting textures. Just when the automatics were invented is hard to discover but by the early 1900's machines existed that used a pre-set mechanical data store to program the knitting action of coloured, patterned fabrics.

Today's machines are more complex again and more precisely constructed. The many hundreds of pieces of wire, called needles, that guide the thread are about half the thickness of a paper clip and they clear each other by only 100 μm. Each needle has to last at least 300 000 000 operations. A typical bulk fabric machine churns out large-diameter double jersey at 50 000 km a week.

WHAT WAS THE FIRST PRE-PROGRAMMED MACHINE?

The concept of punched tape or punched card control of a machine process is more or less accepted as a modern concept. Those trained in digital computing will, however, usually put forth that the first use was much earlier. The jacquard system (after a Frenchman of that name) of controlling a weaving loom was introduced in 1810 and used punched "tape". The "tape" was in the form of a durable paper belt, perforated in set positions across each row which controlled the action of the multi-colour weaving machines – rather like a very large version of today's eight hole tape. Silk pictures (Stevengraphs are the most famous products) of incredibly intricate detail were made on fine machines in Victorian times. However, the jacquard system was more normally used for the production of heavier clothing fabric. Modern looms still use this principle to control the pattern.

Further delving into industrial history reveals the existence of an even earlier controlled loom – Falcon's loom of 1728 also used punched hole control. There is also claim to a paper tape unit three years before this (by Bouchon) but the truth of this appears to be in doubt.

Falcon's loom (a working unit exists in the Science Museum) uses thick cards (more like boards) with 20 holes across and four rows down. These cards, by the absence or presence of holes, give the instructions that decide the appropriate partings for the threads, ready for the next throw of the shuttle. Each card has the data for a row of weave. This machine, like Lee's knitter, is also a complex masterpiece of craft and ingenuity.

The jacquard system was eventually applied to knitting machines and is still used today – the rather fragile tape data store has been replaced by more robust steel equivalents such as steel tapes, pattern wheels, drums and discs. A control arbor of one manufacturer's method is shown in Fig. 2; teeth have been selectively cropped to suit the needs of the pattern.

Until about four years ago machines could be broadly classified as those with no variable program ability (for simple texture, one-colour cloth) and those that incorporated a mechanical form of pre-programming. Mechanically, machines still resemble earlier designs. A pre-1940's design of a basic circular knitting machine is shown in Fig. 3. The yarns feed up and

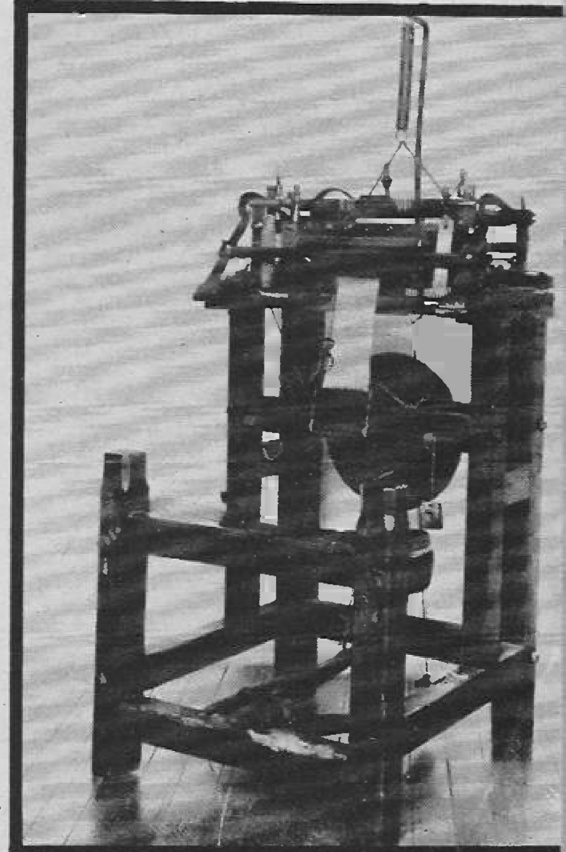


Fig. 1. The first knitting machine – after the design of Rev. Lee (1589) (Courtesy Science Museum London).

KNITTING - 1974

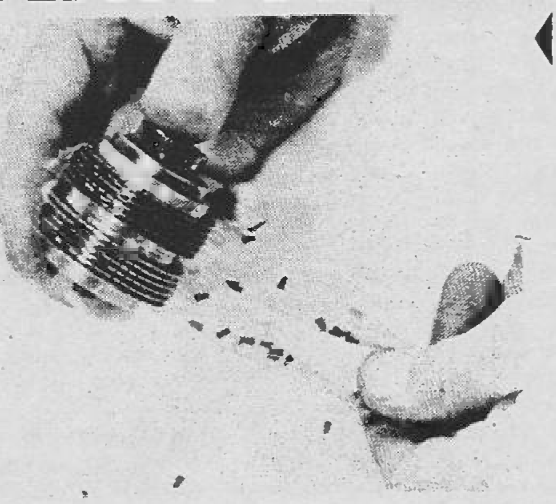


Fig. 2. Cropped-discs assembled on an arbor are used by one manufacturer to control the pattern produced by a knitting machine.

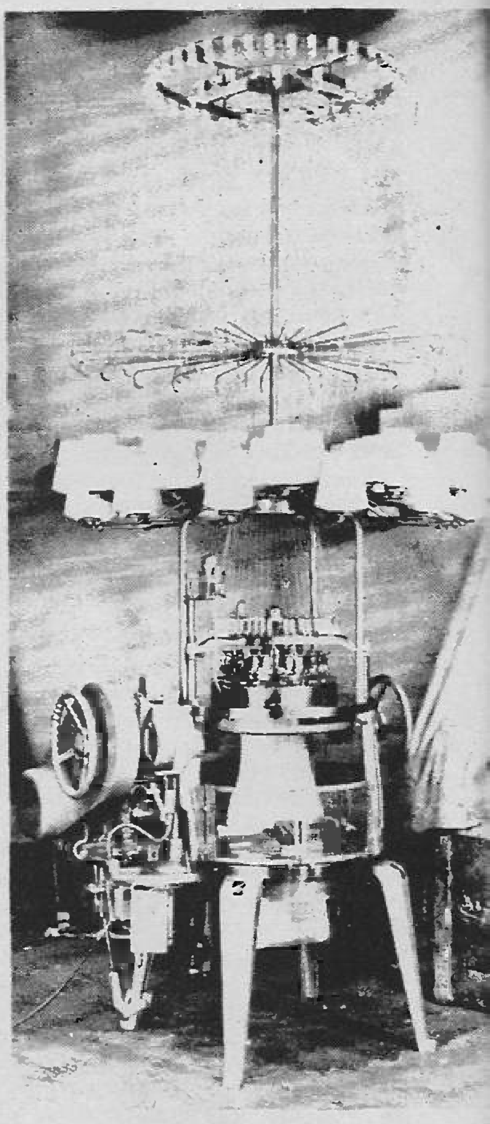


Fig. 3. Knitting machines looked like this forty years ago.

over tensioning and guidance heads then down into the centre of the circular knitting head. The knitted material is pulled off with the roller seen underneath the main frame. The mechanism is powered by an electric motor.

Materials, such as cheese-cloth, are used as a flattened circular belt of material; jersey fabric is usually cut open to form a single flat width from which garments are fashioned by the normal tailoring methods. Machines that knit shapes are another breed — here we are mainly concerned with continuous material production.

Today, a third class of machine has been added. There now exist knitters that can be directly actuated with electrical commanding signals — these are the new computer controlled machines.

THE MANUFACTURER'S PROBLEM — FROM DESIGN TO FABRIC

Whichever type of machine is available to the manufacturer, the aim is the same — to produce saleable cloth to the customer's requirements within a competitive time-scale.

The work flow required to produce a patterned fabric is shown in Fig. 4; it consists of several sequential stages. Firstly, the artist/designer prepares a coloured drawing of the design in conjunction with the customer. This is then edited into a form suitable for knitting production. The designer must allow for the modular stitches which preclude a perfectly smooth pattern because of their discrete nature.

Next the now quantized stitch pattern layout is transferred into permanent machine instructions — the control arbor, for instance. Finally, the machine is run for a test period to verify that the cloth is correct. If the product is acceptable, the run is commenced; if not, it is back to an earlier part of the process to modify the data.

From the manufacturer's point of view any method of speeding-up part of this process without increasing the product price is a worthwhile investment for the knitting machines can then be better utilized and the customer gets the assignment sooner.

SOME UNSOLVED PROBLEMS

Mechanical automatics lack the highly desirable ability to produce a short run of fabric at a reasonable cost. Often the manufacturer needs to show the prospective customer an actual sample, to provide a special fabric for an important yet limited requirement occasion (Fig. 5 shows a coat of arms design recently made by Kirklands of Leicester), or to cater for specialised needs of clubs or societies who desire special uniforms, curtains or what have you. The production of special intricate designs for such small markets is very expensive as the whole process must be invoked including the manufacture of the steel data medium.

Consideration of the work-flow diagram of Fig. 4 shows that certain parts cannot be eliminated — the human interaction is vital as the desired effect is often highly subjective.

There are, however, two significant bottle-necks in the process. They occur in the editing and permanent data preparation stage and in machine control. Modern developments have concentrated on these parts of the process making use of the now

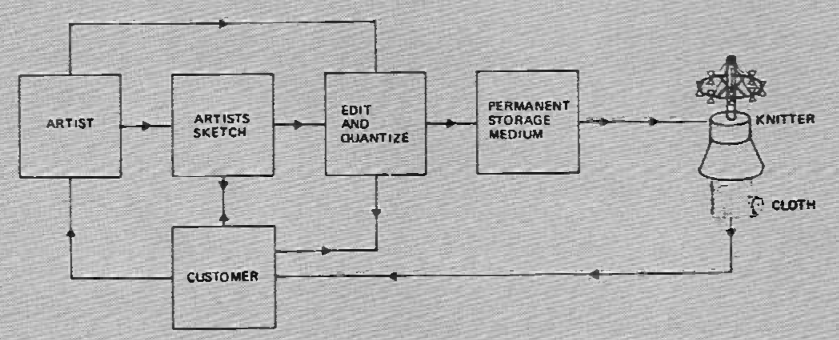


Fig. 4. Generalised flow diagram of work-load in preparation of cloth in knitting industry.

extensive computing and commanding power of the relatively inexpensive mini-computer. About ten knitting machine manufacturers are currently working on these problems.

THE DATA PREPARATION STAGE

Commonly used equipments require the operator to instruct the data storage medium about the colour of each stitch at each position. With around 10 000 or more stitches to a complex pattern cycle (try counting the stitches in the coat of arms of Fig. 5) this can be an extremely slow and tedious task.

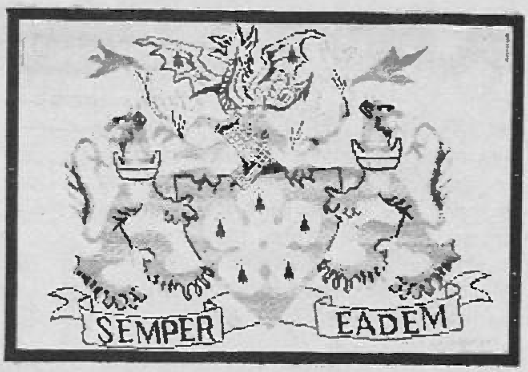
Latest equipments, such as the Kirkland "Time-saver" system (that this article is based upon) use automatic scanners. The "Time-saver" system, shown in Fig. 6, is based on a wide-bed Calcomp plotter (extreme right) and a Hewlett-Packard, model 2100A, mini-computer (seen in the top right of the central console).

The artist's hand-drawn design, which can be nearly a metre in width and of any length, is placed on the scanner feed rollers. A custom-built optical reading head (designed by Barr and Stroud) moves across the pattern recording colour and positional data. The reading head scans over its separate colour differentiating channels using optical filters to decide the colour at each point. Up to six colours can be accommodated but in the knitting trade it is rare to use more than three – blue, red and yellow along with the shades white and black. The designer invariably produces the drawings as discrete coloured areas – continuous colour toning is not relevant in this application.

During the scanning process, which takes place at around 45 stitches per second (a 10 000 face stitch pattern is scanned in four minutes) the collected data is stored up in the computer. Whilst this is happening the data can be used to reconstruct the design on a high quality multi-colour visual display unit (vdu for short). The monitor used is more than a straight adaptation of a commercial colour television monitor for better resolution and less distortion are needed. This part of the Kirkland system was designed in conjunction with Sarek Controls.

The computer can also be used to repeat the basic pattern cycle on the vdu, see Fig. 7, thus enabling the operator to see whether the pattern repeats correctly – the top of the pattern may not join exactly with the bottom of that above. It also enables the designer to look for unexpected unpleasantries. The computer can also provide a number of standard background patterns such as bird's eye, herringbone, vertical stripes etc

Fig. 5. This coat of arms (for Leicester) was produced on an electronically controlled knitting machine system to commemorate the era when computer control became practice.



and several overlying patterns can be merged into a common form of data.

At some stage it is usual for the designer to require interaction with the data as the vdu may show up features which need editing.

An interesting problem arises in direct automated data acceptance from continuous line drawings. If the original has continuous smooth curves that are not already squared-off into discrete stitches the computer must make decisions about the allotment of a stitch: the simplest criteria is to provide a full stitch when the original edge overlaps more than 50% of the reference-grid squares and no stitch for less. Fig. 8 illustrates what happens to Mickey Mouse when he is quantized in this way. Some edges have become ragged and unpleasing to the eye. The designer needs to decide the compromise needed between the true shape desired and the degree of fuzziness that can be allowed.

It is a moot point in the trade whether it is better to produce a very carefully drawn original on squared paper, in a digitized form or to feed in a rough sketch then edit the display afterwards. It appears to be false economy to use computer editing. The drawings to be prepared are usually within the skills of most colourists and colourists cost less than computer time.

The facility does exist in the computerized method for editing if needed. A roving spot is moved across the vdu pattern. When the operator has the spot in the required position, commands can be given, via the tele-typewriter, to delete or add stitches as necessary. A similar process can be used to remove areas and move areas around at will.

Another way to view the appearance of the final cloth is to use the scanner unit as a plotter. This is achieved within seconds by changing the reading head to a multi-colour head. The plotter can then be used to provide a hard copy of the design for storage or for sending to the customer. In this way the need to actually knit samples of fabric is largely avoided.

PUTTING THE DATA TO WORK

Once the pattern has been verified and accepted the next task is to convert it to the appropriate means of control for the machine in use. If mechanical control this means mechanical production; if electrical, direct use of the tapes.

Mechanical – the control tape is used

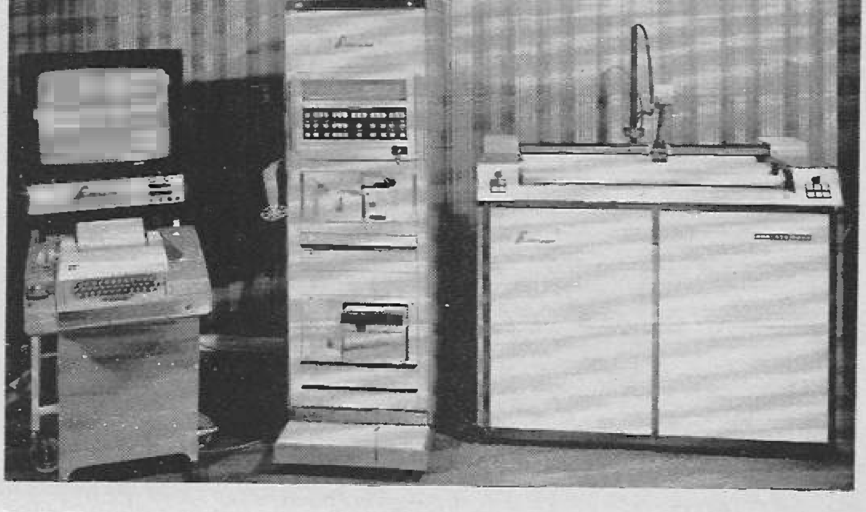


Fig. 6. Time saver pattern data preparation system.

to operate a special-purpose machine like that of Kirkland's shown in Fig. 9. In this arrangement the discs to be cropped are loaded onto standardised arbors that fit onto the cropping heads, (seen on the left-hand side of the unit of Fig. 9). Data on the punched tape decide which teeth are plucked out and which are not. The arbors then go to the knitting machine for the start of the fabric run.

Electronic — in many cases the customer wishes to see a short length of fabric or, alternatively, the run requirement may be short. Here the tape can be used immediately to control knitters that have direct electrical input controls. The illustration on page shows the complete electronically controlled knitting machine. The console houses the Hewlett-Packard mini-computer and the tape reader. The unit interfaces with the many electro-magnetically actuated needles of this special knitting machine. Rather than use entirely computer-based instructions on a continuous basis the actuators have an inbuilt facility to hold the positions given them thus releasing the computer. There is also provision in this machine for the use of permanent magnets as permanent pattern storage — they will be used to hold the actuators.

The computer linked machine is not intended as a replacement for the mechanical automatic. The latter is more economic when rapid pattern change is not needed. It does, however, offer a new dimension in the marketing of knitteds.

It is not hard to envisage a facility of the near future whereby the customer is able to enter a "knitteds-to-order" shop, design a pattern with the help of the resident designer and after a short wait, leave the store with the finished cloth. ●

Fig. 7. The designer needs only to produce one cycle of the pattern — the computer-based colour display repeats it to provide a view of the complete pattern.

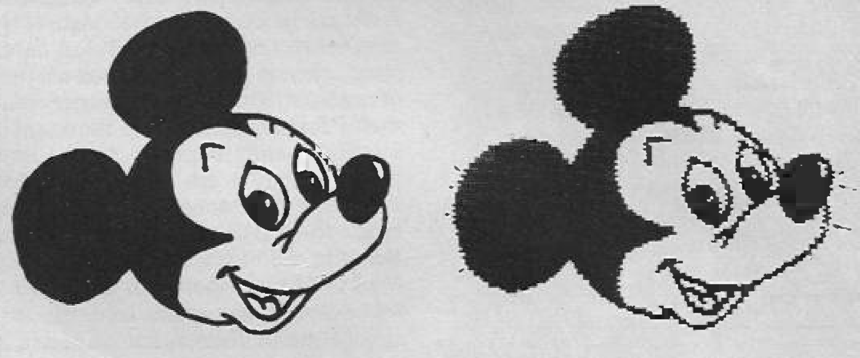


Fig. 8. Automatic digitization of normal drawings often needs editing. (a) The roughly drawn artist sketch (b) the quantized appearance representing the final fabric appearance.

Fig. 9. "Discomatic" produces cropped discs from paper tape control.

eti PROJECT

TEMPERATURE ALARM

Under or over temperature — or both — will activate this alarm.

The completed temperature alarm.

THIS circuit is designed to provide an alarm (either audible or by relay contact closure) whenever a temperature, as monitored by a thermistor, drops below, or rises above, a preset level. The thermistor sensor is a negative temperature coefficient device (NTC), that is, as temperature rises the thermistor resistance falls.

Using thermistors, the range of temperatures over which the unit will operate is from −20 to +150°C. However any one single type of thermistor is only useful over a 30°C range and it is therefore necessary to select a thermistor for the desired operating point by referring to Table 1.

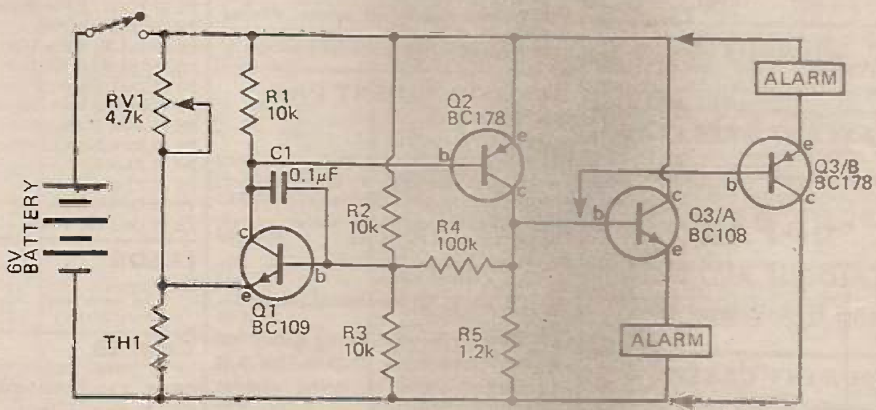
Select the desired temperature from column 1. The corresponding nominal value of thermistor will be found in column 2. The thermistor will have a value of resistance between 1 and 4 k at the operating temperature.

The hysteresis, or deadband, between the on and off switching points is only a few degrees centigrade and the circuit may therefore be used to switch a heater, etc, for temperature control in non-critical applications. If desired, the deadband may be widened by reducing the value of resistor R4.

TABLE 1

Operating Temperature °C	Suggested Thermistor (resistance, in ohms, at 25°C).
−20	180
0	560
+25	2200
+40	3900
+70	10 k
+100	27 k

NOTES:
Q3A IS USED FOR AN OVER TEMPERATURE ALARM.
Q3B IS USED FOR AN UNDER TEMPERATURE ALARM.



Circuit diagram of the temperature alarm.

HOW IT WORKS

The emitter of Q1 is connected to the junction of RV1 and TH1 (thermistor) which form a voltage divider. As TH1 varies with temperature the voltage at the emitter of Q1 will also vary with temperature.

Transistors Q1 and Q2 together form what is known as a Schmitt trigger. The Schmitt trigger is in fact an amplifier with positive feedback. If the temperature is below the point set by RV1, transistors Q1 and Q2 will be off, that is, not-conducting. The voltage at the base of Q1 will be set by R2, 3, 4 and 5. Since Q2 is off it does not affect the parallel arrangement of R4 plus R4 with R3. Thus with a 6 volt supply there will be 2.86 volts at the base. If the emitter voltage of Q1 falls below 2.86 − 0.6 volts, i.e. 2.26 volts, Q1 will turn on. This causes Q2 to turn on thus effectively putting R4 in parallel with R2. This causes Q1 to latch on, hence, its emitter voltage now has to exceed 3.14 − 0.6 volt before the transistor will turn off.

Reducing the value of R4 will make the difference between these two voltages greater thus increasing the deadband.

The relay or alarm is driven by Q3 which buffers the output of Q2. The circuit may be used for over-temperature, under temperature or both types of alarm simply by using the appropriate Q3 circuitry.

PARTS LIST Temperature Alarm

R1,2,3,	resistor	1.2k	½W	5%
R4	"	10k	"	"
R5	"	100k	"	"

RV1 potentiometer 4.7k linear
TH1 Thermister see Table 1
Q1 Transistor BC108 or similar
Q2 " BC178 or similar
Q3 " See circuit diagram
Audible warning device (12V version available from Doram, P.O. Box TR8, Wellington Road Industrial Estate, Wellington Bridge, Leeds LS12 2UF) or 6V relay.
SW1 SPST toggle switch
6V battery
Pieces of matrix board.

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CH5. 1·5mH 28p
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NORMAN ¼" Cores & Formers 8p
⅜" Cores & Formers 10p

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BA4	5¼"	×	4"	×	1½"	50p
BA5	4"	×	2½"	×	2"	42p
BA6	3"	×	2"	×	1"	34p
BA7	7"	×	5"	×	2½"	70p
BA8	8"	×	6"	×	3"	90p
BA9	6"	×	4"	×	2"	58p

P & P 10p on each box

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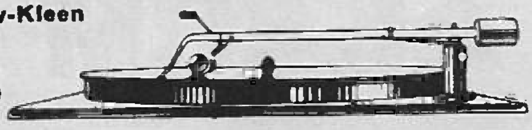
Chrome Finish Model 60 £1·50



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PS 26	Jack 3·5mm Plastic	0·16
PS 27	Jack ¼" Plastic	0·30
PS 28	Jack ¼" Screened	0·35
PS 29	Jack Stereo Plastic	0·30
PS 30	Jack Stereo Screened	0·38
PS 31	Phono Screened	0·18
PS 32	Car Aerial	0·22
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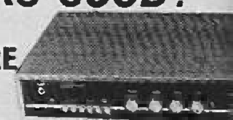

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7403	0·18	0·17	0·16	7453	0·18	0·17	0·16	74145	£1·65	£1·55	£1·45
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7408	0·20	0·19	0·18	7473	0·41	0·39	0·35	74155	£1·50	£1·45	£1·35
7409	0·20	0·19	0·18	7474	0·41	0·39	0·35	74156	£1·50	£1·45	£1·35
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7412	0·39	0·34	0·31	7480	0·74	0·71	0·64	74161	£2·10	£2·00	£1·90
7413	0·32	0·31	0·30	7481	£1·30	£1·25	£1·20	74162	£4·40	£4·15	£3·85
7416	0·48	0·44	0·42	7482	0·96	0·95	0·94	74163	£4·40	£4·15	£3·85
7417	0·48	0·44	0·42	7483	£1·20	£1·15	£1·05	74164	£2·20	£2·10	£2·00
7420	0·18	0·17	0·16	7484	£1·10	£1·05	£1·00	74165	£2·20	£2·10	£2·00
7422	0·55	0·53	0·50	7485	£3·50	£3·40	£3·30	74166	£3·20	£3·10	£3·00
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7425	0·55	0·53	0·50	7489	£4·00	£3·75	£3·50	74175	£1·75	£1·65	£1·55
7426	0·50	0·46	0·44	7490	0·74	0·71	0·64	74176	£1·85	£1·75	£1·65
7427	0·50	0·46	0·44	7491	£1·10	£1·05	£1·00	74177	£1·85	£1·75	£1·65
7428	0·55	0·53	0·50	7492	0·74	0·71	0·64	74180	£1·50	£1·40	£1·30
7430	0·18	0·17	0·16	7493	0·74	0·71	0·64	74181	£5·00	£4·50	£4·00
7432	0·50	0·46	0·44	7494	0·85	0·82	0·75	74182	£2·00	£1·90	£1·75
7433	0·75	0·73	0·70	7495	0·85	0·82	0·75	74184	£3·20	£3·10	£3·00
7437	0·70	0·68	0·65	7496	0·96	0·93	0·86	74190	£2·15	£2·10	£2·00
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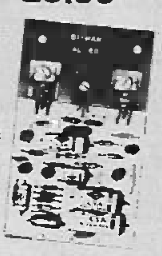

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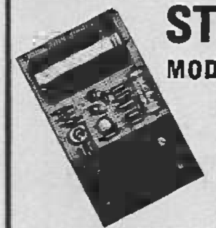

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UIC02=12×7402	0·55	UIC50=12×7450	0·55	UIC92=5×7492	0·55
UIC03=12×7403	0·55	UI351=12×7451	0·55	UIC93=5×7493	0·55
UIC04=12×7404	0·55	UIC53=12×7453	0·55	UIC94=5×7494	0·55
UIC05=12×7405	0·55	UIC54=12×7454	0·55	UIC95=5×7495	0·55
UIC06=8×7406	0·55	UIC60=12×7460	0·55	UIC96=5×7496	0·55
UIC07=8×7407	0·55	UIC70=8×7470	0·55	UIC100=5×74100	0·55
UIC10=12×7410	0·55	UIC72=8×7472	0·55	UIC121=5×74121	0·55
UIC20=12×7420	0·55	UIC73=8×7473	0·55	UIC141=5×74141	0·55
UIC30=12×7430	0·55	UIC74=8×7474	0·55	UIC151=5×74151	0·55
UIC40=12×7440	0·55	UIC76=8×7476	0·55	UIC154=5×74154	0·55
UIC41=5×7441	0·55	UIC80=5×7480	0·55	UIC193=5×74193	0·55
UIC42=5×7442	0·55	UIC81=5×7481	0·55	UIC199=5×74199	0·55
UIC43=5×7443	0·55	UIC82=5×7482	0·55		
UIC44=5×7444	0·55	UIC83=5×7483	0·55	UICXI=25 Assorted 74's	1·55
UIC45=5×7445	0·55	UIC86=5×7486	0·55		

Packs cannot be split, but 25 assorted pieces (our mix) is available as PAK UIC X1.

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market. the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL60 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.

Three switched stereo inputs, and rumble and scratch filters are features of the PA100. which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.

SPECIFICATION:

Frequency response	20Hz—20kHz ±1dB
Harmonic distortion	better than 0·1%
Inputs: 1. Tape head	1·25mV into 50KΩ
2. Radio, Tuner	35mV into 50KΩ
3. Magnetic P.U.	1·5mV into 50KΩ

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ±1dB from 20Hz to 20kHz.

Bass control	±15dB at 20Hz
Treble control	±15dB at 20kHz
Filters: Rumble (high pass)	100 Hz
Scratch (low pass)	8kHz
Signal/noise ratio	better than +65dB
Input overload	+26dB
Supply	+35 volts at 20mA
Dimensions	292×82×35 mm

only £13·15

LINEAR I.C's—FULL SPEC.

Type No.	Case		1	25	100+
72702	DIL	14	0.50	0.48	0.45
72709	DIL	14	0.35	0.33	0.30
72710	DIL	14	0.45	0.43	0.40
72741	DIL	14	0.40	0.38	0.35
72741C	TO-5	8	0.45	0.43	0.40
72741P	DIL	8	0.38	0.36	0.34
72748P	DIL	8	0.38	0.36	0.34
SL201C	TO-5	8	0.50	0.45	0.40
SL701C	TO-5	8	0.50	0.45	0.40
SL702C	TO-5	8	0.50	0.45	0.40
TAA263	TO-72	4	0.80	0.70	0.60
TAA293	TO-74	10	£1.00	0.85	0.80
TAA350A	TO-5	10	£1.85	£1.80	£1.70
µA703C	TO-5	6	0.28	0.26	0.24
µA709C	TO-5	8	0.35	0.33	0.30
µA711	TO-5	10	0.45	0.43	0.40
ZN414	TO-18	4	1.20		

DTL 930 SERIES LOGIC I.C's

Type	1	25	100+
BP930	0.15	0.14	0.13
BP932	0.16	0.15	0.14
BP933	0.16	0.15	0.14
BP935	0.16	0.15	0.14
BP936	0.16	0.15	0.14
BP944	0.16	0.15	0.14
BP945	0.30	0.28	0.25
BP946	0.15	0.14	0.13
BP948	0.30	0.28	0.25
BP951	0.70	0.65	0.60
BP962	0.15	0.14	0.13
BP9093	0.45	0.43	0.40
BP9094	0.45	0.43	0.40
BP9097	0.45	0.43	0.40
BP9099	0.45	0.43	0.40

DUAL-IN-LINE SOCKETS.

14 & 16 Lead Sockets for use with DUAL-IN-LINE I.C's TWO Ranges PROFESSIONAL & NEW LOW COST.

PROF. TYPE No.	1–24	25–99	100up.
TSO 14 pin type	33p	30p	27p
TSO 16	38p	35p	32p
TO 24	75p	70p	68p
LOW COST No.			
BPS 8 pin type	13p	13p	11p
BPS 14	16p	14p	12p
BPS 16	17p	15p	13p

NUMERICAL INDICATOR TUBES

Type	Description	
3015F	Minitron 7 Segment Indicator	£1.50
MAN 3M	L.E.D. 7 Segment Display 0.127" High Characters	£1.96
CD 66	Side Viewing 'Nixie Type' Tube 16 mm	£1.87
GR 116	Side Viewing 'Nixie Type' Tube 13 mm	£1.70

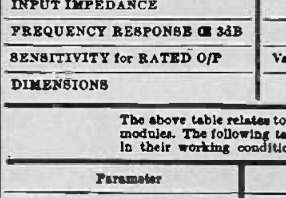
3 TERMINAL POSITIVE VOLTAGE REGULATORS

To3 Plastic Encapsulation 0.P. 1.5 Amps.

µA7805	5V (Equiv. to MVR5V)	£1.76
µA7812	12V (Equiv. to MVR12V)	£1.76

BI-PAK
CATALOGUE AND LISTS
Send S.A.E. and 18p.

AL10/AL20/AL30 AUDIO AMPLIFIER MODULES



The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 10 watts R.M.S.

The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home.

Parameter	Conditions	Performance
HARMONIC DISTORTION	Po = 3 WATTS f=1KHz	0·25%
LOAD IMPEDANCE	—	8 – 16 Ω
INPUT IMPEDANCE	f=1KHz	100 kΩ
FREQUENCY RESPONSE ⊕ 3dB	Po=2 WATTS	50 Hz – 25KHz
SENSITIVITY for RATED O/P	Vs=25V. Rl=8 Ω f=1KHz	75mV. RMS
DIMENSIONS	—	3" × 2½" × 1"

The above table relates to the AL10, AL20 and AL30 modules. The following table outlines the differences in their working conditions.

Parameter	AL10	AL20	AL30
Maximum Supply Voltage	25	30	30
Power output for 2% T.H.D. (RL = 8 Ω f = 1 KHz)	3 watts RMS Min.	5 watts RMS Min.	10 watts RMS Min.
PRICE	£2·20	£2·59	£3·3

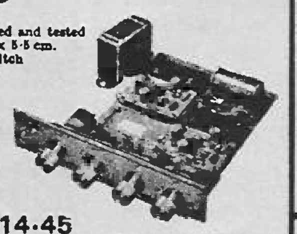
TEAK VENEERED CABINETS for:

STEREO, 20
TC 20. £3·95 p&p 30p.

MK 50 KIT
TC 100. £6·50 p&p 40p.

E.M.I. LEK 350 Loudspeaker System Enclosure kit in Teak Veneer, including speakers. Rec Retail Price £45·50 per pr. OUR SPECIAL PRICE £35·50 per pair p&p £1. *ONLY WHILE STOCKS LAST!*

The STEREO 20



The 'Stereo 20' amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm × 14 cm × 5·5 cm. This compact unit comes complete with on/off switch volume control, balance, bass and treble controls, Transformer, Power supply and Power amps. Attractively printed front panel and matching control knobs. The 'Stereo 20' has been designed to fit into most turntable plinths without interfering with the mechanism or, alternatively, into a separate cabinet. Output power 20w peak. Input 1 (Cer.) 300mV into 1M. Freq. res. 25Hz-25kHz. Input 2 (Aux.) 4mV into 30K. Harmonic distortion. Bass control ±12dB at 60Hz typically 0·25% at 1 watt. Treble con. ±14dB at 14kHz.

£14·45

FRONT PANEL, 4 knobs, Headphone Socket, on/off switch and neon for PA 100/MK 50. FPK 100 £2·95.

TRANSFORMERS

T461 (Use with AL10) £1·38 P & P 15p
T538 (Use with AL20 & AL30) £1·93 P & P 15p
BMT80 (Use with AL60) £2·15 P & P 25p

POWER SUPPLIES

PS 12. (Use with AL10. AL20 & AL30) 88p
SPM 80. (Use with AL60) £3·25

PA 12. PRE-AMPLIFIER SPECIFICATION

The PA 12 pre-amplifier has been designed to match into most budget stereo systems. It is compatible with the AL 10, AL 20 and AL 30 audio power amplifiers and it can be supplied from their associated power supplies. There are two stereo inputs, one has been designed for use with *Ceramic cartridges while the auxiliary input will suit most †Magnetic cartridges. Full details are given in the specification table. The four controls are, from left to right: Volume and on/off switch, balance, bass and treble. Size 152mm × 84mm × 35mm. PRICE £4·35

Frequency response— 20Hz – 50KHz (–3dB)
Bass control— ± 12dB at 60Hz
Treble control— ± 14dB at 14KHz
*Input 1. Impedance 1 Meg. ohm Sensitivity 300mV
†Input 2. Impedance 30 K ohms Sensitivity 4mV

FRONT PANEL FP12 with knobs £1·20.

Giro No. 388 7006

Please send all orders direct to warehouse and despatch department

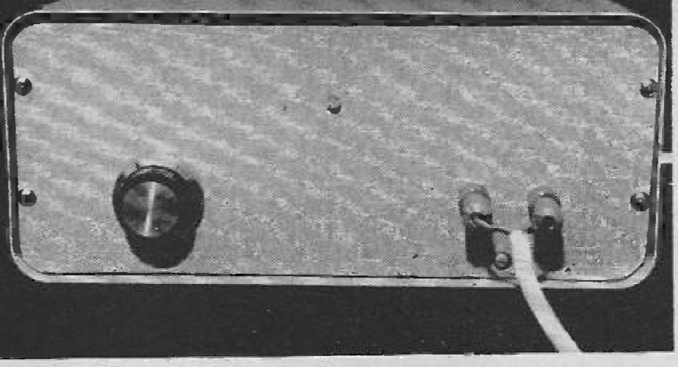
BI-PAK

P.O. BOX 6, WARE · HERTS

Postage and packing add 11p Overseas add extra for airmail Minimum order 55p Cash with order please

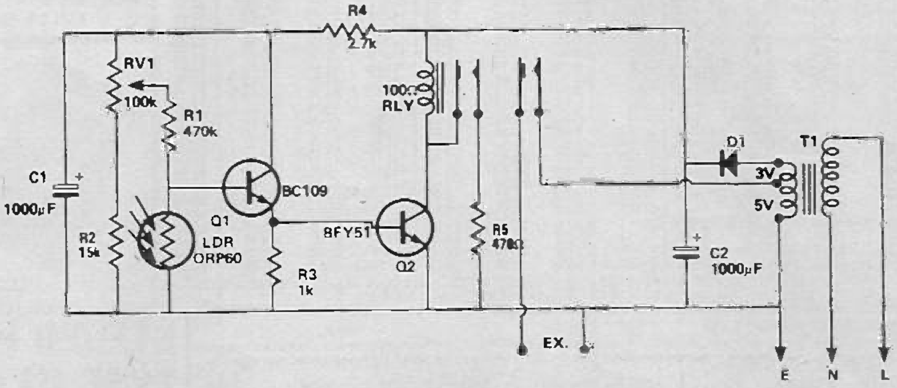
Guaranteed Satisfaction or Money Back

AUTO LUME



THIS UNIT is automatically operated by the level of general illumination, or the strength of light falling upon it. The most frequent uses of such a device include operating a child's night light, or switching on a light in a room, when darkness falls, as a deterrent to burglars, when leaving the house unoccupied.

The unit is operated from a.c. mains, and is adjustable to operate over a wide range of light intensities. It switches on an external circuit when light fades below a set level, as in the evening and switches off this circuit when light increases, as with the arrival of morning.



The circuit.

AUTO-LUME CIRCUIT

This is shown in Fig. 1. The resistance of the light-dependent resistor LDR rises as the illumination reaching it falls. This allows the base of Q1 to move positive so that it conducts. Q1 emitter and Q2 base also move positive, so that Q2 collector current rises. This current flows through the relay windings, closing the relay contacts.

RV1 is the sensitivity control, so that the device can be set to work at the desired light intensity. Spare contacts on the relay close to bring R5 into circuit, providing additional current through the winding. This means that the relay release current through Q2 is lower than the pull-on current, and avoids vibration or flicking on and off of the relay when darkness slowly comes and light has fallen to a level where the unit is about to operate.

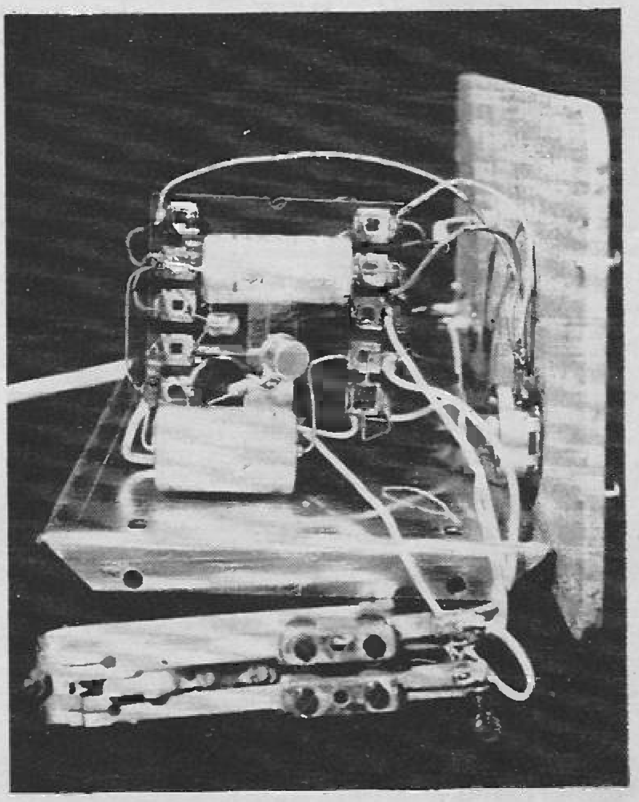
A bell transformer or similar transformer T1 provides current, and the operating voltage is not very critical. The second set of relay contacts result in 5V a.c. being available at the extension sockets EX, which does well for a child's night light equipped with a 6V 3 watt or similar bulb. By changing the connections to T1 secondary, 3V or 8V may be obtained instead, if required.

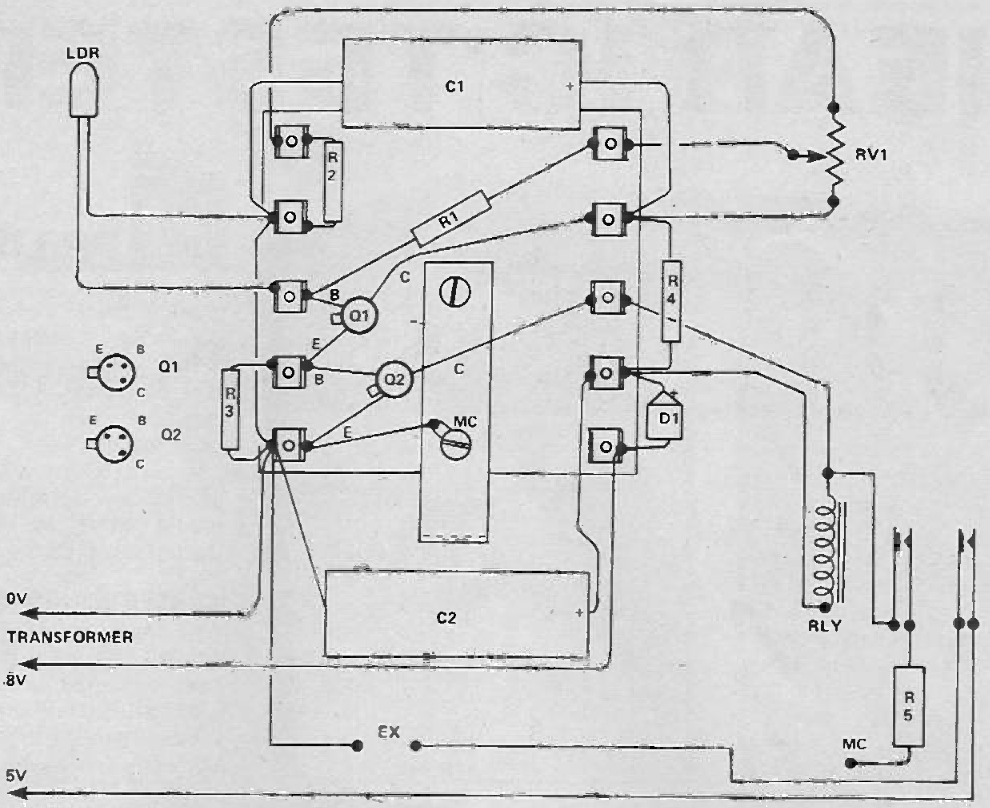
To switch on a mains-voltage lamp, it is necessary either to use a mains-voltage relay here, or to employ the extension circuit to control a relay which in turn switches on the mains-voltage equipment. Normally, however, a 3 watt or 6 watt low voltage lamp will provide enough light for the purposes for which the unit will be used.

TAG BOARD

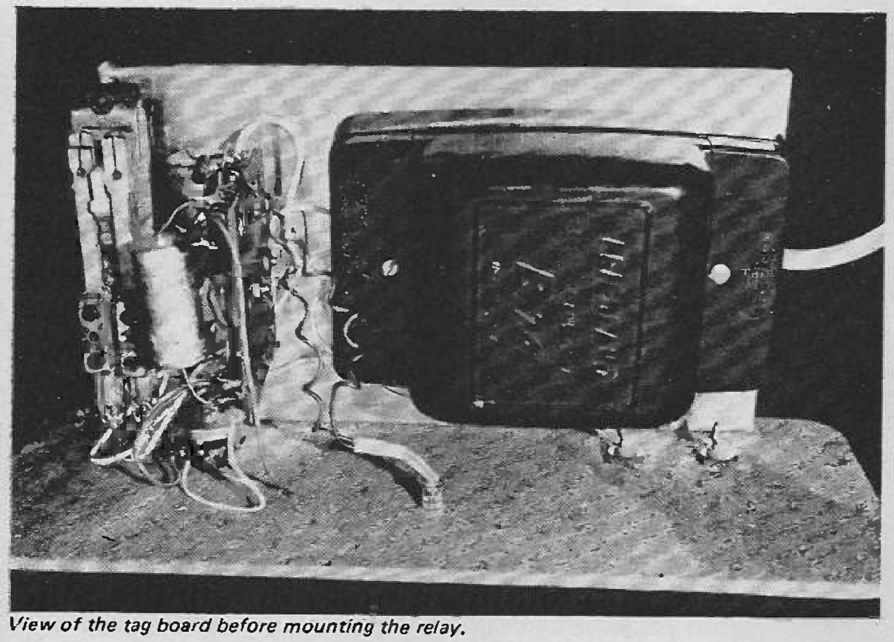
The small components are assembled on a tag board as in Fig. 2. This also shows the positions of the leads of the semiconductors. A bracket bolted to the board allows it to be mounted vertically, and also forms the negative or metal chassis return.

Layout of the major components.





Positioning of the components on the tag board.



View of the tag board before mounting the relay.

Leads run from various tags to the relay and other components, and these connections are most easily added after the board is fitted in position.

Construction can be completed on a shallow chassis 7 x 4 in. in dimensions, which will take the transformer, tag-board, and relay. The unit illustrated has a 9 x 4 in. panel, fitting a case 9 x 4 x 4 in. The extension circuit sockets, sensitivity control RV1, and LDR are fitted to the panel. The LDR is cemented in a small hole, and its leads are extended to reach to the tags shown. All connections can be seen from Fig. 2.

SETTING UP

The unit and lamp controlled must be placed so that light from the lamp does not operate the LDR. The Auto-Lume is best placed near a window when to be controlled by daylight, or at a position near the room main light, when it is to take over automatically as the room light is switched off. The extension circuit can then run to the bulb to be controlled, situated clear of the Auto-Lume. The disposition of unit and bulb is in no way critical, provided they are sufficiently separated.

RV1 is then set so that the controlled must be placed so that light LDR is shaded with the hand, and sensitive control over a wide range of illumination values should be obtained.

When a low-voltage 3 watt, 6 watt or similar lamp is to be used with a conventional type table lamp, the latter should be fitted with a small bayonet cap or miniature Edison screw holder to suit, and a mains-type plug should *not* be used for connecting to the Auto-Lume extension sockets. This will avoid any chance of someone eventually plugging the lamp into a mains voltage outlet. Various small night-light lamps and similar lamps can also be easily adapted to take a suitable bulb. ●

COMPONENTS

R1	470k	¼W
R2	15k	¼W
R3	1k	¼W
R4	2.7 k	¼W
R5	470 ohm	½W
RV1	100k linear pot.	
C1	1000μF	16V
C2	1000μF	16V or 25V
LDR	ORP60	
Q1	BC109	
Q2	BFY51	

Relay, 100 ohm coil, double pole switch.

SR1 Selenium rectifier, 50V 1A or similar.

T1 Bell transformer, 200/250V, 3/5/8V secondary, 1 ampere, or 8VA, or as required for lamp.

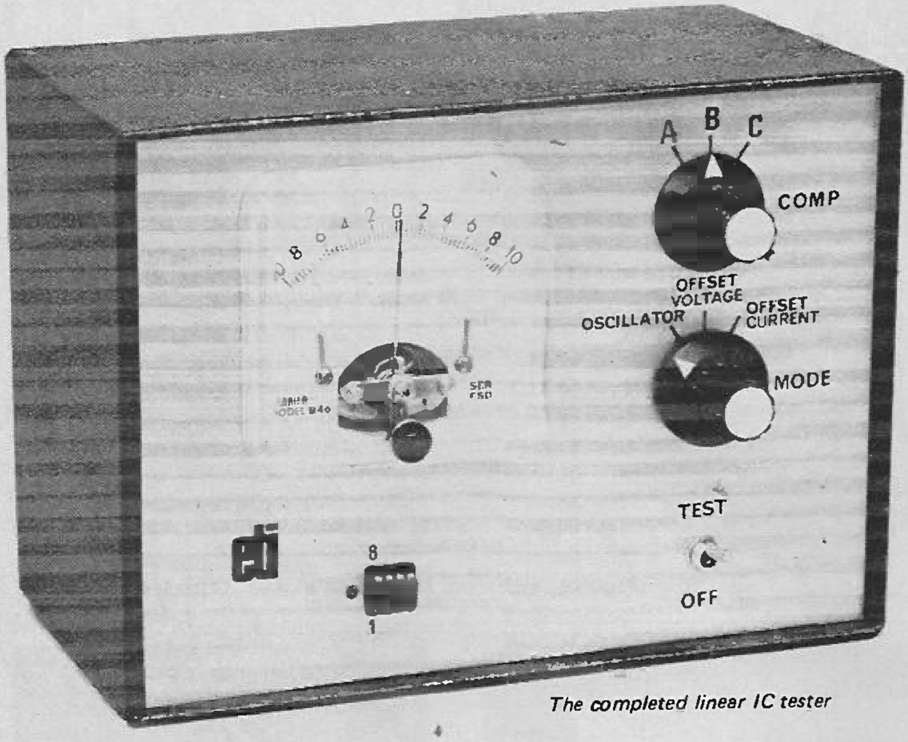
Case, internal dimensions approx, 9 x 4 x 4in.

7 x 4in. chassis (Universal Chassis flanged side, Home Radio).

Tag-board, knob, sockets, 3-core mains lead, etc.

LINEAR IC TESTER

eti PROJECT 115



The completed linear IC tester

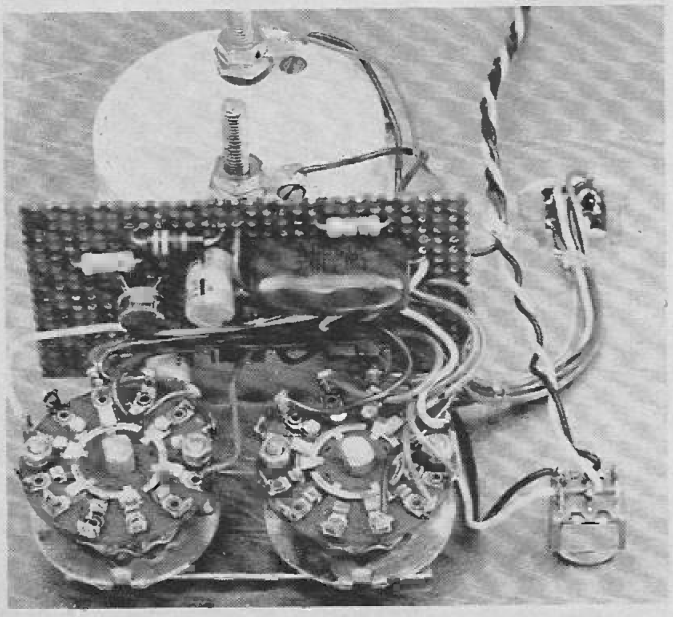
Test all commonly available operational amplifiers for three vital parameters.

LINEAR integrated circuits are available today at prices little higher than those of discrete transistors. As they offer far better performance parameters, and greater versatility than transistors they are being used in new designs in ever increasing numbers.

Most linear ICs are now built into a standard 8-pin, dual-in-line plastic pack, have the same pin connections and very similar characteristics. Hence as the only real difference is in the associated frequency compensation network, a universal, linear – IC tester is quite a feasible proposition.

The tester, described here provides a quick check of vital operating parameters. Checks are provided for offset voltage (max ±10mV), offset current (max ± 1000 nA) and of operation in an actual circuit configuation.

It is a most valuable instrument; saving an experimenter time that would otherwise be spent tracing down faulty ICs.



Showing the internal construction of the tester. Note that matrix board hold the majority of the components.

CONSTRUCTION

We chose to mount our circuitry on a small piece of matrix board, rather than a printed circuit board, as there are relatively few components used.

Make sure that IC1 is orientated correctly (note pins 1, 5 and 8 are not used). The wires from the compensation switch (SW2) should be as short as possible in order to minimise the chance of unstable operation.

The test socket should be glued into place (taking care not to get glue down the pins) and, after the wires to the socket are soldered on, these should also be held to the panel with glue or a metal clamp.

The wires to the socket must be supported in some way, as detailed above, to prevent the rather fragile pins breaking off.

HOW TO USE

The parameters of commonly-available ICs are detailed in Table 1. An IC on test should not exceed these figures. Those that do exceed these values may not operate correctly in some circuits and should be discarded.

To test an IC, plug it into the test socket making sure that it is orientated correctly. Select the appropriate equalization as detailed in column 4 of Table 1 and switch the unit on. Select 'OSCILLATOR' mode and observe that the meter should sweep up and down the scale at about 1 Hz.

Now switch to 'OFFSET VOLTAGE' mode and read the meter which is calibrated at 10 mV full scale deflection.

Next switch to 'OFFSET CURRENT'. In this mode the meter is calibrated at 1000 nA (1 microamp) full scale deflection.

Discard any IC that does not oscillate or has excessive offset current or voltage.

TABLE 1

TYPE	MAX OFFSET CURRENT	MAX OFFSET VOLTAGE	COMPENSATION
301	50 nA	±7.5 mV	C
307	50 nA	±7.5 mV	A
308	1 nA	±7.5 mV	C
709	500 nA	±7.5 mV	B
741	200 nA	±6 mV	A
748	200 nA	±6 mV	C
777	20 nA	±5 mV	C
1456	30 nA	±12 mV	A

PARTS LIST ETI 115

R1,2	Resistor	100	5% ½W
R3,5	"	2.2M	" "
R4	"	1 M	" "
R6	"	22 k	" "
R7	"	1.5 k	" "
R8	"	3.9 k	" "
R9	"	33 k	" "
R10	"	150 k	" "
C1	Capacitor	1μF polyester	
C2	"	0.0047μF polyester	
C3	"	33pF	ceramic
C4	"	220pF	"
C5,6	"	10μF 16V electrolytic	

IC1	integrated circuit	μA741
M1	meter	0.5 mA — 0 — 0.5 mA (available in the 38 series of Henelec from Henry's Radio)
SW1	Switch	2 pole, 3 position rotary
SW2	"	2 pole, 3 position rotary
SW3	"	2 pole on-off toggle.

Metal box approx. 150 x 180 x 90mm.

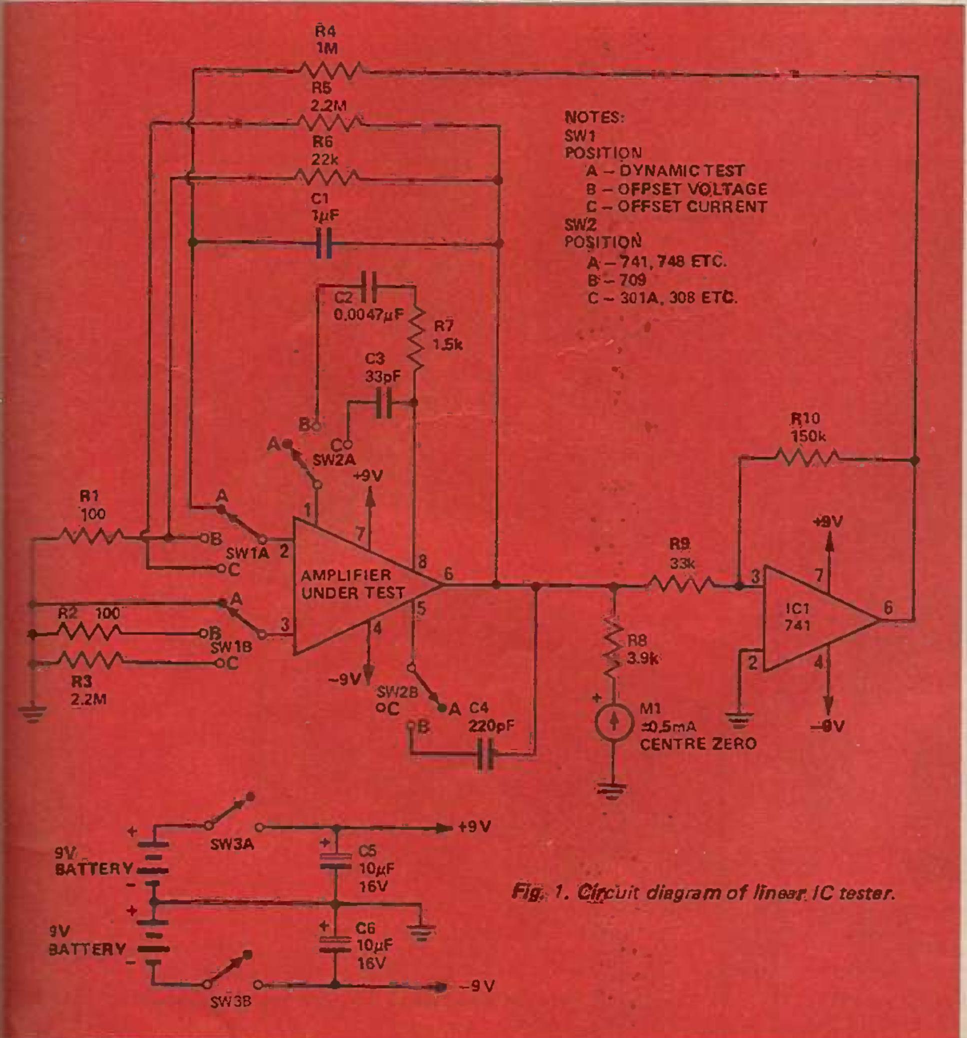


Fig. 1. Circuit diagram of linear IC tester.

HOW IT WORKS – ETI 115

Centre-zero meter M1, via resistor R8, indicates the output voltage from the IC under test. The frequency compensation components for the particular IC under test are selected by SW2, and the test mode is selected by SW1.

In position "C", of SW1, a 2.2 megohm resistor is connected from the output (pin 6) of the IC under test to the inverting input (pin 2), and a 2.2 megohm resistor from the non-inverting input (pin 3) to ground. Current is drawn by both pin 2 and pin 3 of the IC and, if these currents are equal, the output voltage will be zero. Any difference in input currents will therefore be indicated as an output voltage on meter M1.

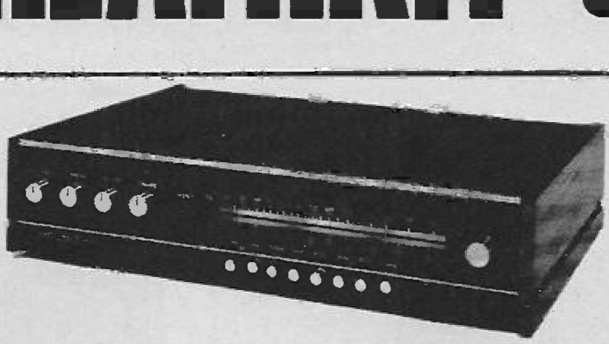
In position B the resistor from pin 6 to pin 2 is reduced to 22k and a 100 ohm resistor, R1, is connected from pin 2 to ground. This results in the IC having a voltage gain of 220. Resistor R2 is also made 100 Ω so that offset current does not affect the operation in this mode. Hence the IC will now amplify any offset voltage between pin 2 and pin3 (that is, it is operating in the linear mode) by 220 and the meter deflection will be proportional to the offset voltage.

If either offset voltage or offset current are excessive the meter will read off scale and the IC should be discarded.

In mode A the IC is connected as a triangular wave oscillator having an operating frequency of 1Hz. Integrated circuit IC1 is connected as a Schmitt trigger where the output of the Schmitt goes high if its input drops below -1.5 volts, and will go low if the input exceeds 1.5 volts. The output of IC1 is taken, via a 1 megohm resistor, to the input of the IC under test and the output of the Test IC becomes the input of the Schmitt trigger. An integrating capacitor, C1, is connected across the IC under test. The effect of this is to cause the output of the test IC to rise at 7 volts per second until +1.5 volts is reached. At this point the Schmitt operates and the output of the test IC now commences to fall at the same rate. When -1.5 volts is reached the direction reverses again and the cycle repeats. Thus we have an oscillator with a frequency low enough to be followed by the output meter as an indication of correct operation.

ETI/HEATHKIT COMPETIT

GOLD



TUNER AMPLIFIER (AR-1214)
15W r.m.s. per channel with AM and FM stereo radio in a first class cabinet.

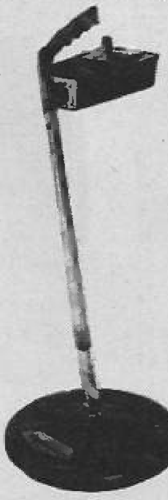
DIGITAL DEPTH SOUNDER (MI-101). Gives accurate readings from 2½—199ft with automatic warning light.

5MHZ G.P. OSCILLOSCOPE (IO-102)
Perfect for the serious experimenter, a unit with 6 x 10cm viewing area and sensitivity of 30mV/cm.

DIGITAL FREQUENCY METER (IB-1101). 1Hz to 100MHz capability, accepting inputs from 50mV to 140V.

The Gold Prize can be any of items illustrated or any goods in the current catalogue up to the value of £85.

SILVER



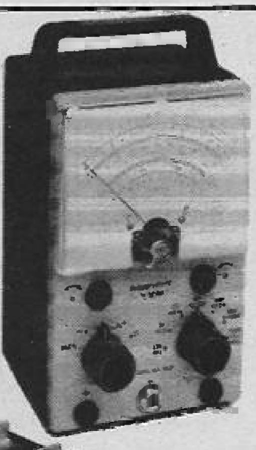
METAL LOCATOR (GD-48)
Picks up coins as small as ½p; has output on speaker plus a meter read-out.

DIGITAL CLOCK (GC1005)
Displays hours, minutes and seconds in a 12 or 24-hour format — and with full alarm facilities.

The Silver Prize can be either of the units shown or a voucher to the value of £40.

BRONZE

VALVE VOLTMETER (1M-18D)
Seven D.C., A.C. (r.m.s) and A.C. (peak) ranges with 11Mohms input impedance. Seven resistance ranges from 10ohms to 1Mohm centre scale.



C.D. IGNITION SYSTEM (CP-1060)
Better performance is what you can expect using this rugged transistorized ignition system.

The Bronze Prize can be either of the units shown or a voucher to the value of £25.

ION

PRIZES TO THE VALUE OF £150 MUST BE WON

Solve our Cross-Number printed below and you could win one of three great Heathkit Electronic Kits. The Gold Prize will go to the first correct entry drawn after the closing date, the Silver Prize to the second, the Bronze to the third. And you have a choice, within a price range, of your prize.

The competition is not easy: our experience with competitions has shown if the answers are a bit challenging readers enjoy entering more and that we receive more replies, but don't worry: we have not set deliberately trick questions - just tough ones. You will probably have to rope in your friends and use some easily available reference books, there's no restriction on how you obtain your answer.

So that you can familiarise yourselves with the prizes, every person who completes the right-hand section of the coupon will receive the latest Heathkit catalogue: 64 pages describing masses of kits, many of them newly available.

RULES

This competition is open to all U.K. and Northern Ireland readers of Electronics Today International except employees of the magazine, their printers and distributors and employees of Heath (Gloucester) Ltd.

All entries must be on the coupon cut from the magazine, photostats are not acceptable. As long as the correct coupon is used, readers may submit as many entries as they wish.

The Gold Prize will be awarded to the first correct entry drawn after the closing date, the Silver Prize to the second correct entry, etc. No correspondence can be entered concerning the competition. It is a condition of entry that the judges decision in all matters is regarded as final.

The winners will be notified by post. The answers and a list of prizewinners will appear in a future issue of ETI. The winners, on notification, may either specify which prize they require immediately or receive a voucher which must be exchanged within three months.

Entries should be sent to: ETI/Heathkit Competition, 36 Ebury Street, London SW1W 0LW to reach us by November 30th, 1974.

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The latest Heathkit catalogue will be sent free to every valid entrant to the competition who fills in the right hand section of the coupon. This applies even to those who fail to complete the Cross-Number.

HOW TO ENTER

Solve the clues shown and enter them on the form below as though it were a crossword but you will be entering numbers. All figures, (where applicable) should be rounded off to the number of decimal points for which there is space. Decimal points need not be entered and are not applicable in the other direction. For numbers less than 1, ignore the first zero. Therefore 0.025 will appear as 025.

Some of the clues are tough — but they are not tricks and those which you cannot answer from your head will be available in common reference books.

ACROSS

1. Twenty-two divided by seven is frequently used as a close estimate for this.
5. A Jumbo number.
7. Post war election year resulting in the largest Conservative majority.
10. Atomic Number of the element Francium.
11. Doc may ask you to say this.
12. S.F. film with 'Thus spake Zarathustra' as the theme music.
15. $\sqrt{11^4}$
17. e

DOWN

1. –, –, –, Zero.
2. Commonest i.f. in the U.K. (in kHz).
3. Two thirds as a percentage.
4. Air gun calibre.
6. Square yards in an acre.
8. $(104)^2 - (29)^2 - 83$
9. CMXXXII.
11. Colour code: white-brown-brown.
13. One-eighth expressed in binary form.
14. $\sqrt[3]{2924207}$
16. "–, –, Buckle my shoe".

CUT

TO: ETI/HEATHKIT COMPETITION
36 EBURY STREET,
LONDON, SW1W 0LW.

Please find attached my competition entry. I agree to abide by the rules and judges decision.

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ADDRESS ....

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Entries must be received by November 30th 1974.

1		2		3	■	4
	■		■	5	6	
7	8		9	■	10	
■		■		■		■
11		■	12	13		14
15		16	■		■	
	■	17				

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The articles appear as they did originally but have been amended where applicable.

And to round off the book we have included several pages of our popular Tech-Tips for the experimenter.

You asked for it, we've published it. Copies will appear at the end of October at your newsagents. If you have any difficulty in getting ETI usually (and we know that over a third of you do have problems) you can obtain it direct from us for 75p plus 10p postage.

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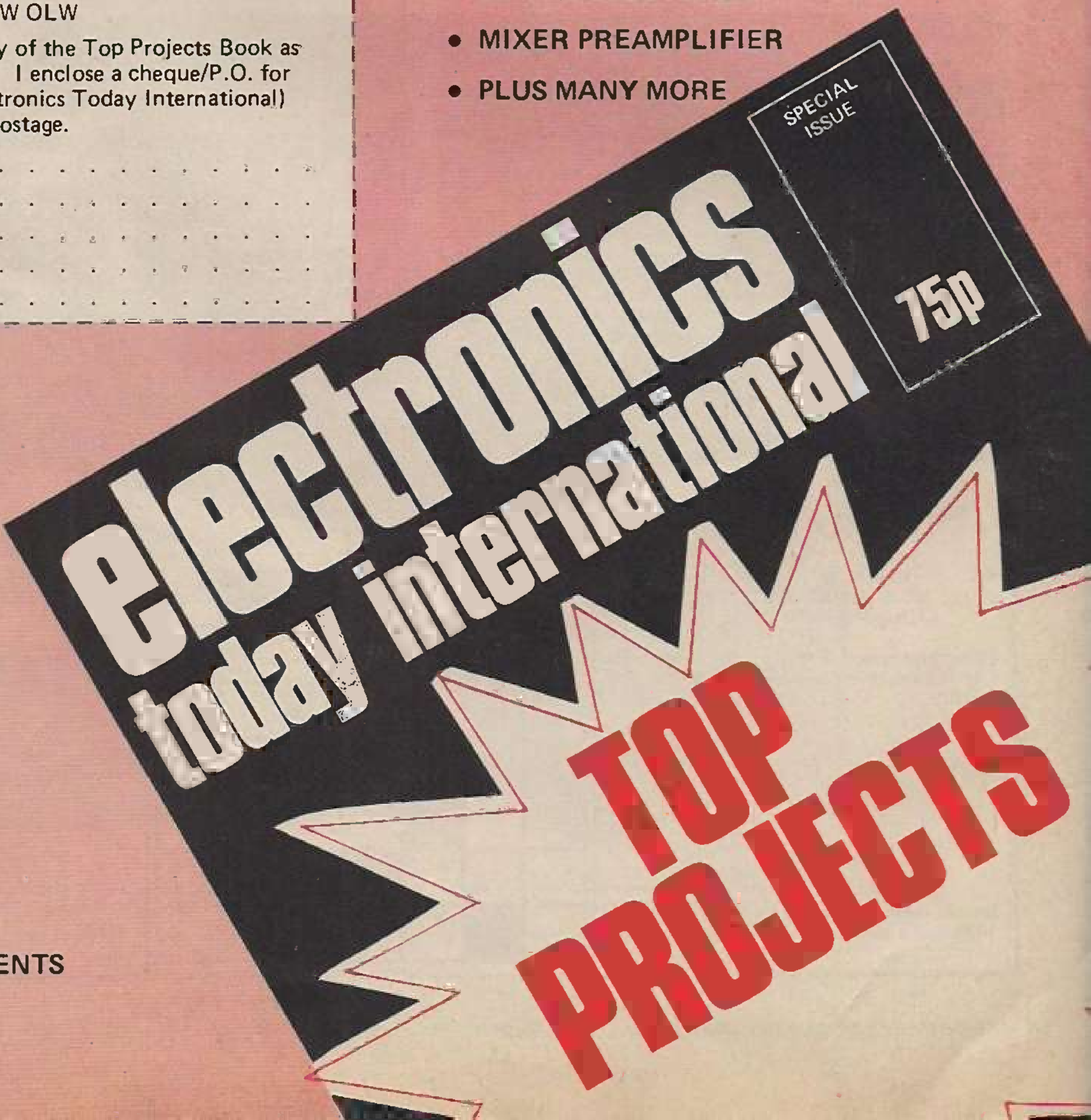

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A basic application note will be provided with each chip. The price of £1.00 is inclusive of VAT but readers *must send a stamped, self-addressed envelope* with each order for the return of the goods or money if the offer is oversubscribed. Orders should be sent to Ambit International, 37 High Street, Brentwood, Essex CM14 4RH.

The LM381 will be an ideal companion for our offer in next month's issue for LM380 3W audio amplifiers.

40 *SILICON DIODES*

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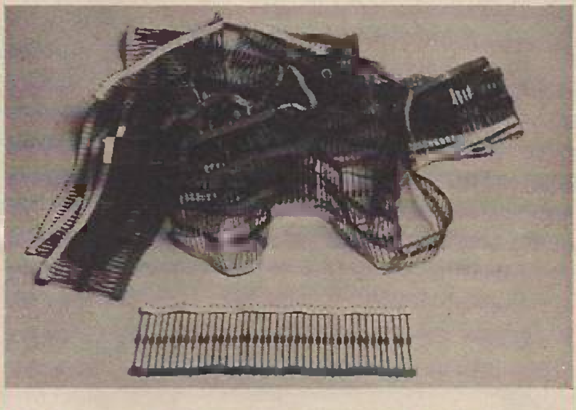

There are some components which find themselves into almost all circuits: silicon diodes are one example. For this reason we have arranged with Trampus Electronics to supply ETI readers using the coupon below with twenty 1N4001 (50V, 1A) silicon rectifiers and twenty 1N914/1N4148 type diodes.

These are not reject devices and fully up to manufacturer's specification and are guaranteed.

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Offer closes November 30th, 1974.

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What to look for in December's ETI

1 READER OFFER: TWO LM380 AUDIO IC's FOR £1.00
The LM380 is an excellent 3W plus audio i.c. suitable for numerous applications. The offer is rounded off with a series of projects using the device.

2 ROAD SAFETY—AN ELECTRONICS APPROACH
The world's death toll on the road has reached enormous proportions, yet electronic techniques could reduce this by reducing the possibilities of driver - and mechanical - error.

3 PICTURE TO SIGNAL
TV cameras have come a long way since Baird - this detailed article explains how modern TV cameras work.

4 HI-FI TODAY
Audio equipment sales are currently falling and manufacturer's are forging ahead with new techniques to tempt the buyer. We will be taking a look at these new techniques.

5 TACHO—TIMING LIGHT
A more sophisticated version of the project in our September issue. It incorporates a tachometer and enables the engine to be checked over the entire range of r.p.m.

6 SPRING LINE REVERB UNIT
A circuit suitable for use with stereo equipment and incorporating its own mixer. As with all ETI projects, the spec is excellent.

7 FAMILY FERRY
An electronic version of an old game. Just a few components will enable you to make a game to keep all age groups amused for hours.

8 ELECTRONICS IN CRIME—PART THREE
Continuing our series we show how electronics is being used to prevent hi-jacking of aircraft and how the terrorists are being beaten.

DECEMBER ISSUE ON SALE NOVEMBER 15TH – 25p
The features mentioned here are, at the time of this issue going to press, in an advanced state of preparation. However, circumstances, including highly topical developments, may affect the final contents.

electronics today INTERNATIONAL

HANDLING CMOS

The Do's and Don'ts by Vic Yates — Director of MOS Marketing Motorola, Europe.

THE one disadvantage of all MOS devices is their susceptibility to damage from inadvertent contact with objects carrying static charges.

Such objects include nylon overalls — often used by operatives in industry, conventional polystyrene foam — used for packing normal semiconductor devices and, of course, the human body. There are, in addition, many other ways in which destructive voltages can be applied.

The CMOS logic family, consisting as it does of networks of p and n-channel insulated gate field-effect transistors, can be damaged in the same way if some simple precautions are not taken.

The metal gate electrodes of the MOS devices in the CMOS family are separated from the diffused region by a layer of insulating oxide about 1200 Å thick. A potential difference of 60 V between the gate and any other terminal on the device is sufficient to rupture the oxide layer and render the device unusable. It can be calculated, since the gate capacitance is typically 5 pF, that a static charge of 10^{-12} coulombs will produce a 60 V gate voltage.

Manufacturers of CMOS logic devices incorporate a system of diodes, connected to each gate input terminal, which are designed to protect the oxide layer. These diodes conduct in either the forward direction or operate in the Zener mode to limit the gate voltage and can withstand the full normal operating current of the protected circuit.

In spite of these diodes, Motorola recommend that the following precautions be taken when handling CMOS devices.

Personnel handling CMOS devices should wear anti-static clothing. Cotton is ideal. Nylon gloves, finger cots and smocks must not be worn under any circumstances.

Before touching a CMOS device, operatives should first touch an earthed surface to discharge any personal static charges and should avoid dropping CMOS devices — they may fall on a charged surface.

Until actually required for use, the CMOS devices should have all their leads short circuited; they are normally supplied in black conductive plastic foam which protects them.

It is good practice to ensure that all leads of a CMOS device are earthed during either conventional or reflow soldering. Printed circuit cards can be plugged into dummy sockets with all pins earthed and conductive adhesive tapes can also be used.

Soldering irons, solder pots and flow soldering equipment should be in good electrical and mechanical condition and must be properly earthed. The same comments apply to automatic insertion equipment and machinery. All work-benchtops should be clad with metal which is at earth potential.

Test equipment should be checked to ensure that spurious voltage transients do not occur anywhere in the test set-up even when switching the equipment from one operating mode to another.

Never plug-in or unplug a CMOS device or a printed circuit card containing CMOS devices when the power supply is switched on. Ensure that the action of switching on and off power supplies does not generate transients.

Even if all the conditions mentioned above are satisfactorily met, component fatalities can still occur if one or two basic rules are not followed during the equipment design phase.

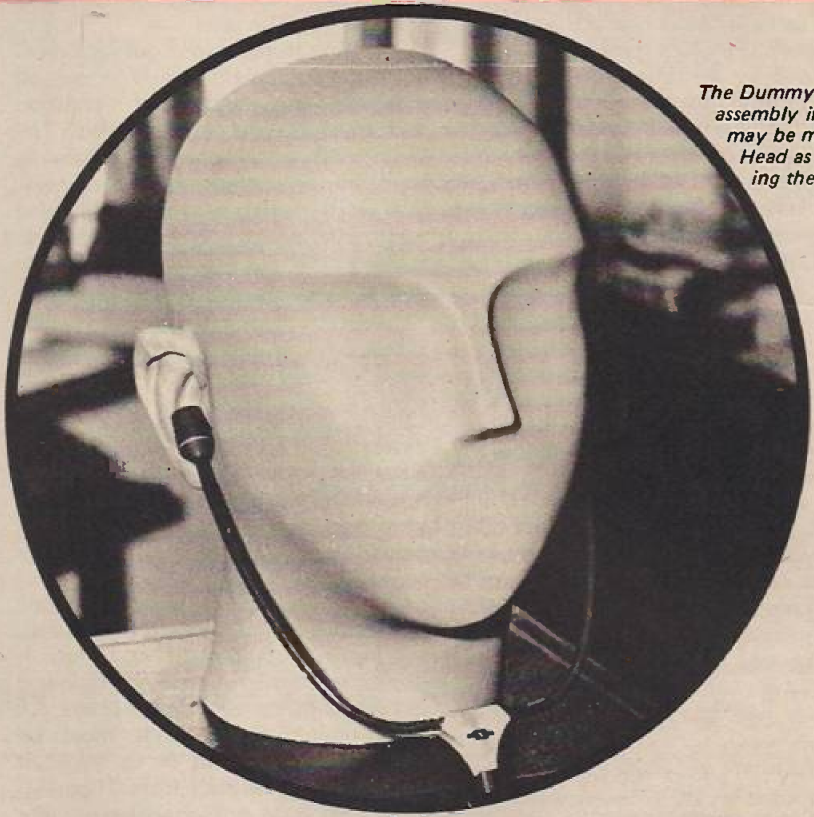
All unused input leads must be connected to ground or to V_{DD} to prevent the input from floating. Floating inputs not only destroy the very real noise immunity benefits to be gained from the use of CMOS, but can also result in the destruction of the device itself. In addition, while the actual supply voltage is not critical large transients on the supply rails must be avoided.

The rules governing the handling of CMOS devices have been outlined; the reader could be forgiven for thinking that CMOS is difficlult to use and will 'blow up' at the slightest provocation.

These rules have been developed by us — a manufacturer of CMOS circuits — so that we can say to our customers: follow them and you should have no problems. If the truth be known, the rules could probably be relaxed without danger. We know of CMOS circuits which have been lying about unprotected on development engineers' benches and have been soldered in and out of circuits without damage. However, during the manufacture of equipment, chances cannot be taken. The rules we give are simple straightforward common sense and should not cause any great expense or problem to implement. ●

etI product test

SENNHEISER'S DUMMYH RECORDING SYSTEM



The Dummy Head with micro assembly in position. Recor may be made either by usi Head as shown here — or ing the microphones on

SOUND recording and reproducing has come a very long way since Edison — nearly ninety years ago. Yet no matter how good the microphones, recording apparatus or playback equipment there is still something missing.

What is missing is an impression of the spatial and temporal characteristics of the original performance.

Four-channel sound was, supposedly, going to fill this gap. But it hasn't.

A NEW TECHNIQUE

Late last year we heard that researchers at Berlin's Heinrich Hertz Institute had developed a new recording technique which was capable of providing full spatial and temporal information — JUST USING TWO CHANNELS.

In effect the German researchers had gone back to nature. They had imitated all parts of the human head essential to the listening process. For instance the shape and softness of the external part of the ear plays an important part. So they made a model of the complete mid-ear and inner-ear, then installed condenser microphones where the human eardrum registers sound pressures.

Subsequent to our learning of this development, the editor of an associated journal visited the Sennheiser company in West Germany. There she discovered that Sennheiser was proposing to make a commercial version of the dummy head and triaxial microphone at a price low enough to enable the equipment to be sold on the domestic market.

At the same time, Sennheiser were producing a small sample record demonstrating the effect of this new equipment.

We heard this record as long ago as March 1974. It is a gem, demonstrating technical innovation of an advanced order. The effect was quite uncanny and closer to reality than any other technique which we had previously observed (an opinion we have not changed in any way since).

It was, then, with eager anticipation that we accepted an offer to evaluate the Triaxial Microphone and Dummy Head.

The Dummy Head is a replica of an 'average' person's head. It is moulded from a soft muddy-grey plastic material and is normally used mounted on the top of its carrying case — which, although rectangular, is said to provide similar acoustic properties to that of the human torso.

The Triaxial Stereo Microphone (MKE2002) consists of two miniature microphone capsules mounted on the ends of two spiggots and a plastic yoke. This assembly clips into the outer ear cavity of the Dummy Head — or the recordist himself.

The lightweight cords from the yoke assembly terminate in a small battery-operated preamplifier (which fits conveniently into the recordist's pocket if he is wearing the microphone assembly himself).

Both yoke and microphone capsule adaptors are light and quite comfortable to wear.

The preamplifier has a miniature light which can be illuminated when the preamplifier is switched on. It acts also as a battery condition indicator, dimming rapidly when the battery requires changing. Apart from switching on the power supply and following normal recording procedures, no additional or complex techniques are required.

A three-metre long cord from the preamplifier terminates in a 5-pin DIN plug.

Our first experiments consisted of recording three people who were moving around whilst dictating data in our office.

The results were, to say the least, exciting. The quality was good and the spatial effects uncannily real.

On replay using a set of HD 424 headphones, it was readily possible to localise and point out, with the eyes closed, where the other two speakers were, whilst there was no doubt that the speech of the person wearing the headphones was right between one's ears, i.e. in the middle of one's own head. Every twist and turn of either the wearer's head, or movement of the people close by was readily discernible.

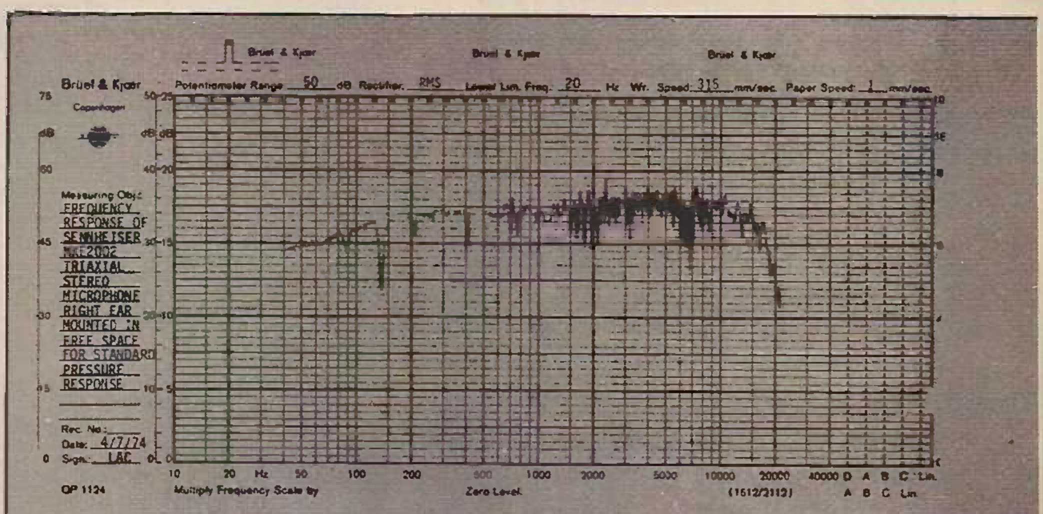
We repeated the same exercise on live

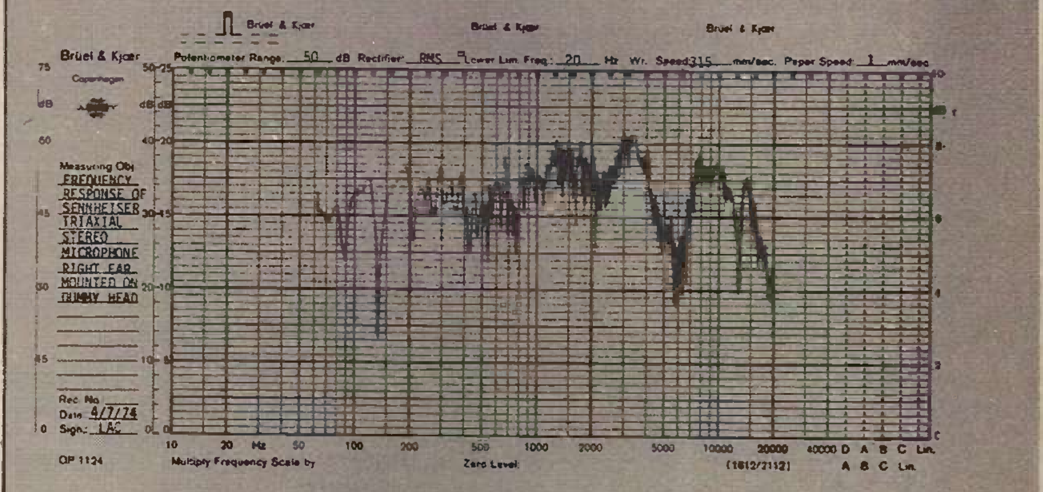
EAD

SUMMARY: The Sennheiser System is so good that it causes one to question very seriously indeed the future of four-channel sound.

Compared with any four-channel systems that we have heard yet, this essentially two-channel system leaves them dead ... and that is a very carefully considered statement.

The MKE2002 has a Recommended Price of £109.00 + VAT. Further information is available from the distributors: Hayden Laboratories Ltd., Hayden House, 17 Chesham Road, Amersham, Bucks HP6 5AG.





music and the same uncanny realism persisted. People speaking *behind* our seated position could be pin-pointed with almost total accuracy.

As far as this extraordinary ability to locate the sound source is concerned – whether in front of, behind, or even above the recordist (or Dummy Head) our overall impression of the recording was that it is the closest we have ever heard to our own perceived response.

This does not mean to say though that the reproduced sound is an exact replica of the original. It isn't, for reasons that we could not pinpoint until we started instrument measurements.

Our first test was to measure the frequency response of the two microphone capsules when dis-associated from the Dummy Head, (i.e. a free-field plot). We did this with a 12.5 mm Bruel and Kjaer 4134S Reference Pressure Microphone located centrally between them.

This measurement (Fig 1) shows a number of minor peaks and bumps but these are early reflections from our not totally anechoic environment. They are not non-linearities in the Sennheiser capsules. The true response is within 3 dB from 40 Hz to 18 kHz. That is as flat as one could wish for.

However in use, the triaxial microphone assembly is used in conjunction with an artificial (or human) head. This results in a reflection component from the side of the head and the shape of the ears. It is also evident that the ear's cavity absorption effect also affects the frequency linearity of the microphones.

That this was indeed so was proved when we repeated our measurements with the triaxial microphone in position on the dummy head. The results, shown in Fig 2, are not nearly as flat, as the free-air results. In fact there are excursions of the order of ±10dB – particularly at frequencies above 2000 Hz. This is still quite acceptable for amateur recording purposes – indeed we expect that it is actually *necessary* in order to provide the frequency discrimination required for the stereo effect. However this non-linear response may be a serious drawback for professional users.

Sennheiser say that their system is as good as a professional Dummy Head with implanted microphones. We cannot accept this premise and believe that prospective users seeking high precision would be better advised to spend the extra money and go for the professional models.

For amateur use though, the Sennheiser head and microphones are a revelation. They have an added advantage that one can use one's own head in order to produce one's own personal binaural recordings.

The recorded sound is coloured compared with the original signal – but not badly.

But no matter whether the recording is made via the Head, or one's own ears, the recorded sound, especially if replayed via 'open-air' headphones, is as big an advance as was the change from mono to stereo reproduction. Despite minor colouration, reproduced sound has a naturalness never before experienced. ●

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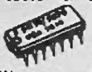

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BC149	0.10	OC36	0.60	2N3614	0.65
BC169C	0.15	OC44	0.20	2N3702	0.11
BC182	0.12	OC45	0.20	2N3714	1.41
BCY32	0.85	OC71	0.18	2N3771	1.77
BCY39	1.50	OC72	0.28	2N3773	2.40
BCY55	2.64	OC77	0.64	2N3790	2.10
BCY70	0.18	OC81	0.29	2N3819	0.38
BCY71	0.22	OC83	0.27	2N3886	0.72
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SC50A	1.46
SC50B	1.57
SC50D	1.80
SC50E	2.00
Also	
40430	0.85
40669	0.90
40486	0.85

SILICON CONTROLLED RECTIFIERS

See above for small quantity discounts. Large quantities and OEM phone 01-723 3646

	£ p
T05 1 Amp	
CRS1/05AF	0.42
CRS1/10AF	0.48
CRS1/20AF	0.52
CRS1/40AF	0.60
CRS1/60AF	0.78
T048 3 Amp	
CRS3/025AF	0.38
CRS3/10AF	0.48
CRS3/20AF	0.54
CRS3/40AF	0.65
CRS3/60AF	0.80
T048 7 Amp	
CRS7/400	0.84
CRS7/600	1.14
T048 16 Amp	
CRS16/100	0.78
CRS16/200	0.85
CRS16/400	0.96

ZENER DIODES

400 m/w BZY88/BZX83. From 3.3 volts–33 volts 10p each.

1.3 watts 5% Miniature Tubulars IN4700 series. From 3.3 volts–33 volts 18p each.

SILICON RECTIFIERS

1 amp series IN4001 to IN4007. From 6p each.

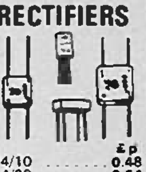
1.5 amp PL4001 to PL4007 from 7p each.

3 amp PL7001/IN5400. From 32p each.

Send for full list No. 36.

BRIDGE SILICON RECTIFIERS

FEATURING SMALL SIZE AND LOW COST
See above for small quantity discounts. Large quantities and OEM phone 01-723 3646



	£ p		£ p
½ Amp		B4/10	0.48
B025/025	0.14	B4/20	0.64
B025/05	0.16	B4/40	0.60
1 Amp		B4/60	0.70
B1/05	0.20	B4/80	0.90
B1/10	0.21	**6 Amp**	
B1/20	0.24	B6/05	0.50
B1/60	0.25	B6/10	0.58
B1/100	0.30	B6/20	0.68
2 Amp		B6/40	0.75
B2/05	0.30	B6/60	0.87
B2/10	0.35	**1 Amp Tubular**	
B2/20	0.40	W005	0.27
B2/40	0.44	W01	0.29
B2/60	0.45	W02	0.30
B2/100	0.55	W06	0.33
4 Amp			
B4/05	0.46		

LINEAR IC'S

New types arriving every day

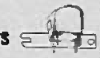
RCA		
CA3012	IF limit amp	£1.32
CA3014	IF limit amp/discrim	£1.80
CA3018	Transistor array	£1.02
CA3019	Diode array	£1.12
CA3020	Wide band power amp	£1.80
CA3022	Low power video amp	£1.93
CA3028A	Diff cas wide band	£1.03
CA3036	Dual Darlington pair	£1.08
CA3046	Transistor array	£1.03
CA3048	4 X low noise pre-amps	£2.76
CA3075	FM IF limiter and detector	£1.75
CA3081	Hi-Amp 7 seg com emit driver	£1.80
CA3089E	Complete FM IF system	£2.94
CA3090Q	PLL stereo decoder	£5.40
Signetics		
NE555	Timer	£0.85
NE560B	Phase lock loop (PLL)	£5.00
NE561B	PLL analogue multiplier	£5.00
NE562B	PLL open loop for dividers	£5.00
NE567B	PLL tone detector	£3.50
Motorola		
MC1303L	2 X low noise pre-amp	£1.42
MC1304P	Stereo MPX decoder	£1.79
MC1310P	PLL (coil-less) MPX decoder	£2.91
MC1458CPI	Twin op-amp	£0.77
MC1710CG	Level detecting op-amp	£0.60
MFC4000P	250mW amp	£0.46
MFC4010P	Wide band pre-amp	£0.55
MFC6040P	AF attenuator	£1.00
Others		
TBA800	5W power amp	£1.50
SN76003N	5W power amp (finned) (2 for £2.85)	£1.50
SN72741P	8 pin d.i.l. op-amp	£0.60
SN72748P	8 pin d.i.l. Hi-Z op-amp	£0.61
702C	(TO5) op-amp	£0.75
709C	(TO5 or d.i.l.) op-amp	£0.39
723C	(TO99 or d.i.l.) reg	£0.90
728C	(TO99 or d.i.l.) reg	£0.45
741C	(TO5. 8 or 14 pin d.i.l.) gen pur op-amp	£0.50
747C	(TO5 or d.i.l.) gen pur dual op-amp	£1.00
748C	Hi-Z op-amp	£0.61
LM309K	5V 1.6A reg	£2.00
TAA960	3 st filter (ultra's'ic trened)	£1.75

CASH AND CARRY PRICES
for callers or by post

GB Post/Packing 15p per item

Ref No.		Price
1.	D1203 telephone amplifier—SUCTION	£4.95
2.	D1201 telephone amplifier CRADLE	£7.50
3.	T12D6 2 station intercom	£4.95
4.	T1306 3 station intercom	£9.95
5.	T1406 4 station intercom	£12.50
6.	TAIA 2 station telephones intercom	£13.50
7.	W1.2 2 station wireless intercom	£18.20
8.	DP303 door phone intercom	£7.00
9.	PK3 ETCH your own printed circuits	£2.25
10.	EA41 reverberation amplifier	£11.75
11.	U550 ultrasonic switch	£12.75
12.	XP4002 photoelectric alarm system	£13.50
13.	Solid state tachometer	£11.30
14.	Power dash transistor assisted ignition	£13.50
15.	Car auto lock	£2.75
16.	4 amp 6–12 volt battery charger	£4.85
17.	FF21 car radio/tape quad adaptor	£4.68
18.	Fully disappearing car aerial	£2.00
19.	Electric disappearing car aerial	£7.80
20.	ET (F1009) Morse code key/buzzer	£1.70
21.	VH105 aircraft band converter	£4.50
22.	LM300 50K disco mic.	£12.95
23.	DF50B 50K communications mic.	£5.75
24.	Car lighter plug 12w voltage adaptors 300mA (state 6/7½/9 volt)	£1.95 each
25.	STC tuner delay module	£1.50
26.	Gravenire 931A photo electric unit (with data)	£3.50
27.	3 cw. 3 X 500 watt sound to light	£21.50
28.	3 cw. 3 X 1000 watt sound to light + override	£41.25
29.	150 watt light display projector with wheel	£23.50
30.	MM1 (BZ005) 4 channel 9 volt mixer	£4.20
31.	MX100 deluxe 4 channel mixer	£6.78
32.	H67(G1320) stereo headphone amplifier	£10.50
33.	MP12 6-CH. slider control mixer	£27.95
34.	RE208 stereo phone adaptor	£2.25
35.	MD802 stereo phones	£2.20
36.	CIS200 stereo phones	£2.75
37.	CIS250 stereo phones	£6.50
38.	G1301 and G1305 stereo phone controls	£2.95
39.	Car stereo speakers in pods. Special offer Pr.	£2.95
40.	Crystal lapel microphone	£0.60
41.	F1052 car speakers front/rear fadar	£1.00
42.	Bib groove clean (ref. No. 42)	£1.76
43.	Bib record care kit (ref. No. 43)	£2.20
44.	Bib cassette recorder care kit (ref. No. 26A)	£1.96
45.	Bib cassettee tap splicing kit (ref. No. 24)	£1.64
46.	BASF reel-reel hobby box	£2.40
47.	2000 ohm headphones	£1.50
48.	4000 ohm headphones	£1.55
49.	Cassette recorder mic. (2½ and 3½mm plugs)	£1.85
50.	420 ES microscope	£5.70
51.	UP050 low cost 9 volt eliminator	£2.28
52.	RE 527 tape head demagnetiser	£1.70
53.	Cambridge pocket calculator	£17.95
53A.	Sinclair Cambridge Memory	£23.95
54.	BC808 % pocket calculator	£21.95
55.	BC817 memory pocket calculator	£28.95
56.	BCM 850 % and memory calculator	£33.25
57.	Sinclair scientific calculator	£27.20
58.	Antex soldering iron kit (SKI)	£3.30
59.	Bib record care kit (ref. No. 59)	£1.17
60.	5pc chassis punch kits	£5.50
61.	Longs desoldering tool	£5.50
62.	1 amp in line mains suppressors	£2.50
63.	BSS2 (E1013) 7-way stereo speaker switch	£2.20
64.	Welle 8200D-PK expert gun kit	£6.20
65.	'S' dec breadboard	£1.98
66.	'2' dec ..	£4.29
67.	'4' dec ..	£7.50
68.	'T' dec ..	£3.65
69.	Instant head soldering gun	£2.30
70.	40 watt soldering iron	£1.90

ELECTRONIC COMPONENTS



(Post/Packing 15p per 1–6 items GB unless stated)

Ceramic Filters
Miniature filters 10.7MHz 40p pair
IC IF Unit
CA3089 10.7MHz IC £2.94

IC Clock
MM 5314 single chip clock with CCT £9.00

Sinclair 6 watt IC
IC12 with data and PC board £2.10

Radio IC chip
ZN414 Radio IC with circuit £1.20

Stereo Cassette Tape Heads
Replacement for most recorders £2.00

Ultra sonic transducers
with data/circuits £6.90 pair

Strobe tubes
ZFT8A (similar to 4A £4.00
ZFT12A £5.00

7 segment Indicators
3015F with data £1.70 each

Spring delay units
HP42 9" twin spring £3.30 pp 20p
HR1 6" twin spring £6.86 pp 25p

Fibre optics
0.01" dia. mono filament £6.60 per 100 metres 0.13" dia. 64 fibres £1 per metre 15m dia. mares tails £10.50 each

Radio Control XTALS
Matched pair for 465 kHz IF £2.00 pair for all superhet trans RX's.

Handsets
Lightweight telephone handsets brand new complete with diagrams for intercoms £3.00 pair

Marriot tape heads 4 track mono or 2 track stereo
"17" High Impedance £2.50
"18" Med. Impedance £3.50
"36" Med. Impedance £5.00
Erase Heads for "17" "18" and "36" £1.00
"63" 2 track mono. High Imp. £1.75
"43" Erase Head for "63" 75p
(post. etc. 15p any quantity)

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(Please enclose large SAE with all enquiries)

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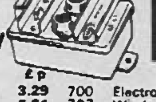
Everything supplied



Model No.		£ p			£ p
310	Radio control receiver	3.29	700	Electronic Chaffinch	7.92
300	4-channel R/C transmitter	6.61	707	Windscreen wiper timer	7.97
345	Superhet R/C receiver	6.61	760	Acoustic switch	12.57
65	Simple transistor tester	1.66	780	Metal Detector (electronics only)	10.91
115	8 watt amplifier	4.50	790	Capacitive Burglar alarm	7.92
120	12 watt amplifier	4.73	835	Guitar preamp.	4.99
125	Stereo control unit	6.61	840	Delay car alarm	6.99
127	Noise reduction unit	9.55	875	CAP. Discharge ignition for car engine (—Ve Earth)	13.19
130	Mono control unit	4.16	80	Scope Calibrator	2.65
157	Private TV loop trans	4.95	255	Level indicator	6.98
605	Power supply for 115	5.31	525	120–160mHz VHF timer	11.31
610	Power supply for 120	5.31	715	Photo cell switch	8.07
615	Power supply for 2 X 120	6.64	795	Electronic continuity tester	4.97
230	AM/FM aerial amplifier	3.29	860	Photo timer	15.51
240	Auto packing light	6.90	235	Acoustic Alarm for driver	8.61
275	Mic. preamplifier	6.98	465	Quartz XTAL checker	9.90
525C	120–160MHz VHF tuner	11.31	220	Signal Injector	2.65
570S	LF generator 10Hz–1mHz	21.46	390	VOX	£13.62
575S	Sq. wave generator 20Hz–20kHz	19.77	432	Testakit	21.83
590	SWR meter	9.47	670	Buffer Battery Charger	7.69
630	STAB Power supply 6–12v 0.25–0.1A	9.24	850	Electronic Keyer	16.37
690	DC motor speed Gov.	3.31			

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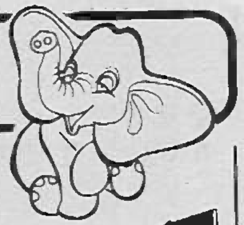
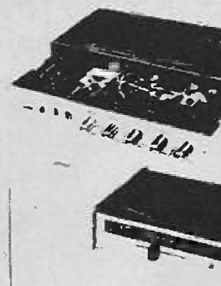


You can build the Texan and Stereo FM Tuner

TEXAN 20+20 WATT IC STEREO AMPLIFIERS



Features glass-fibre PC board. Gardners low field transformer. 6-IC's. 10 transistors plug diodes etc. Designed by Texas Instruments engineers for Henry's and P.W. 1972. Supplied with full chassis work, detailed construction handbook and all necessary parts. Full input and control facilities. Stabilised supply. overall size 15¼in × 2¾in × 6⅜in mains operated. Free teak sleeve with every kit. **£28.50 (GB post paid).**

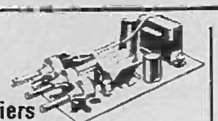
STEREO FM TUNER

Features capacity diode tuning, led and tuning meter indicators, stabilized power supply—mains operated. High performance and sensitivity with unique station indication IC stereo decoder. Overall size in teak sleeve 8in × 2½in × 6⅜in.
Complete kit with teak sleeve **£21.00 (GB post paid).**

JOIN THE LARGE BAND OF HAPPY CONSTRUCTORS!

TRANSISTORISED MODULES

Tuners—Power Suppliers—Amplifiers



Amplifiers (All single channel unless stated)

4-300	9 volt	300 MW	o/p 3–8 ohm, 1–10mVi/p	Special offer	£1.75
2004	9 volt	250 MW	o/p 3–8 ohm, 10–10mVi/p	Special offer	£2.70
104	9 volt	1 watt	o/p 8–10 ohm, 10mVi/p		£3.10
304	9 volt	3 watt	o/p 1–8 ohm, 10mVi/p		£3.95
555	12 volt	3 watt	o/p 8–16 ohm, 150mVi/p		£4.10
555ST	12 volt	1½×1½ watt	o/p 8 ohm, 150mVi/p	Stereo module	£5.95
E1208	12 volt	5 watt	o/p 4–16 ohm, 25–60mVi/p		£5.10
608	24 volt	10 watt	o/p 4–8 ohm, 30–50mVi/p		£4.95
410	28 volt	10 watt	o/p 8 ohm, 160mVi/p		£4.95
620	45 volt	30 watt	o/p 1–8 ohm, 150mVi/p		£9.95
Z40	30/35 volt	15 watt	o/p 1–8 ohm, 100mVi/p		£5.45
Z60	45/50 volt	25 watt	o/p 1–8 ohm, 100–250mVi/p		£6.95
SA6817	24 volt	6+6 watt	o/p 8 ohm, 100mVi/p	Stereo module	£10.20

Amplifiers with controls

E1210	12 volt 2½+2½ watts 8 ohms	Stereo	£8.25
R500	Mains 5 watts 4–16 ohms	Mono	£6.30
SAC14	Mains 7+7 watts 8 ohms	Stereo	£11.75
SAC30	Mains 15+15 watts 8 ohms	Stereo	£14.95
CA038	9 volt 1½+1½ watts 8 ohms	Stereo	£8.95
CA068	12 volt 3+3 watts 8 ohms	Stereo	£10.50

FM Modules

Mullard LP 1186 FM tuner (front end) with data 10.7MHz o/p	£4.85
Mullard LP 1185 10.7MHz IF unit	£4.50
Gorler Permability FM tuner (front end) 10.7MHz o/p	£4.20

FM and AM tuners and decoders (All models fitted dials supplied with instructions)

FM 5231 (tu 2) 6 volt FM tuner	£7.96
TU3 12 volt version (FM use with decoder)	£7.95
SD4912 Stereo Decoder for Tu 3.12 volt	£7.96
SP62H 6 volt stereo FM tuner	£14.95
A1007 9 volt MW–AM tuner	£4.80
Sinclair 12/45 volt FM tuner stereo recorder for above	£7.45
A1018 9 volt FM tuner in cabinet	£13.95
A1005M (S) 9–12 volt stereo decoder FM for above	£7.50
1062 12 volt stereo decoder. General purpose	£6.50

Preamplifiers

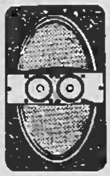
Sinclair	Stereo 60 Preamplifier. With Controls. Special Offer.		£6.75
E1300	CART/TAPE/MIC INPUTS 9 volt	Modules	£2.85
E1310	Stereo 3–30mV mal cart 9 volt	..	£4.75
FF3	Stereo 3mV tape head 9 volt	..	£4.95
3042	Stereo 5–20mV Mag. cart. mains	..	£5.95
EQ25	Mono 3–250mV Tape/cart/flat. 9 volt	..	£1.95

Power Supplies— Mains input (*chassis-rest cased)

470C 6/7½/9V 300mA with adaptors	£2.26
P500 9 volt 500mA	£3.20
HC244R 3/6/7½/9 volt 400mA stabilised	£5.50
*P1124 volt ½ amp £3.30, *P15 28 volt ½ amp	£3.30
*P1080 12 volt 1A £4.70, *P1081 45 volt 0.9A	£7.80
P12 4½–12 volt 0.4–1 amp	£7.15
SK01A 3/6/8/12 volt 1 amp stabilised	£12.75
P1076 3/4½/6/7½/9/12 volt ½ amp	£4.20
Sk800A 1–15 volt 0–½A stabilised	£17.50

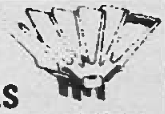
EMI SPEAKERS

Special Purchase



13×8 chassis speakers (carr/packing 30p each or 50p pr)
★150 TC 10 watt 8 ohm twin cone **£2.20**
★450 10 watt 4, 8, 15 ohm with twin tweeters and crossover **£3.85 each**
FW 15 watt 8 ohm with tweeter **£5.25**
350 20 watt 8, 15 ohm with tweeter **£7.80 each**
*Polished wood cabinet **£4.80** carr., etc. 35p each or 50p pair

EXCLUSIVE 5 WATT IC AMPLIFIERS



Special purchase 5 watt output 8–16 ohm load. 30 volt max DC operation complete with data.
Price **£1.50** ea.
or 2 for **£2.85**.

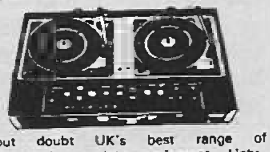
UHF TV TUNERS

625-line receiver UHF transistorised tuners FM. UK operation. Brand new.
(Post/packing 25p each)
TYPE C variable tuning **£2.50**
TYPE B 4-button push-button (adjustable) **£3.50**

SPECIAL EQUIPMENT

Brand new ex-WD portable radiation detectors 0–10r complete with power unit, haversack and probe (CV2247) PRICE **£9.97 carr/packing** £1.00.
Brand new seal photo multiplier units (designed FM fuel tank fire detective) **£3.50.**

PA-DISCO-LIGHTING EQUIPMENT



Without doubt UK's best range of modular and complete equipment. Lighting, mixing, microphones, accessories, speakers, amplifiers, lenses, etc., etc. FREE stock lists (Ref. No. 18) on request CALL IN AND SEE FOR YOURSELF at Henry's Disco Centre, 309 Edgware Road. 01-723 6963

TEST EQUIPMENT

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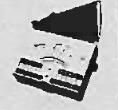
(carr/packing 35p)

U4324 20KV with case	£9.25
U435 20KV with steel case	£8.75
U4313 20KV with steel case	£12.50
U4317 20KV with case	£16.50
U4341 33KV plus transistor tester steel case	£10.00
U4323 20KV plus IKHzd 465KHz OSC with case	£7.70
ITI-2 20KV slim type	£5.95
THL33D (L33DX) 2KV robust	£7.50
TP5SN 20KV (Case £2.00)	£9.25
TPS 105 2K/V	£8.25
TW 205 20K/V	£10.00
TW 50K 50K/V	£11.25
EP 10KN 10K/V	£9.95
AF105 50KV De-luxe (Case £1.80)	£12.50
S100TR 100KV plus transistor tester	£22.50

General Test Equipment



(* carr/packing 30p † carr/packing 50p) unless stated

† 3100 IMA strip chart recorder	£44.00
† Tk40 AC multivoltmeter	£10.75
† Tk15 Grid dip meter 440KHz–28MHz	£19.91
† Tk65 28 range valve voltmeter	£22.50
* Tk200 RF generator 120KHz–500MHz	£10.96
† Tk220 AF generator 20Hz–200KHz	£10.95
* NM350 In circuit transistor tester	£19.50
* C3025 De-luxe meter 1–300 MHz	£8.95
* TT145 Compact transistor tester	£14.75
† G3-36 R/C osc. 20Hz–200KHz	£19.75
* C3042 SWR Meter	£5.75
* SE350A De-luxe signal tracer	£12.95
* SE400 Mini-lab all in one tester	£15.50
C1–5 Scope 500,000KHz (carr £1.00)	£43.00
* C3043 5 CH F/A meter 1–300MHz	£5.75
Resistance sub box (Post etc 20p)	£2.40
Capacitator (Post etc 20p)	£2.10
2 amp variable transformers (carr £1)	£9.56
Radio activity counter 0–10r (carr £1)	£9.97
Mains unit for above (carr 50p)	£3.76

JOSTY KITS IN STOCK

(Post, etc., 15p each)

AF20	Mono transistor amplifier	£5.81
AF25	Mixer	£3.30
AF30	Mono transistor pre-amp	£3.20
AF35	Emmiter amplifier	£2.43
AF80	Small 0.5W amplifier for mic	£4.00
AF305	Intercom	£7.06
AF310/2	Mono amplifier (for stereo use two)	£7.56
M180	Multivibrator	£2.19
M1302	Transistor tester	£8.34
M191	Vu-Meter	£5.37
M192	Stereo balance meter	£5.94
LF380	Quadrophonic device	£10.82
AT60	Psychedelic light control, single channel	£7.80
AT65	Psychedelic light control, 3 channel	£10.53
AT25	Window wiper robot	£5.82
AT30	Photo cell switching unit	£6.80
AT50	400w Triac light dimmer speed control	£6.19
AT56	2 200w Triac light dimmer speed control	£8.76
AT5	Automatic light control	£3.76
GU330	Tremelo unit for guitars, etc	£8.10
HF81	Diode detector	£3.07
HF65	Frequency modulated FM transmitter	£3.21
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GP310	Stereo pre-amp. for use with 2. AF 310	£22.01
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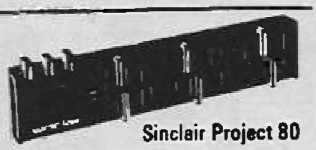
AE9	Treblefilter	£1.06
AE10	CCIR—filter	£1.06

AMATEUR ELECTRONICS by Josty Kit, the professional book for the amateur—covers the subject from basic principals to advanced electronic techniques. Complete with circuit board for AE1 to AE10 (see above). PRICE £3.30 (no VAT).

SINCLAIR MODULES AND KITS



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KITS FOR THE CAR

With the ever escalating costs of motoring it is becoming increasingly necessary to ensure ones car is at its best. Despite the possibilities, automotive electronics is still in a low growth area. Jeff Maynard continues his series of reviews and looks at two kits to help todays driver and considers a further DIY exercise.

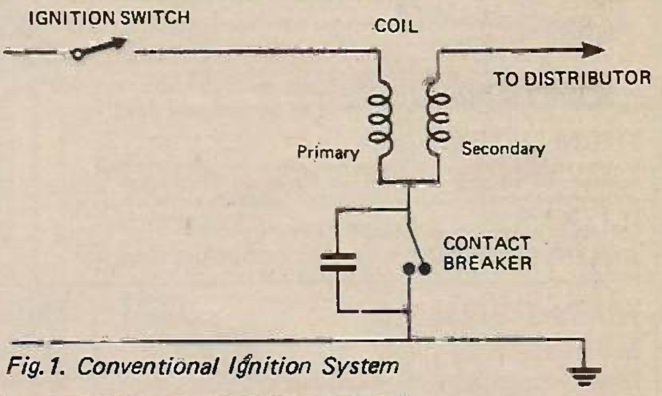
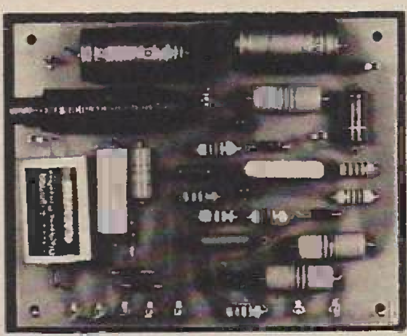


Fig. 1. Conventional Ignition System



The Scorpio MkII from Dabar.

THE AREA OF automotive electronics of most recent interest is undoubtedly that of electronic ignition systems, or specifically capacitor discharge ignition systems. In order to appreciate the benefit of such a system it is necessary to understand the working of a conventional system as shown in Fig. 1.

The contact breaker points are opened and closed by a cam driven from the engine timing gearing. An opening of the points interrupts current in the primary of the coil thus inducing a high voltage in the secondary. This is led to the appropriate sparking plug by the distributor.

Although conventional ignition systems have been in use for a number of years, they do suffer from a number of disadvantages. The major of these, from the owner/driver's viewpoint, is the need for constant attention if peak performance is to be maintained. During use, the contact breaker points become pitted and dirty resulting in an inferior waveform being applied to the plugs. This can be worsened by inaccurate timing and points gap adjustment.

A four cylinder engine running at 6,000 rpm requires 1200 sparks per minute with the time between sparks being 5mS. Current flowing in the primary of the coil rises exponentially at a rate determined by the inductance and resistance of that coil. With typical values of 11mH and 3.5Ω this gives a time constant (i.e. the time to reach 63% of final value) of about 3mS.

Contact breaker points are closed for about 60% of the time and at 6000 rpm therefore are in the charging (closed) position for 3mS (60% of 5mS). Thus the current flowing through the primary will only rise to 63% of its low speed value. Thus at high revs the spark energy is reduced and is further weakened by the relatively slow rise time of 100μS.

(Note that the situation with a 6 cylinder engine is worse because of the need for 3 sparks per engine revolution).

The capacitor discharge ignition system contains a free running transistor oscillator used to charge a capacitor to about 400V. When the contact breaker points open a thyristor is triggered and discharges the energy stored in the capacitor through the coil. The advantages of such a system have been much discussed in the electronics Press and can be briefly summarised thus -

1. fast rise time for spark voltage (typically 25μs)
2. low current drain
3. constant output over entire engine speed range.

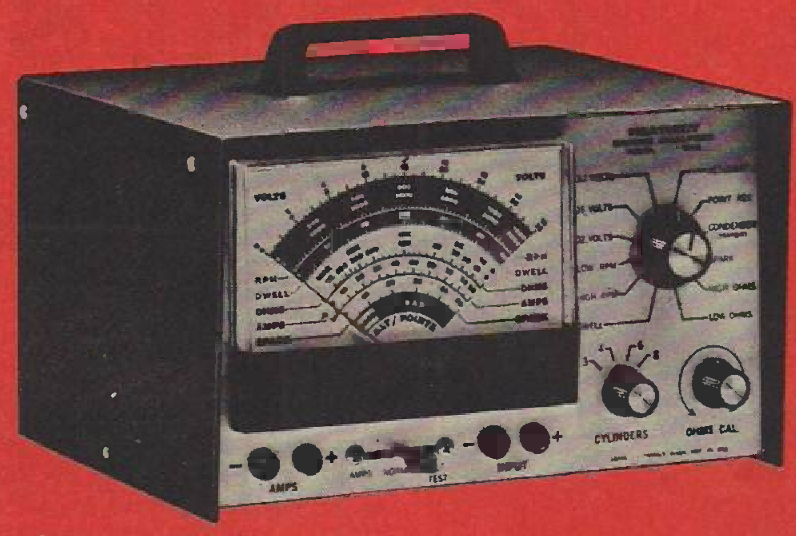
A further advantage is that contact breaker wear (pitting) is considerably reduced allowing the engine to remain in tune longer.

ELECTRONIC IGNITION

The electronic ignition kit from Dabar Electronics is based on the well tried "Scorpio" design and is complete to the last piece of wire. In addition to the passive components (all of which are of high quality) the delivered package contains 12 semiconductors, a ready wound transformer with colour coded leadouts, a waterproof die-cast case and a roller tinned PCB together with all the necessary hardware.

The instructions supplied are brief but together with component identification and PCB layout, provide sufficient information for even the first-time constructor. The main danger with this unit is that the power transistors or thyristor can be shorted to the case with the likelihood of damage to the unit. However, a clear warning of this is provided in the 9 page instruction manual.

Pre-installation checking is limited to aural verification of oscillation (at about 2kHz) and confirmation of current consumption. Vehicle installation presents no problems provided a well

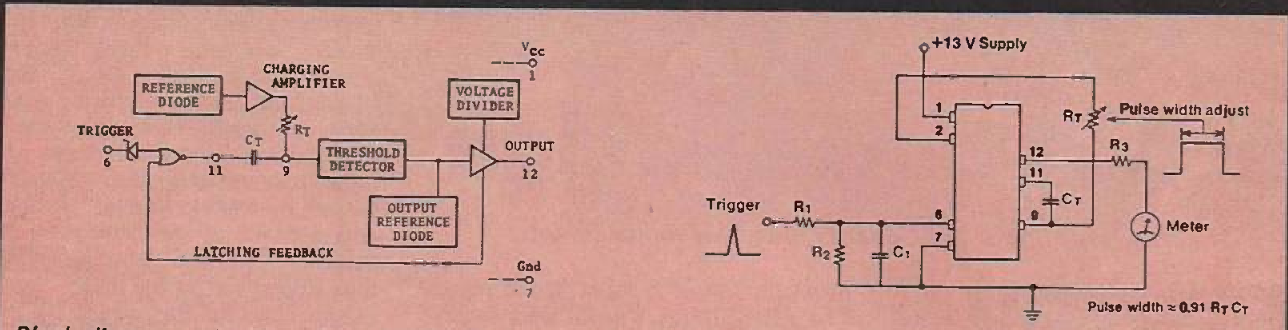


The Heathkit C1050 Engine Analyzer

SCORPIO Mk II IGNITION SYSTEM
Dabar Electronic Products,
98A Lichfield Street,
Walsall, Staffs, WS1 1UZ
Kit: £12.72 inc. VAT

CM1050 ENGINE ANALYZER
Heath (Gloucester) Ltd.,
Gloucester, GL2 6EE
Kit: £38.90 inc. VAT

SW781 TACHO DRIVER
A. Marshall (London) Ltd.,
42 Cricklewood Broadway,
London NW2 3HD
IC: £5.67 inc. VAT + 20p P&P.



Block diagram and wiring of the SW781 Tachometer from Marshall's.

ventilated location is used - usually anywhere in the engine compartment not immediately adjacent to the exhaust pipe will suffice. Total time to build and install is about 2 hours.

The method of connection is such that in the event of a malfunction the conventional system can be restored by reconnecting a single wire. A warning is given to owners of cars with a ballast system in their ignition. These cars will require a new coil before fitting a Scorpio. (Note - an electronic ignition unit will not function satisfactorily with a ballast system).

Latest news from Dabar is that they are bringing out a Mk II version of the kit. An AMP block replaces the terminal block and an RFI filter has been incorporated in the circuit. It comes in a painted box and in 6V or 12V versions.

Details are also provided for rewiring those tachometers that will not work with an electronic ignition system.

Of course it is all very well having any form of bolt-on performance improvement device, but it will not be of any benefit unless the engine is properly tuned.

Devices for home tuning tend to be limited to timing lights and other simple devices. However, the situation is much improved by the availability of the CM-1050 Engine Analyser from Heathkit.

ENGINE ANALYSER

As with most multi-range measuring devices, most of this unit consists of complex switching arrangements to provide the necessary input to meter connections. This unit is no exception, the main function selector switch being 8-pole 12-way.

The task of interwiring to this switch is much simplified by the unique Heathkit instruction method. Having been told to cut various coloured wires to precise lengths the constructor is required to attach them to specified lugs. The bottom wafer of the switch is then soldered to the roller tinned and screen-printed PCB. The previously cut lengths of wire now conveniently reach the required PCB holes. The majority of interconnections are completed by use of a ready made wiring loom.

The unit is suitable for use on conventional electronic and magneto ignition systems fitted to 4, 6 or 8 cylinder vehicles and is temperature compensated.

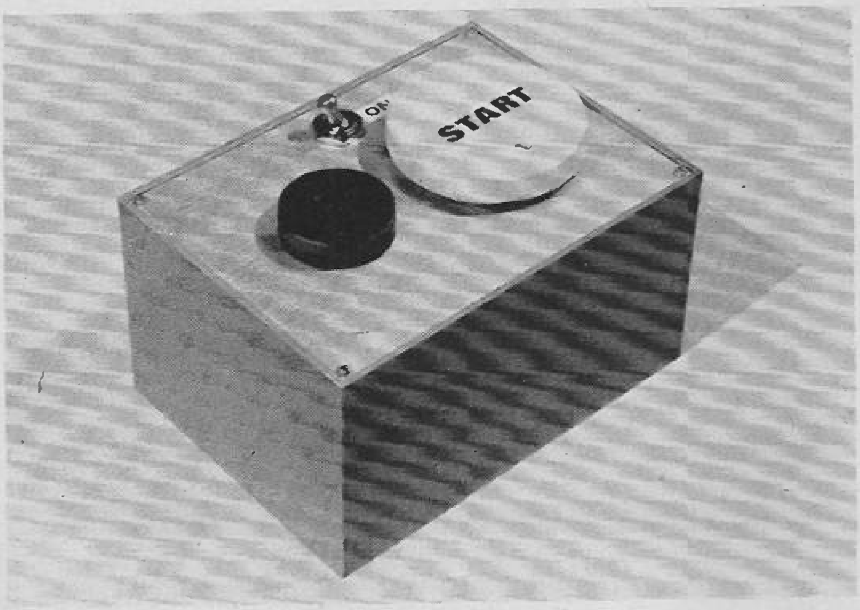
As usual with Heathkit units the finished job is very professional looking; the rear of the analyser contains a compartment for the supplied test leads, calibration cable and current shunt together with a battery compartment. A nice finishing touch is the inclusion of a pocket-sized grease resistant operating manual containing a number of tune-up hints in addition to a description of each analyser function.

IN CAR TACHO

Once the vehicle engine is tuned it is just as important to observe good driving techniques if petrol economy is to be maintained. A useful help here is a dashboard mounted tachometer. Any 1 milliameter can be converted to a linear scale tacho with the aid of the SW781 IC, recently available from Concord Instrument Company. Whilst this is not strictly a kit, its simplicity (6 external components only required) merits a mention. ●

ETI PROJECT 526

THE PRINTIMER



an A.J. Lowe design

Improve your photo print quality with this simple design.

ONE OF the major causes of poor quality in enlarging black and white photographs is lack of consistency in print-development time.

Many photographers think that they can get away with making enlargements without exposure test strips by pulling the print out of the developer when it looks about right. The PRINTIMER should teach them better 'manners' and help them produce better prints.

The unit described in this article gives an alarm - a fixed time after pushing the start button. Once the timer is set at the development time you believe is right for you, whether that is 1½ minutes, three minutes, or anywhere between, consistent development times will be obtained giving consistency of results. Poor prints are then the result of wrong exposure, not a combination of wrong exposure *and* wrong development.

WHAT IT DOES

As can be seen from Fig. 1, the timer has an on/off switch and a start button as its only visible controls. It can be turned on, and left on, for the whole of a darkroom session as the current drawn is very low. Once an exposed photo paper has been truly dunked in the developer, the start button is touched, and (say) two minutes later, an audible alarm beeps for a few seconds to indicate the expiry of the chosen development time. The device is ready for immediate re-use. It saves all the problem of watching a clock while development is taking place. The start button, which has been made super large, costs nothing and can't be missed in the darkroom. It can be operated with an arm or wrist by those darkroom workers who like having their fingers wet all the time.

Other uses for this device are as an egg timer, or even as a timer for quiz shows where a contestant must answer in a particular time. It could also be used as an STD telephone-call timer to remind you of the passage of time. Although it is basically a preset timer

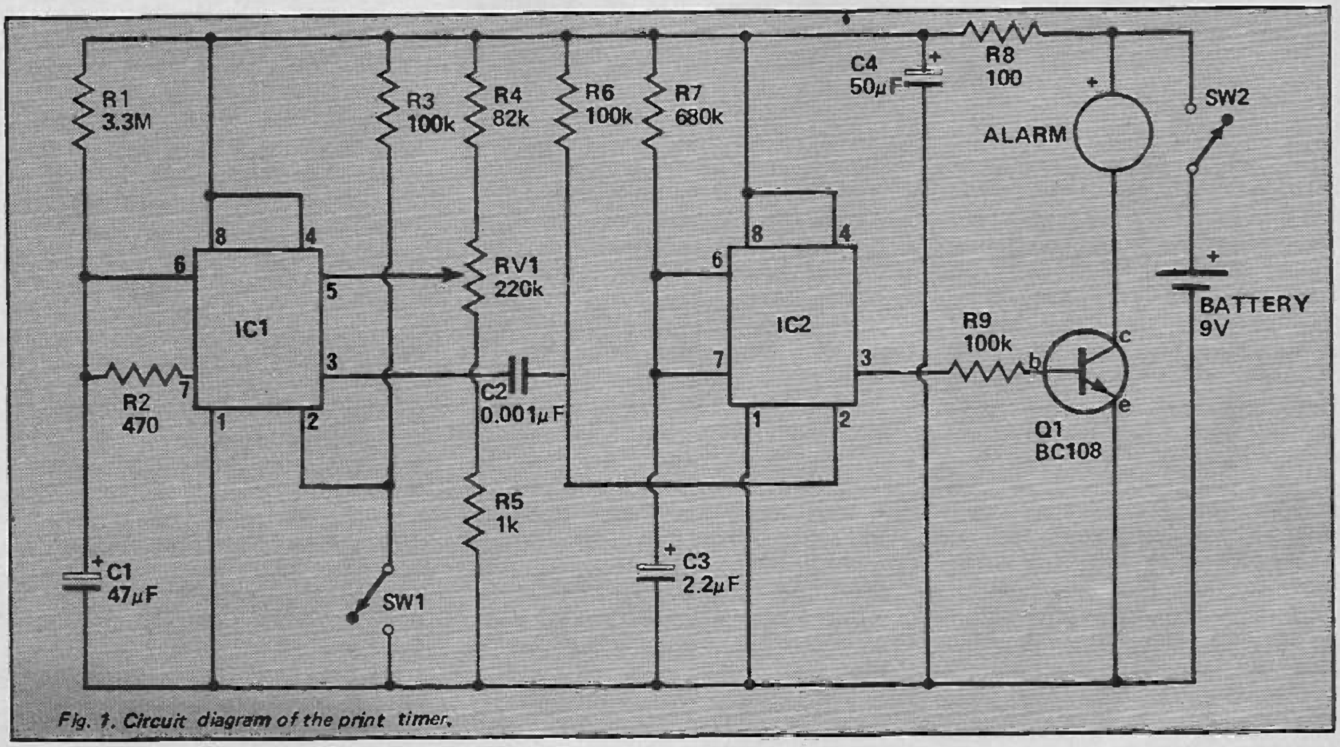


Fig. 1. Circuit diagram of the print timer.

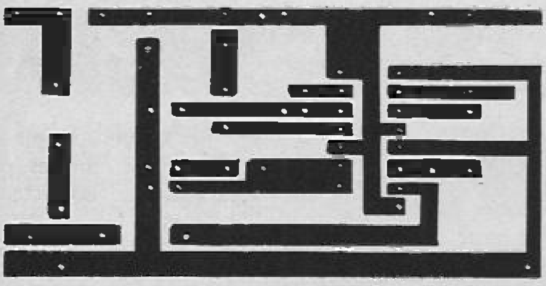


Fig. 2. Printed circuit board (full size).

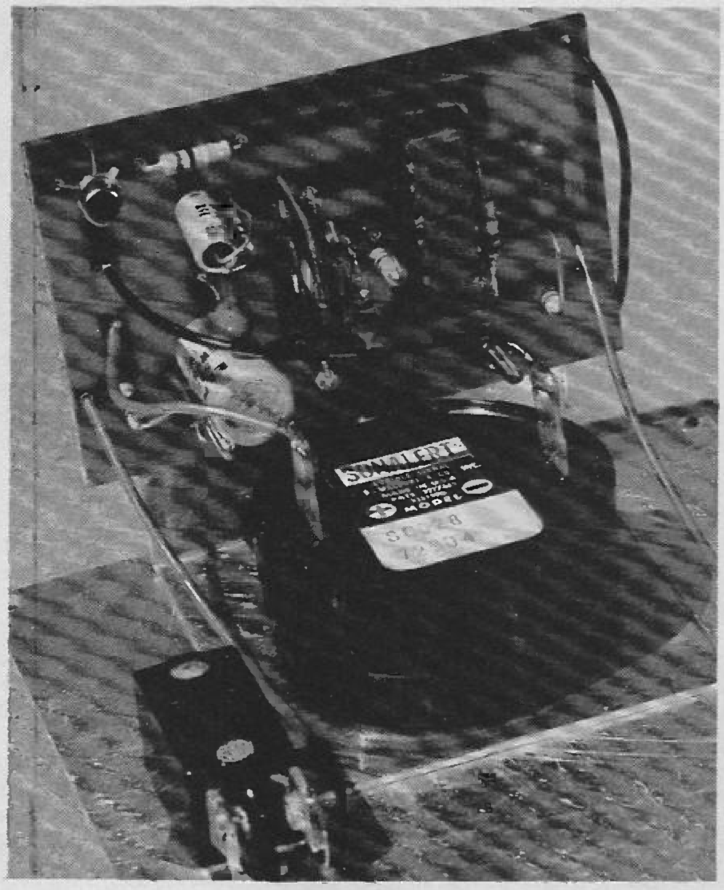


Fig. 3. The printed circuit board is mounted on an aluminium bracket which, in turn, is secured to the front panel by means of the Sonalert.

HOW IT WORKS

The timer uses two NE555V IC timers as shown in the circuit diagram Fig. 1.

Integrated circuit IC1 is the main timer – its time of operation being determined by the values of R1, C1 and the preset pot RV1. When the start button, S1 is pressed, terminal 2 of IC1 is connected momentarily to the negative rail. This sends the output of IC1 (terminal 3) high.

At the preset time, terminal 3 goes low, and so applies a negative going pulse to terminal 2 of IC2 which is the second NE555V timer. Terminal 3 of IC2 goes high, turning on the BC108 transistor Q1, thus allowing current to flow through the Sonalert. After the Sonalert has sounded for a couple of seconds or so, as determined by the values of the timing components of IC2 (R7 and C3), terminal 3 of IC2 goes low again, and the Sonalert is turned off.

The fact that terminal 3 of IC1 is low (in the quiescent state of the device) does not cause IC2 to restart as a negative going pulse is required to do that.

Resistor R8 and capacitor C4 stabilise the supply to the ICs so that they are not affected by pulses produced when the Sonalert switches off and on.

PARTS LIST

R1	Resistor	3.3 megohms	¼W
R2	"	470 ohms	"
R3,R6,R9	"	100k	"
R4	Resistor	82k	"
R5	"	1k	"
R7	"	680k	"
R8	"	100 ohms	"
RV1 Preset potentiometer 220k			

C1 Capacitor electrolytic 47μF 6.3 volt tantalum
C2 Capacitor .001μF ceramic
C3 Capacitor electrolytic 2.2μF 25 volt
C4 " " 50μF 25 volt

IC1 IC2 Integrated circuit timers NE 555V

Q1 Transistor BC 108

Alarm Sonalert type SC628, or Morganite type MB-12

S1 Push button switch — see text.

S2 Toggle switch on/off

Battery 9 volt

Case, p.c. board, aluminium for bracket etc.

NOTE: R9 may be too high a value for some circuits. This may either be reduced or even omitted to obtain correct operation.

it could be made readily adjustable, as described later.

CONSTRUCTION

The timer was built into a plastic case measuring 140 x 100 x 75 mm with the works mounted on a printed circuit board 70 x 47 mm. The printed circuit board is mounted on an aluminium bracket, which in turn is secured to the front by the Sonalert as shown in Fig. 3. The arrangement shown leaves enough room in the case for a 9 volt Eveready battery, type No 276-P, which will last a very long time.

There is nothing critical about the layout, – and those who prefer Veroboard or matrix board construction can easily work out their own layouts.

The copper side of the printed circuit board used in the prototype is shown full size in Fig. 2, and the layout of components on it is shown Fig. 4.

Both ICs are mounted in one 16 pin DIP socket with their notches nearer the positive rail. Note that pin 5 of IC2 is not used and so the bottom right hand corner pin of the IC socket may simply be run through a hole in the board or cut off.

Polarity of electrolytic capacitors C1 C3 and C4 must be observed, as must the polarity of the Sonalert.

The large 60 mm diameter push button marked START is a gift from your friendly jam manufacturer – it's the screw cap off one of his jars. The 'spring' of the push button (developed after much experimenting) is a disc of plastic foam about 3 mm thicker than the depth of the cap, and about

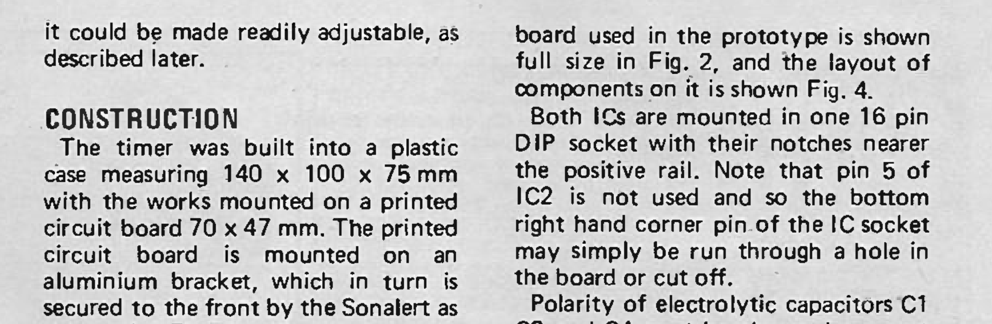


Fig. 4. Component overlay.

THE PRINTIMER


The completed print timer.

20 mm less in diameter.

First solder a flexible lead to the inside of the screw cap — out near the rim. Then paint the cap white if it carries some brand name.

Next carefully remove the paint from the lower edge of the rim of the cap by rubbing it on a piece of emery cloth. The edge of the cap must be clean all round because this is the surface which makes contact with the aluminium panel, and it must 'make' wherever the button is touched. Glue the plastic foam 'spring' centrally, to the inside of the cap. When it is set the push button is ready for mounting on the panel. Its position should be determined and then a hole drilled obliquely through the panel at some point below the cap, but clear of the foam-plastic spring. Thread the lead (soldered to the cap) through the hole, and position the cap so that the lead does not cause any restraint to pressing the cap.

When all is in position the bottom side of the plastic foam may be glued to the front panel. You now have a first class push button, far bigger than any you could buy.

Note that the battery negative lead is connected to the panel by means of a suitable tag on the printed-circuit board mounting bolt. From there the negative lead goes to the printed-circuit board itself.

The battery should be anchored inside the box by a suitably shaped aluminium bracket.

ADJUSTMENT

With the component values shown the timer range is from about ½ to 3½ minutes. Component tolerances could affect these figures, but timing is not sensitive to battery voltage variations. The actual time delay before the Sonalert sounds is set by the preset pot RV1. This should be adjusted to the time of development you intend to use.

Those who want to have an adjustable timer, for other purposes, could bring out leads from the printed-circuit board and substitute a panel mounted potentiometer for the preset pot RV1. ●

ELECTRONICS IN CRIME PART 2

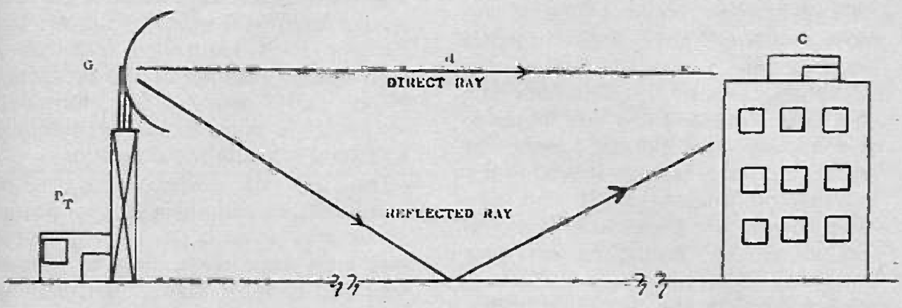


Fig. 1. How a radar station can destroy computer data. This is an actual case that was discovered at one of the main international airports in the USA. A computer centre was located 2 km from the airport's long-range radar antenna — which had a power gain of 2500 (34 dB) Peak transmitted power was 3 MW. The electric field at the computer centre (point 'C') was 237 volts/metre — direct ray only. With the addition of the reflected ray, which arrived in-phase with the direct ray, the intensity was 474 volts/metre! This is 54 dB higher than the potential susceptibility level of the computer.

In the war with crime, *both* sides are using increasingly sophisticated techniques. Electronics Today reports —

GEORGE ORWELL'S novel '1984', described a future in which people live under the terror of a totalitarian regime where both the rank and file as well as privileged party members are subject to surveillance, control and whims of 'Big Brother' (an arch-dictator) and his secret police.

While a blaring propaganda machine manipulates the populace, other sinister organisations collate data on individuals and subject them to such meticulous scrutiny, that even their inner-most fears are no longer secret. Privacy is non-existent and both in the home and on the streets the ever present "electronic" eye of "Big Brother" maintains a constant watch. Dissenters to the system are summarily dealt with, and after signing "confessions" disappear into oblivion.

We still have ten years before Orwell's prophesized regime — yet even now there are signs that some of what Orwell feared may happen.

Already we are scrutinized — benevolently or otherwise.

Social security organisations collate data on individuals, state security organisations scrutinise their own agents as well as individuals and groups who, they believe, could be prejudicial to the security of the state.

Commercial interests keep dossiers on their personnel. Rival politicians scrutinise each others private lives.

Credit-bureaux keep secret files on customers whilst other government and commercial organisations try to collect all the information they can — with or without the knowledge or consent of the individual. And once this data is stored it is never forgotten.

Closed circuit TVs survey staff and customers alike in department stores, hotels, bars, apartment house lobbies, streets, and banks.

The erosion of privacy of the individual whether by "legal" or criminal means is becoming more commonplace everyday; a more sorry aspect is that the conditioned public is beginning to accept this as a way of life.

Electronic intrusion devices, whether used "legally" or otherwise, constitute the most distasteful and sociologically dangerous misuse of technology.

The aquisition and storage of personal data, whether by government bodies or others, is questionable — both morally and ethically. Despite what the computer companies tell you, such data *is* vulnerable to intrusion by unauthorised persons, and it is a fact that criminal use has and will continue to be made of such data.

COMPUTER SECURITY AND DATA PRIVACY

As more and more information is stored in computer memory systems the danger of intrusion by the "computer criminal" even when elaborate security precautions are taken, ever increases.

It also places the computer itself in danger. Criminals, knowing that their records are stored in such a machine or tapes, may make attempts to destroy them by destroying the machine. More subtle intrusion methods may involve the "writing-in" of a program of commands to eradicate specific data without the knowledge of the authorities.

In the commercial world industrial espionage is commonplace. The industrial spy is a highly specialised professional versed in the latest electronic techniques and the computer presents a most vulnerable target; especially where remote machines necessitate the sending of data over lines. Ironically, whilst frowned upon by legal authorities, no concrete laws exist to stop such malpractices. The industrial spy can blatantly operate with little fear of the law.

The growing awareness of the need for computer security was vividly brought to focus in 1970 in the USA.

There, a militant group of dissidents, aware of the damage that can be done, placed a bomb in the US Army Mathematics Research Centre at the University of Wisconsin. The resultant explosion killed a research employee and destroyed a 1.5 million dollar computer complex and caused a further five to six million dollars damage to the facility. Data which had been collected over 20 years and represented *1.3 million man-hours* of effort were irretrievably destroyed.

Unfortunately there have been and continue to be further examples of this type of crime underscoring the vulnerability of computer systems.

Dynamiting a computer is nevertheless a crime of the "old school" with chances of apprehension in favour of the police.

COMPUTER vs COMPUTER

A recent case reported from California deals with the theft of information by one computer from another. The spying computer took over a computer services' bureau terminal, having previously obtained the pass code by electronic interception. The only reason that the crime was detected was that the bureau, in accordance with a previously made arrangement, delivered the punched cards to its customer. When the customer denied having ordered these cards they were printed out to discover what error had occurred.

Even more amazing was the sequel to this event when an over-excited sergeant of police mistakenly wrote out a charge under Californian state law indicting the computer with unauthorised acquisition of information from another computer! Perhaps this is a portent of things to come.

A much more serious threat is posed by the "new breed" of criminal: the electronic expert, highly educated with above average intelligence, knowledgable and ingenious as any circuit designer. Because, by virtue of his education, he is capable of commanding a high salary in conventional employment, he plays the game for the highest stakes, and in a manner that makes orthodox police detection methods useless. It is opening up the field for a new kind of police officer — virtually a duplicate of his criminal counterpart but on the right side of the law.

The computer's first characteristic of interest is the "inhuman" speed and scale of its operation. It can perform in a few seconds work that would take thousands of man-hours to do otherwise.

The computer needs only to be criminally instructed by one man to have the criminal capability of thousands.

Computers are becoming more and more sensitive to their electromagnetic environment.

A unit located on the 60th floor of a new New York building was found to give a more than normal number of errors. On investigation it was found by spectral analysis (RF) that two radio towers, a microwave link and an "in house" RF paging system were producing electromagnetic fields of a critical level in the computer room. The resulting interference picked up in the computer circuits resulted in faulty operation.

Having identified the problem, a solid shielded room was built to house the unit and its power supply. Power and signal lines were filtered, and air ducts and other intakes and outlets treated as necessary.

Similar cases of units actually failing in the vicinity of airport radar installations and naval bases have been reported.

This indicates how the computer is vulnerable to both interference or destruction by directed beams of high RF power. Highest susceptibility has been found over a frequency range of 450 MHz to 3000 MHz.

Since the computer circuits themselves radiate power, effective shielding techniques have to be applied to these radiated signals as they can be picked up by surveillance receivers and data extracted.

Within a computer complex, security measures cover both physical security of the computer and the "integrity" of the circuitry and signals. In high security systems routine checks for clandestine transmitters and integrity are made with an EMI/RFI sweep. This, with other suitable equipment measures and locates any electromagnetic interference.

Mini-computers have been designed to provide programmed access to selected areas. Personnel are admitted or locked out from pre-determined areas at pre-selected times based upon their authorization level. A print out and alarm occurs on a security console if any attempt is made to subvert the system. Each controlled area has a card reader installed at the protected point of entry or terminal. Magnetically encoded ID cards enable entry only to authorised persons.

The use of coded cards, keys, combinations and passwords for access to security areas is standard practice. Yet even these are subject to human frailities such as theft, transference, loss and duplication.

Technology is still searching for a "foolproof" system. Some recent innovations utilise hand geometry, fingerprint and voiceprint identification with claimed high reliability.

Where a computer is linked with remote terminals via cable or radio link, susceptibility to intrusion increases considerably.

The sophisticated criminal can lease or purchase equipment to wiretap data lines.

The hard wire tap or a micro-wave receiver introduced into the "link" path enable virtually total acquisition and print-out of data being sent.

Fortunately, such activities can be detected. Microwave systems for example are designed with a "fade margin" which allows for degradation of received power. If an intruding antenna is introduced into the path further deterioration of the signal is apparent — and detectable. Special cables have been developed that are sensitive to any tampering, giving instant alarm, but their high cost precludes their use on other than short distance links.

The most effective method to safeguard data transference is to use crypto-devices. Such devices are available commercially.

Operational data security can only be achieved through the proper evaluation of threats and vulnerabilities to the system. The process is dynamic because of the design changes in computer hardware and the constraints imposed by the operating environment.

A great deal of work is still required to establish secure systems. More active participation at graduate level in

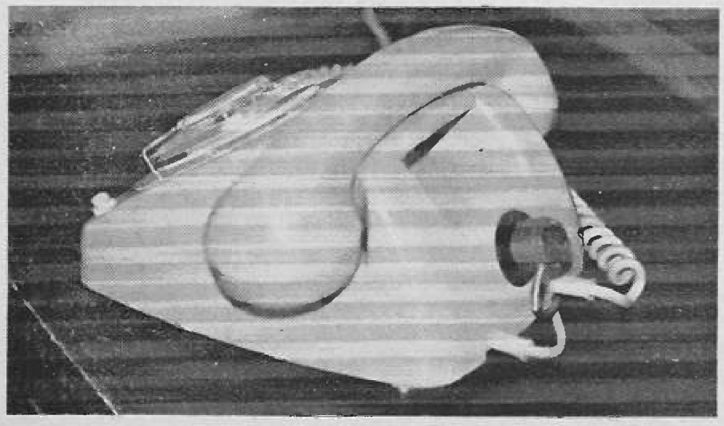


Fig.2. Inductive taps (such as this shown attached to a telephone) are commercially available from many tape recorder manufacturers!

In one of his 1969 Boyer Lectures, Professor Zelman Cowen quoted an American source as saying "there are only nineteen years left until 1984, but American listening devices will meet that deadline easily".

THE LAW AND THE POTENTIAL "BUGSTER" – DON'T!

There are laws pertaining both to tampering with the telephone system and felonious intrusion on third party communications. Both carry the most severe penalties, including imprisonment.

If the reader feels tempted to "experiment", either to see if his phone is bugged or try to bug one himself, he is liable to be dealt with to the full extent of the law.

Tampering is very rapidly detectable and the chances of apprehension and subsequent prosecution are very high.

If the presence of a bug is suspected contact the telephone authorities. They will (if they believe it necessary) bring in experts to deal with the matter and apprehend the responsible parties. DON'T TRY TO DO IT YOURSELF.

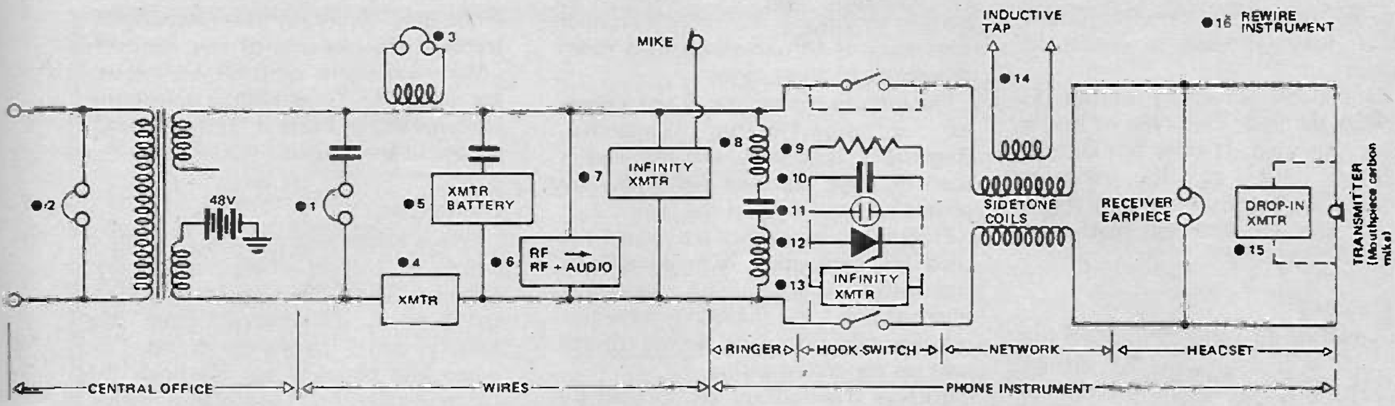


Fig.3. How telephone systems are bugged, the various numbered points indicate vulnerable points – as explained in the main text.

colleges and universities is also warranted. Formal courses treating operational data security in the depth are required.

BUGGING – AN OLD TECHNOLOGY

Bugging dates back to the introduction of wire telegraphy.

The use of a suitable detector such as a morse sounder, wired across the telegraph line enabled the operator to intercept any messages.

From these early beginnings the "art of intrusion" has evolved into a highly sophisticated exercise in the application of state-of-the-art technology.

The vulnerability of the individual to such practices has been vividly demonstrated in such cases as the recent Watergate affair. The devices used and the methods of their concealment are such, that they can only be detected with elaborate search both directly and with the aid of specialised instruments. Even after careful searching it is hard to ascertain if a place has really been "de-bugged". The "bugs" are in many cases so minute in size and their concealment so ingenious that detection is nigh on impossible. The deliberate placement of "phoney" bugs in easy-to-find places, is also not uncommon to lull the victim into a false sense of security.

Now the introduction of solid-state imaging devices of dramatically smaller size than present video equipment portends the evolution of visual as well as audio-only bugs.

Telephone Bugging

Telephones are particularly vulnerable to bugging.

Most people know that they can be bugged so as to intercept messages – less commonly realised is that they can also be bugged so that they 'listen-in' on conversations within a room, even whilst the receiver is on its rest.

Modern solid-state telephone bugs are small and ingenious. Visual inspection will not always reveal their presence. Other methods must be used to locate them.

Figure 3 shows various ways in which a typical domestic telephone hand-set may be bugged.

The numbers in parenthesis (below) refer to points indicated on this drawing.

Because the law prohibits tampering or bugging only generalised details are shown rather than specific or complete circuits.

Bug detecting services can interfere with the operation of telephone systems, so any such testing is limited to operators who are legally sanctioned by the authorities to do so.

The Phone Tap

A phone tap is some direct or indirect connection to the telephone line that enables an eavesdropper to listen to tape record conversations or signals. (1)

The patch into the telephone system may be made at various places in the telephone network – including the local or central telephone exchange. (2)

Inductive Taps

An inductive tap consists of a pick-up coil, which is sensitive to the magnetic field within the telephone handset. Any voice signals will be picked up by this device and subsequently amplified. Inductive bugs are generally concealed within the telephone receiver and cannot be detected by normal line testing. Only a visual inspection will reveal their presence (3 and 14).

Surprisingly perhaps, inductive taps are sold quite openly by tape recorder manufacturers specifically for taping telephone conversations. (see Fig. 2)

The Transmitting Tap

The series-connected transmitting tap (4) is fairly easy to deal with. An electronic sweep with a surveillance receiver will detect its presence. Since this tap can be installed anywhere along the line from the victim's hand-set transmitter (a replacement drop-in unit) to and including the central telephone exchange, the surveillance receiver must be ultra-sensitive.

The advantages of the transmitting tap is that the listener does not have to have physical access to the phone line once it has been installed. Since the tap obtains its power from the phone line it does not require batteries. It should be noted that this device only transmits when the phone is off the hook and is used to intercept phone conversations only.

The surveillance receiver will detect the presence of this type of bug only if the line is actuated so that the bug transmits. A difference in the off-hook voltage will also be noted at the telephone instrument when compared with the off-hook voltage when no tap is present and therefore a telephone analyser may be used to detect its presence.

A parallel connected transmitter (5) may also be used. This type of bug is battery operated. It does not disturb the line but as it transmits continuously, battery life is very short. It too can be detected with the surveillance receiver.

RF Flooding

This method amounts to flooding the telephone with high level RF energy and retrieving the signal which has been modulated by the carbon microphone inside the telephone handset.

The high level RF energy goes through the hook-switches and the phone does not have to be modified. It is very difficult to use against multi-line sets and is usually used only against single line sets.

A surveillance receiver or a telephone analyser with a built-in RF detector can be used to spot this device but only whilst it is in use.

The Infinity Transmitter

Another device, and one which has received widespread publicity, is the "infinity transmitter".

This device may be installed inside the phone (7). When the eavesdropper wishes to listen into a *room conversation*, he dials the appropriate phone number and by using a pitch-pipe sends a tone down the line just before the bell rings. This actuates a relay in the handset which in turn immobilizes the bell and also connects the handset microphone directly to the line.

All conversations within the room will now be monitored by the microphone *whilst the handset is still on its rest.* Thus an eavesdropper, merely by ringing his victim's number can monitor conversations in a room thousands of miles away.

The infinity transmitter is not a piece of science-fiction apparatus. Regretably it is only too real and is used in large numbers right now by people on both sides of the law.

External microphones are sometimes used in conjunction with an infinity transmitter (7). The external microphone is hidden wherever required and connected to the control unit via concealed wiring.

Infinity transmitters are located by sweeping the line with a tone generator.

Ringer Mechanisms

In many telephones, the ringer coils will transmit sounds within a room onto the lines. The audio signal can be detected by connecting a low-noise high-gain amplifier across the line.(8)

A telephone analyser can determine if an individual instrument is prone to this effect.

Hot-Miking

Some eavesdroppers rewire telephones so that they are 'hot-on-hook'. This enables the eavesdropper to listen-in to a room conversation whilst the hand-set is on its rest.

Various methods are employed to do this. The "earthy" side of the hookswitch is bridged permanently. Across the other set of terminals of the hookswitch can be wired a resistor (9), capacitor (10), neon bulb (11), or an SCR (12). In the case of the SCR and the neon bulb a voltage pulse (100V) has to be applied to activate the "tap".

Having made a tap in any of the methods listed the infinity transmitter (13) described earlier is used. It is modulated either by the receiving or transmitting element of the handset.

Many variations of these techniques are possible. Tests with a telephone analyser will indicate if "hot-on-hook" problems are present.

Transmitter

This is rather a crude way of tapping a phone but is cheap, quick and effective.(15) The original carbon mouthpiece is removed from the handset and a transmitter dropped in. When the phone is off the hook the tap transmits, using the phone power, as well as allowing normal conversation. This device can be detected during a sweep with the lines actuated, by a physical inspection or with a telephone analyzer.

Re-wiring the Instrument

There are many methods (16) of sending room audio down the lines when the instrument is on hook, simply by re-wiring the instrument. Either the receiver or transmitter elements of the handset maybe used as the microphone. Again, a telephone analyser will detect this type of bugging.

IN THE 'INTERESTS OF SECURITY'

Present day bugs can be completely self-contained "wireless microphones", disguised by housing them in everyday objects such as pens, watches, ornaments etc. They can be placed on the premises by "official" visitors, janitors, cleaners or any person able to gain entry legally or illegally.

In many cases they are "built in" into a building. In the case of hotel security for instance, it has been observed that some American hotels have bugs installed in all rooms. It is the duty of the house detective or security man to scan the rooms at regular intervals in a central listening post to "hear" if anyone is discussing the theft of "hotel towels" and other "valuable property."

In the so-called interest of security there is little control over how far this can be carried.

Even though the law does not accept tape-recorded evidence the potential for blackmail is frightening. This most obnoxious of crimes is also on the increase and it is estimated that in the US alone millions of dollars are paid out annually by victims.

The ingenuity of bug designs knows no bounds. On completion of the US embassy in the Soviet Union during the Stalin era, an elaborately carved eagle representing the American great seal was presented to the US by the Russians. This was erected in one of the conference rooms at the embassy.

For several years afterwards the Russians were able to listen in on conversations from a nearby parked truck. The device fitted into the carving was a passive type bug. A resonant cavity with a diaphragm, the bug could be energised at any time by a narrow beam of RF directed at it from a transmitter located outside the embassy grounds.

The frequency transmitted was equal to the resonant frequency of the bug. Any sound vibrations affecting the diaphragm would modulate the RF and could be picked up by a receiver tuned to that frequency.

The bug could operate indefinitely since no batteries were required. The approximate year that this type of bug was produced — 1945.

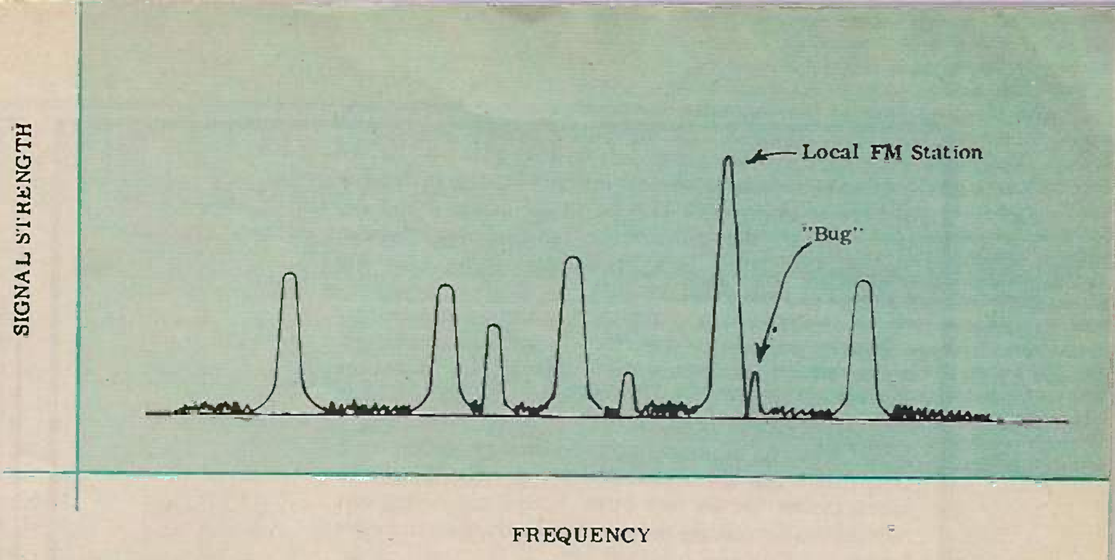
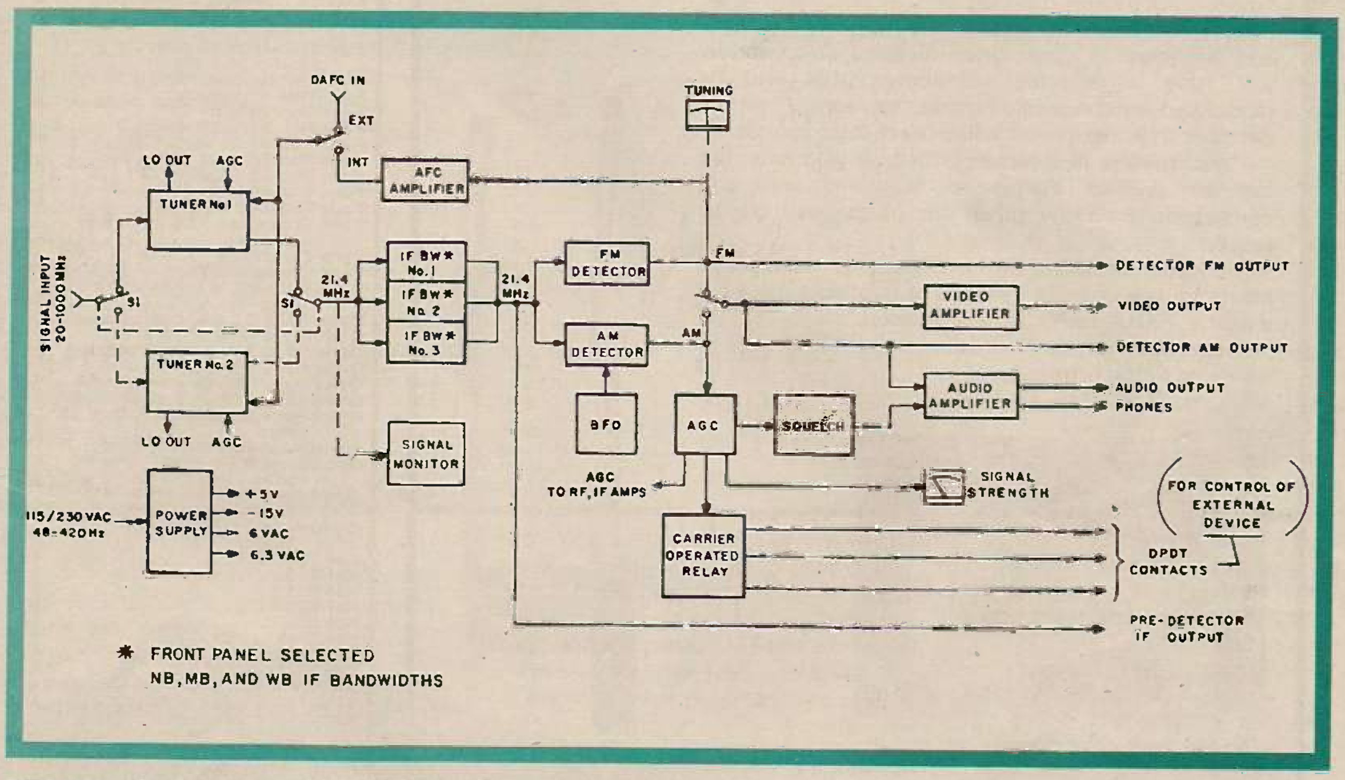


Fig. 4. Experienced bugging operators often tune a bug's transmitter frequency so that it is all but 'hidden' by a strong local station.



Block schematic of typical surveillance receiver used for radio bug location.

EQUIPMENT USED IN "LOCATING BUGS"

The "Telephone Analyser"

This unit is specially designed for testing telephone circuits. Both resistive tests and voltage measurements can be made. Any device "tapped-in" will show up either by a voltage anomaly or change in circuit resistance. Recently, RF detectors have been incorporated so that presence of RF on the line can be detected.

DIODE DETECTOR

This can be a field strength meter, grid dip meter or crystal detector. If a transmitter is located in the area a quick sweep with this device can detect it very quickly. Limitations of this device are its frequency range, selectivity (which is very poor so that a bug whose frequency is very close to that of a local radio or TV station is undetectable) and inability to detect carriers using ac power lines.

COMMERCIAL RADIO RECEIVERS AND COMMUNICATIONS RECEIVERS

Commercial receivers built for communications use are not really suitable for bug location. They have too limited a frequency range and whether AM or FM they do not cover that part of the spectrum used for their IF frequency. (i.e. usually 465 kHz or 10.7 MHz). Experienced bugging operators know this and often design their bugs to work on this frequency.

The majority of bugs operate on FM and will not be detected by an AM receiver.

SPECTRUM ANALYSERS

The spectrum analyser displays on a CRT screen a panoramic picture of radio signals over a wide frequency range. Signals appear as narrow spikes or pips if they fall within the instrument's tuning range. (See Fig.4). A variable bandwidth facility permits the detection of a bug signal close to a local station.

The receiver parts of the spectrum analyser are generally of a lower sensitivity than a narrow-tuned receiver. This type of bug detector is effective but difficult to use because "ghost" signals generated within the analysers are difficult to distinguish from 'true' signals.

SURVEILLANCE RECEIVERS

Surveillance receivers come in every size, shape and price range. Since the bug can operate on any frequency these receivers can cover a very broad range. Variable selectivity is important and both AM and FM detection is necessary for effectiveness.

Modern bugs have shrunk in size to the point where a wireless transmitter can be fitted inside a button, cuff link or even pill size, to be swallowed by the victim. The latter is a "telemetry" type used for location of personnel.

The telemetry bug is a type that can be attached to a vehicle, package or a person. It emits a continuous signal which can then be followed by direction finding equipment and the geographic location of it continously monitored.

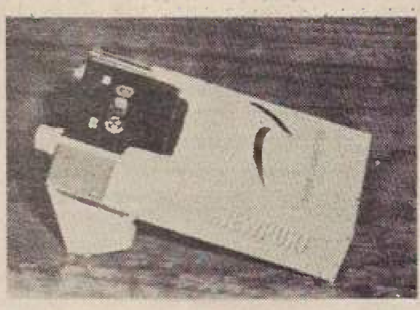
Any wires or cables penetrating into a building are a potential bugging hazard. Apart from the telephone wires, power cables and other household wiring can have audio sent along them and picked up outside the house.

Sound vibrations in the air impinge onto the walls and windows. A laser beam directed at a window will have a reflected component that will be modulated by the sounds inside the room. A simple detector amplifier circuit will extract these sounds.

A microphone stethoscope with high gain amplifier can be pressed against an adjoining wall and conversations on the other side of the wall can be heard.

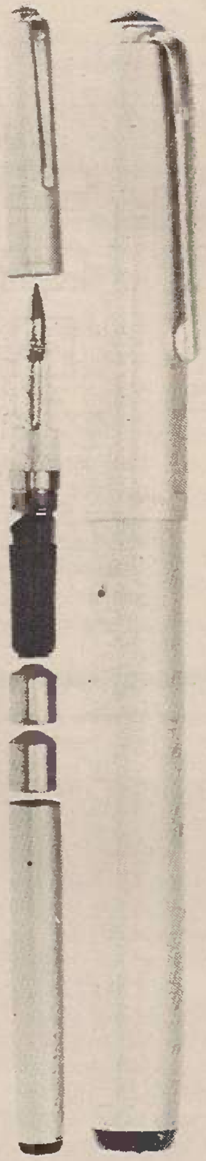
The situation today is such that any determined effort by one or more methods of bugging a place has a nearly 100 percent chance of success.

The privacy of the individual has little chance of surviving in the future. ●



This bug, built into a cigarette packet, has a range of 200 metres.

Telephone insert seen here (centre) is an FM radio transmitter. It monitors all conversations within a room, and broadcasts them over a range of several hundred metres.



This apparently harmless-looking pen is in fact an FM bug. The microphone is in the top half – transmitter, antenna and batteries in the lower half. Capable of operating continuously for three days on one set of batteries, this bug is claimed to have a range exceeding 100 metres.

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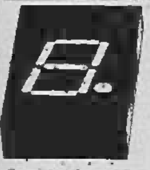

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BSX20	12p	2N3706/7	9p
MJE2955	95p	2N3708/9	8p
MJE3055	62p	2N3710/11	9p
MPU131 put	49p	2N3563/64	16p
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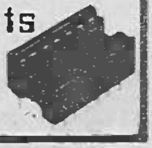

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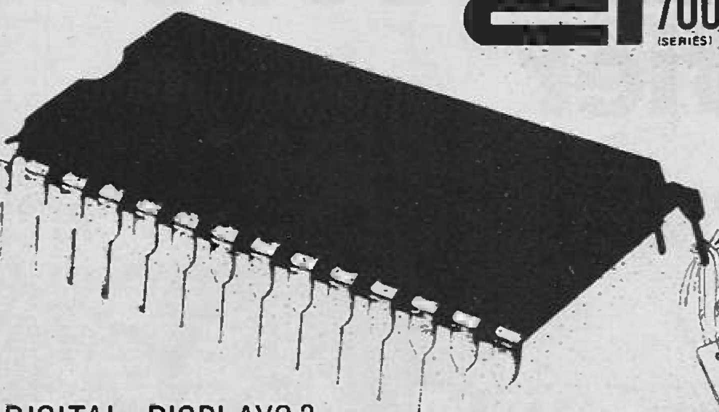

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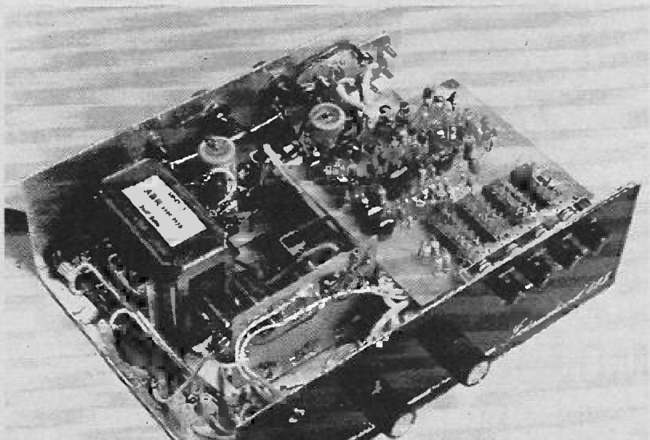

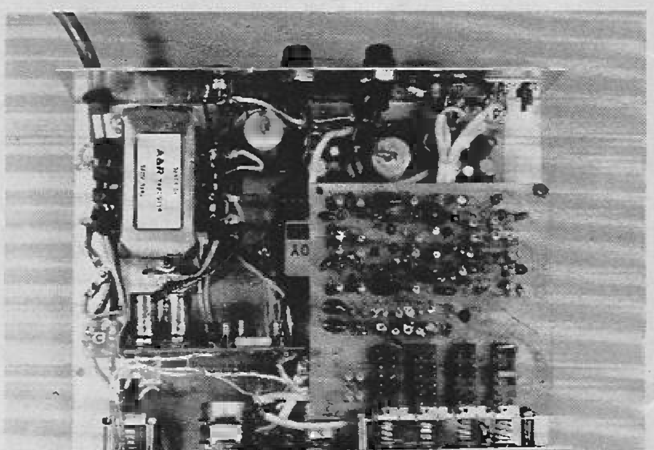

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Distortion	100 Hz	1 kHz	10 kHz
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At 1 watt output	0.14%	0.11%	0.18%
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Maximum Input Voltage	2 V		
Gain			
Input to front output	Unity		
Damping Factor			
100 Hz	5		
1 kHz	30		
10 kHz	30		
SQ Decoder Phase Shift			
30 Hz to 20 kHz	90° ± 10°		

MANY OF US have watched the evolution of four-channel systems with interest, but, being already possessors of a stereo system, have rejected four-channel as being too expensive to implement.

But here is a cheap and relatively simple way to convert your stereo into a full SQ, four-channel system. Apart from this unit the only extra equipment needed are two rear speakers, which need not be as high in quality as your existing front speakers.

The add-on unit is connected to your existing stereo amplifier via the pre-amplifier 'out' and main amplifier 'in' sockets. This facility — together with a 'connect/disconnect' switch is provided on most good quality amplifiers. If it is not, your existing amplifier must be modified by disconnecting the internal wiring and bringing all four points out to the rear panel via shielded cable.

Although this is a quick simple modification, it should only be attempted by those who have a good understanding of amplifier operation — if you don't know how to do it — do obtain advice.

The add-on unit's mode of operation may be readily understood by referring to Fig. 1. It will be seen that the SQ matrixed signals are amplified by the existing preamplifier tone control stages, and then passed to the add-on unit. Here they are decoded into left front, right front, left back and right back channels. The left and right back channels are amplified and passed direct to the rear speakers. The left and right front signals are passed back to the existing main amplifiers and speakers, and there you have it — inexpensive four-channel sound.

The SQ Decoder board is identical to that described for the 4-channel amplifier in the April 1974 or the discrete decoder described in the June issue. Back numbers are available from ETI for 32p each including postage for each issue.

The power amplifier module uses the Sanken SI-1010Y modules and is

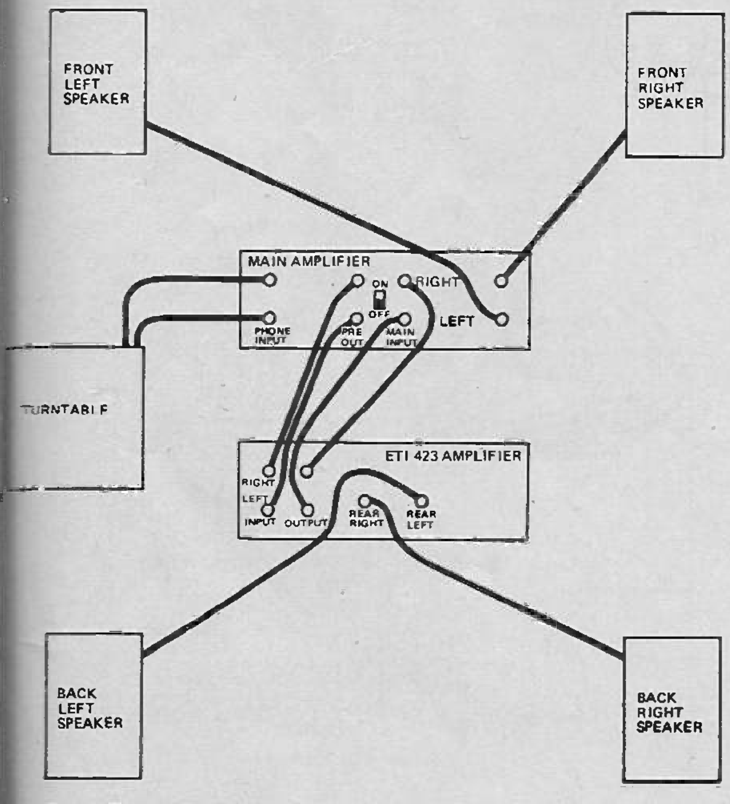


Fig. 1. This schematic drawing shows how the add-on unit is connected into the existing stereo system.

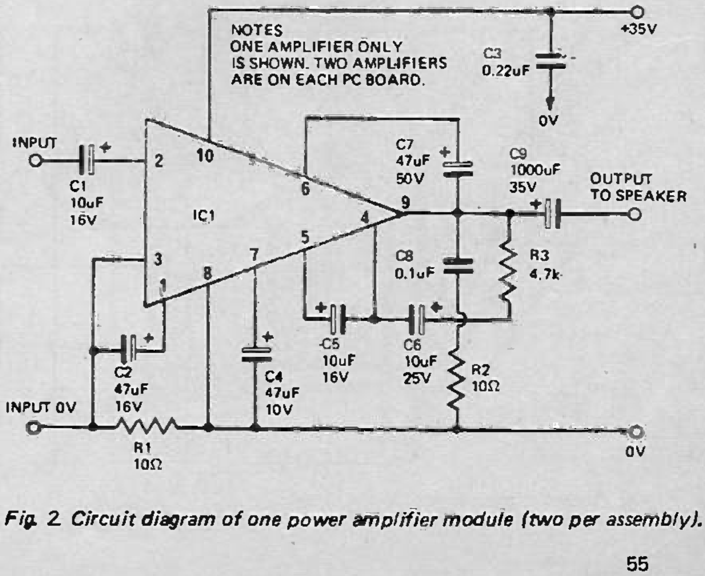


Fig. 2. Circuit diagram of one power amplifier module (two per assembly).

PLUS TWO add-on decoder amplifier

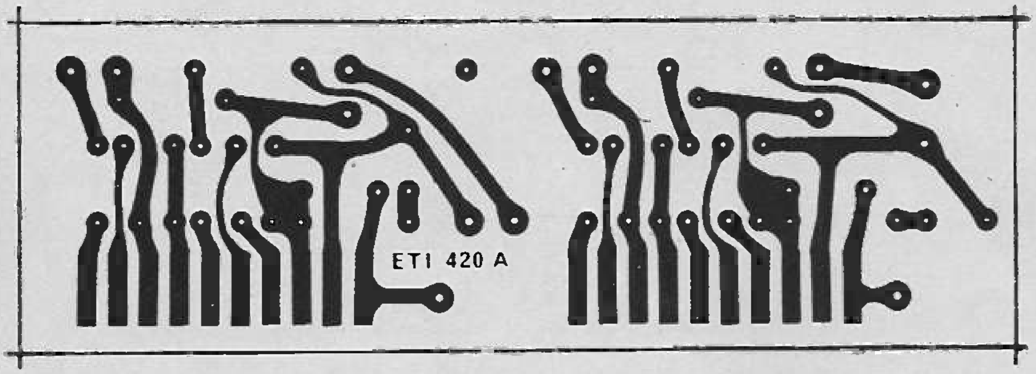


Fig. 3. Printed circuit board for the twin power amplifier assembly.

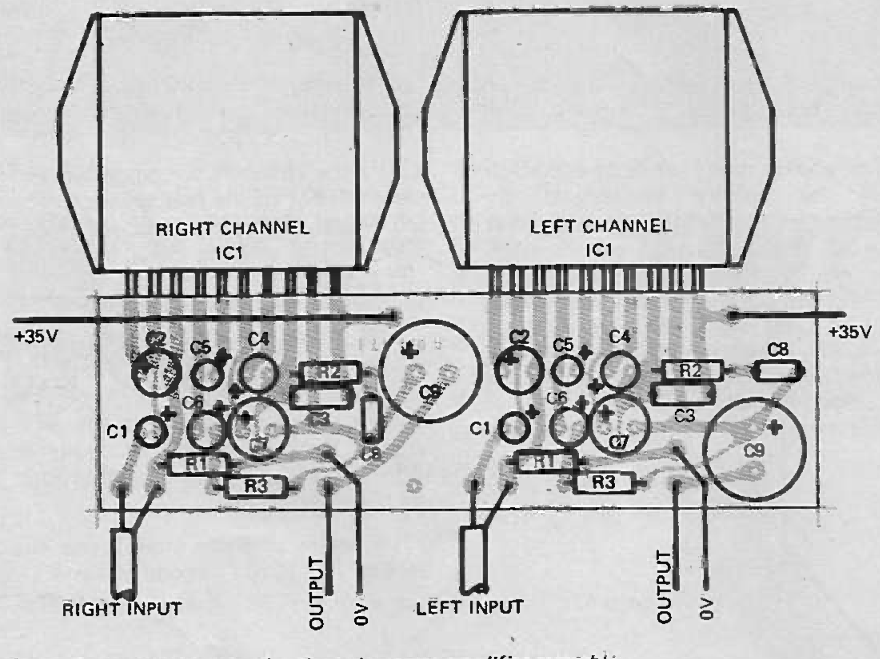


Fig. 4. Component overlay for the twin power amplifier assembly.

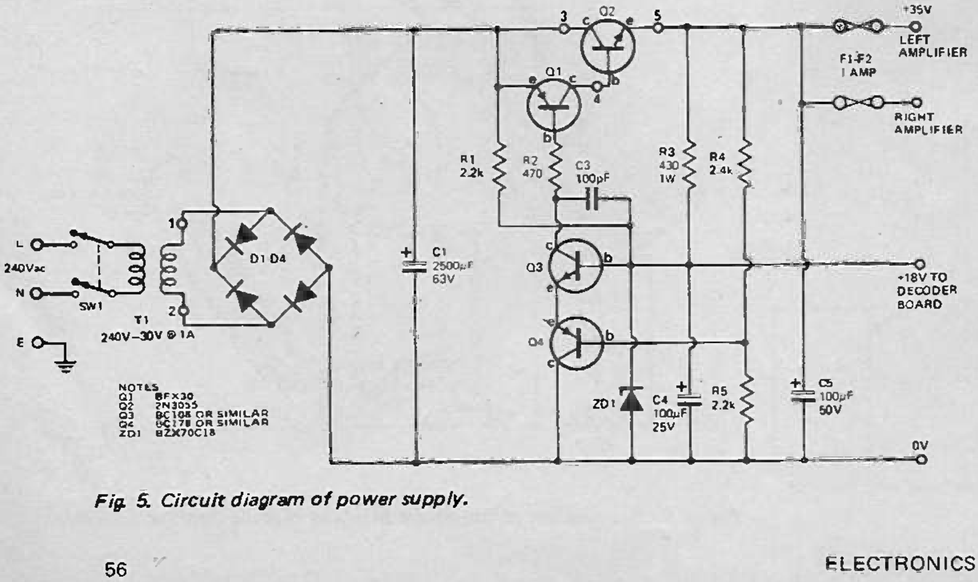


Fig. 5. Circuit diagram of power supply.

PARTS LIST

POWER SUPPLY

R1	Resistor	2.2k	¼W	5%
R2	"	470	"	"
R3	"	430	1W	"
R4	"	2.4k	½W	"
R5	"	2.2k	"	"

C1	Capacitor	2500μF 63V electrolytic
C3	"	100pF ceramic
C4	"	100μF 25V electrolytic PC mounting
C5	"	100μF 50V electrolytic PC mounting

Q1	Transistor	BFX30 or similar
Q2	"	2N3055 or similar
Q3	"	BC108 or similar
Q4	"	BC178 or similar

D1-D4 Diode 1N4002 or similar
ZD1 Zener Diode BZX70C18 18V, 400mW
T1 Transformer 240V/30V @ 1A
SW1 Switch
PC Board ETI 423
F1-F4 Amp Fuse and panel mounting holders
Cover for 2N3055 transistor
Insulation kit for 2N3055

CHASSIS AND MISCELLANEOUS

Complete decoder board as published in ETI April and June '74.
1 spacer ¼" long (plain)
4 spacers ½" long (plain)
2 knobs
2 2 way phono sockets
2 two pin DIN sockets
Mains cord, grommet and clamp
2 way terminal block
Metal chassis to Fig. 13
2 small right angle brackets to hold power supply board
Wood box to Fig. 12
23/0076 wire
Screened cable
Front panel to Fig. 14

AMPLIFIER

R1,2	Resistor	10Ω	½W	5%
R3	"	4.7k	½W	5%

C1,5	Capacitor	10μF 16V electrolytic*
C2	"	47μF 16V electrolytic*
C3	"	0.22μF polyester
C4	"	47μF 10V electrolytic*
C6	"	10μF 25V electrolytic*
C7	"	47μF 50V electrolytic*
C8	"	0.1μF polyester
C9	"	1000μF 35V electrolytic*

* all electrolytics should be PC mounting type

IC1 Amplifier Module. Sanken SI-1010Y. This being replaced by the similar S-1010G - external components are different but details are supplied with the unit. Available from Photain Controls Ltd, Randalls Road, Leatherhead, Surrey. Price is £4.00 plus 25p postage plus VAT.

PC Board ETI 420A

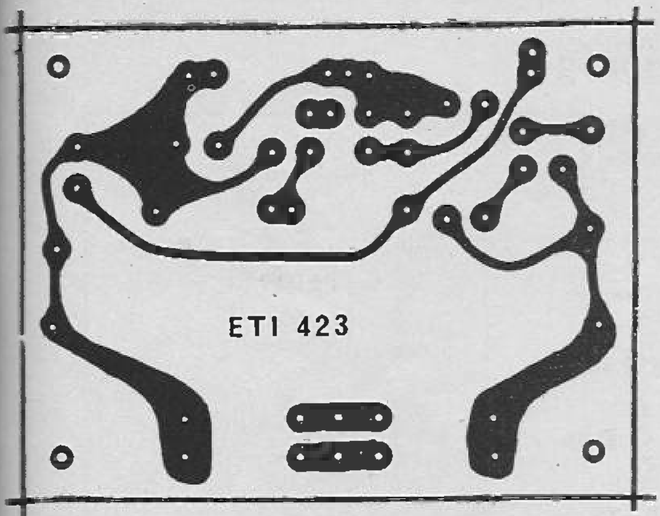


Fig. 6. Printed circuit board for the power supply.

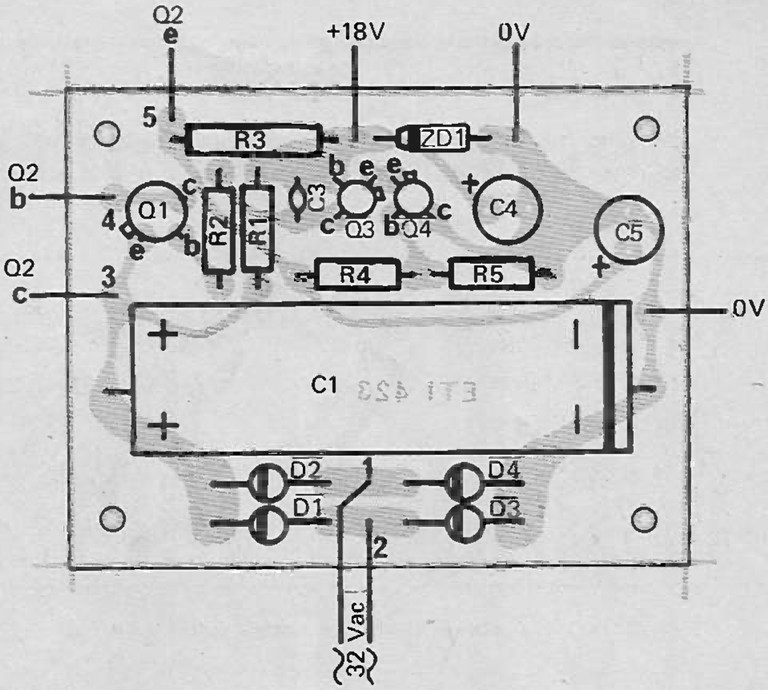


Fig. 7. Component overlay for power supply.

identical to that used in the International 420 four-channel amplifier (April 1974).

CONSTRUCTION

Components should be assembled onto the printed circuit boards with reference to the appropriate component overlays. Take particular care with the orientation of polarized components such as transistors, capacitors and diodes etc.

The interconnection wiring diagrams, Fig. 8 and Fig. 9, give details of the power and signal wiring respectively. The mounting positions of the printed circuits boards, transformer and potentiometers etc may readily be seen from the metalwork drawing and from the internal photograph of the unit.

The rear-channel amplifier may be omitted if a decoder unit *alone* is required. For this, the coaxial cables, that otherwise go to the power amplifier inputs, should now be connected to two additional phono sockets on the amplifier rear panel.

Power requirements for the decoder board are negligible (0.36 watt compared with 30 watts for the complete unit). Thus a much smaller transformer and simpler power supply circuit may be used. A transformer having a secondary of 12.6 volts at 150 mA, a bridge rectifier, D1-D4, and a single smoothing capacitor, C1, is all that is required. The complete regulator section of the power supply may be omitted.

Although the existing printed circuit board could be used, by simply leaving off the unwanted components, it would be simpler and cheaper to use a tag strip to mount the components for this simpler supply.

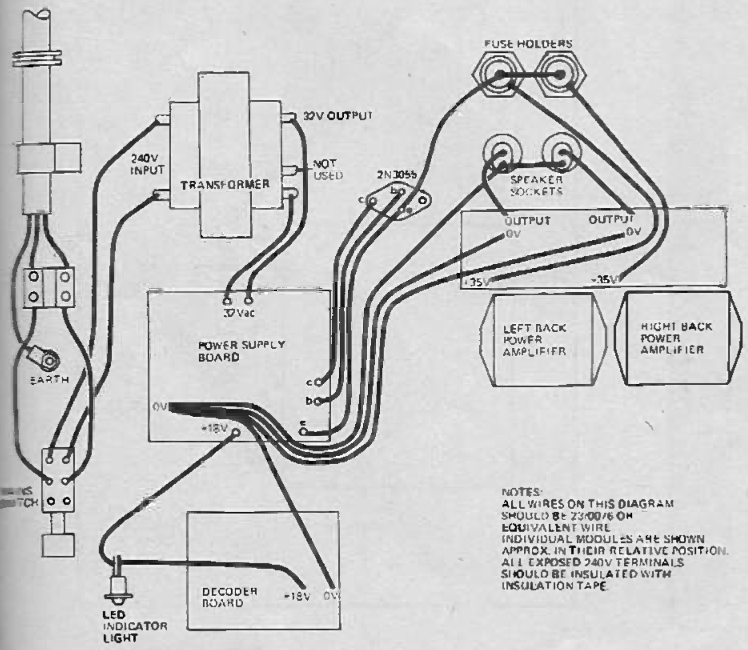


Fig. 8. Interconnections – power wiring.

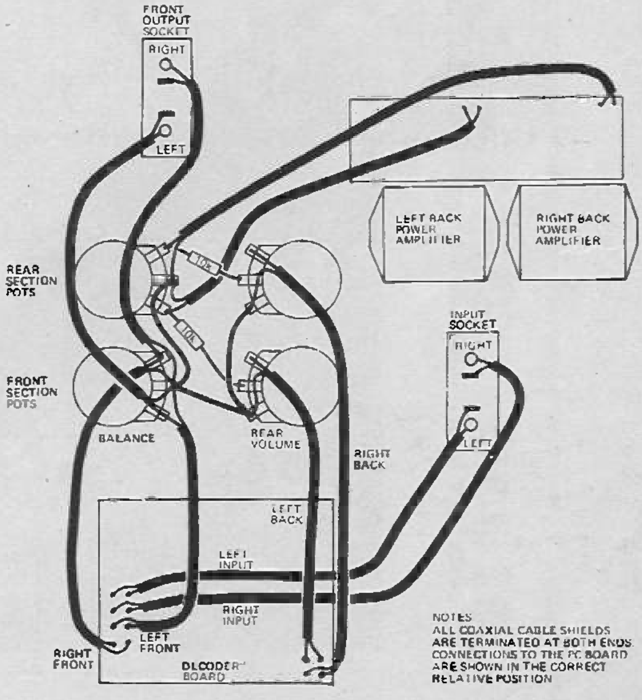


Fig. 9. Interconnections – signal wiring.

PLUS TWO add-on decoder amplifier

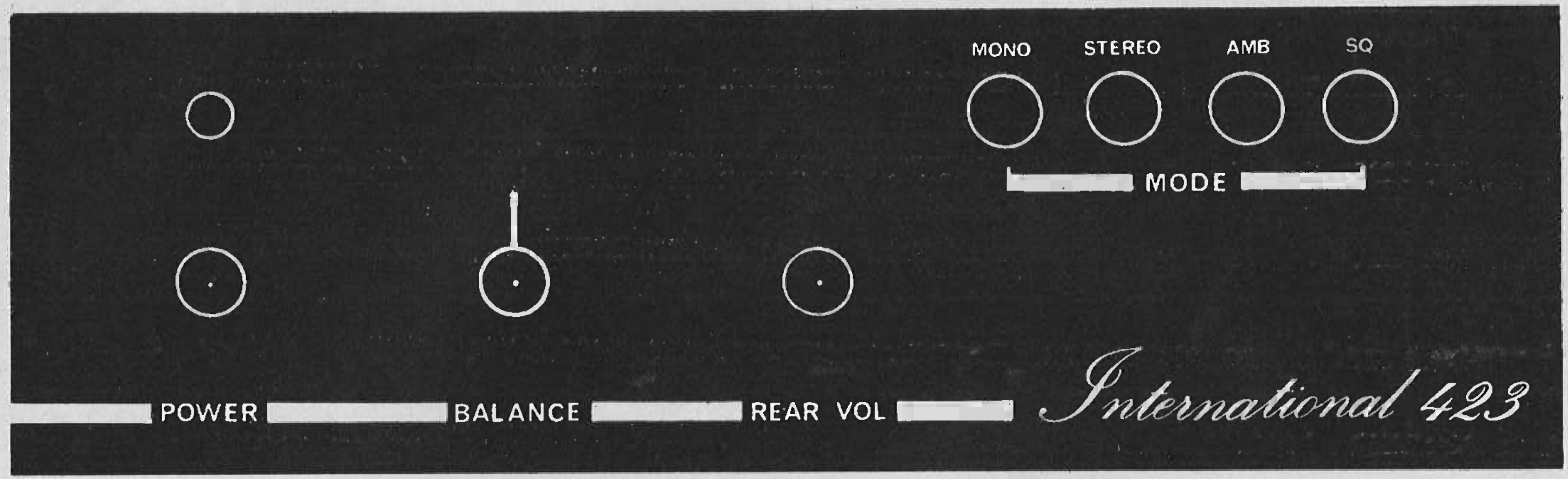


Fig. 10. Front panel artwork.

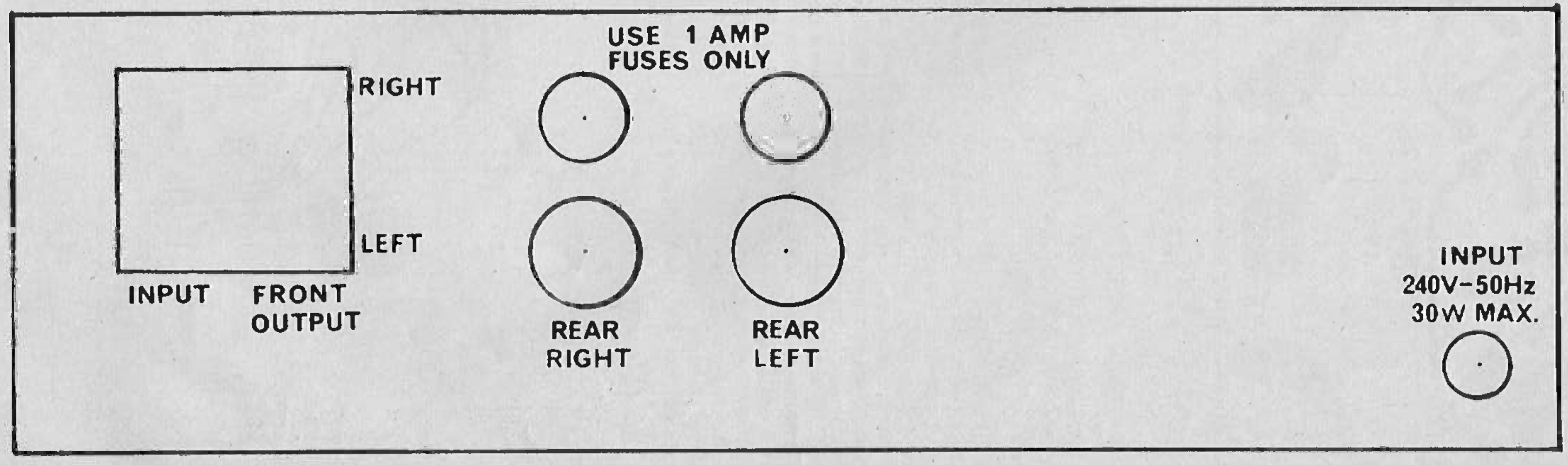
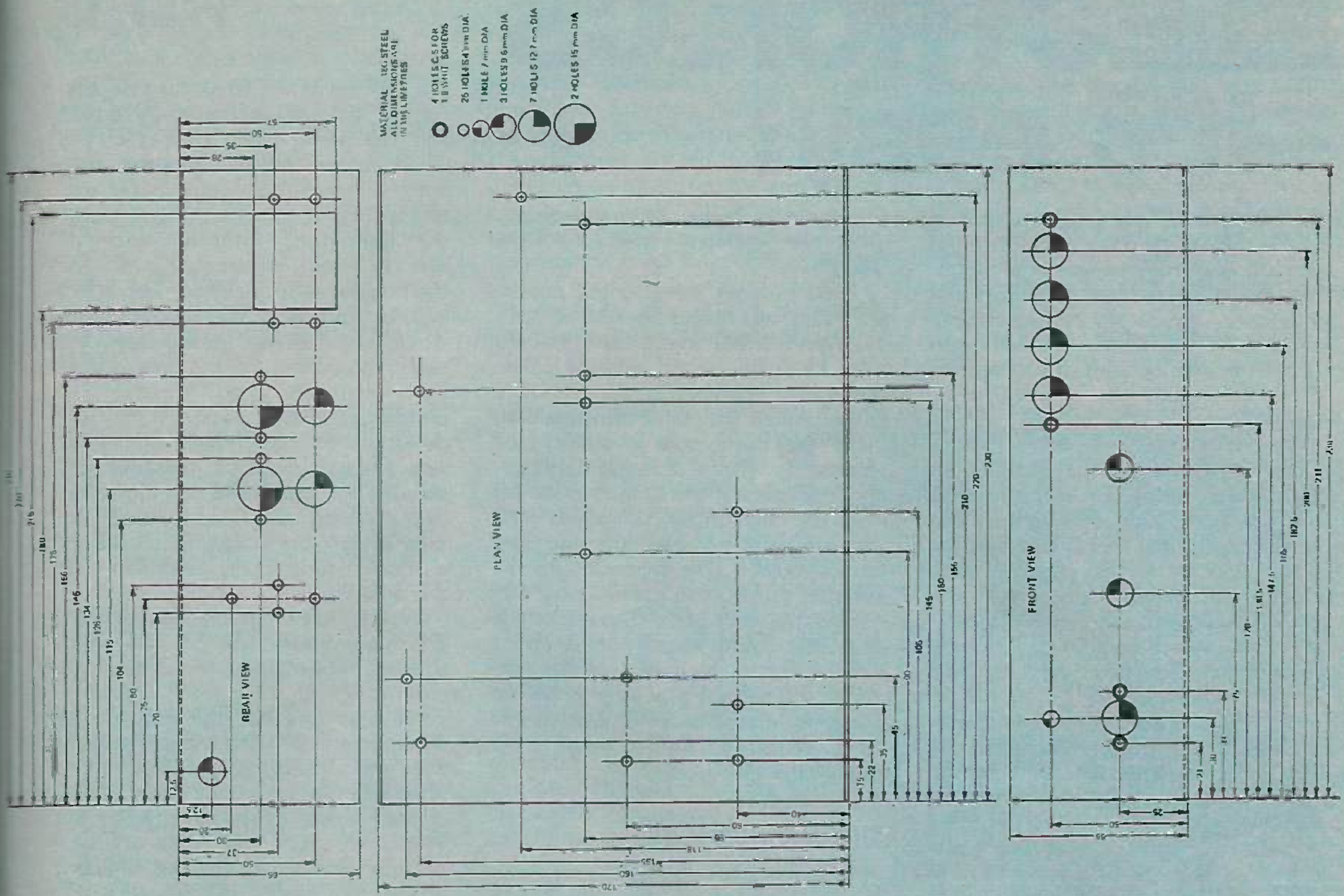


Fig. 11. Rear panel artwork.

Fig. 13. Details of chassis metalwork.



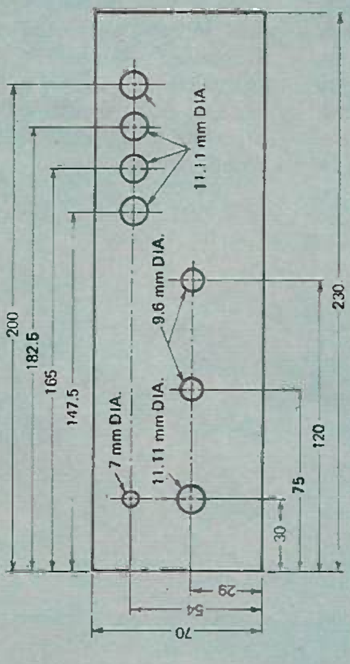


Fig. 14. Front panel escutcheon dimensions and drilling details.

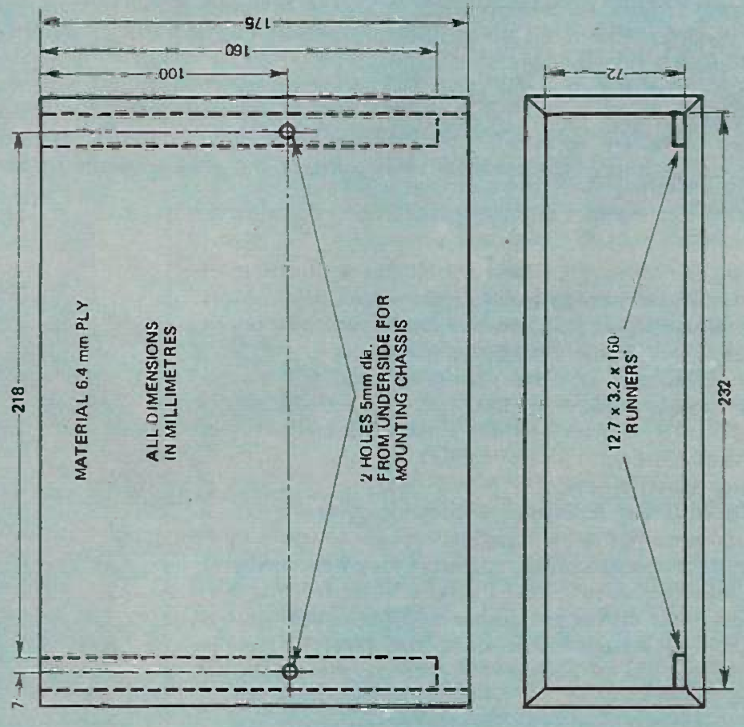


Fig. 12. Details of wooden cabinet.

ELECTRONICS —it's easy!

PART 10

IN PART 9 of this series we looked at the basic devices used in electronics and the way they behave in a circuit. We looked at resistors, capacitors and inductors. These are passive components. In this article we will learn about the development of active components - we will look at the birth of electronics.

In our feature Early Radio Patents (June 1974) we set the background. Signals were being sent along wires as far back as the eighteenth century and in the early nineteenth century the search was on for an effective communications system using electricity. By the middle of the century needle-telegraphs where common. Problems came with attempts at very long distance communication.

A major breakthrough came with the sensitive mirror galvanometer (see Fig. 1) designed by William Thomson (later Lord Kelvin). A moving-coil meter rotated a mirror which deflected a beam of light so that the signal could be seen as a moving spot of light. This enabled exchange of signals between USA and Britain for the first time in 1858.

Detection was as much a problem with radio as it had been with cable. We will leave cable communication for a minute to look at developments in radio signal detection, but the problem of amplification remains for both media. Hertz detected his radio signals with a simple spark gap between the two halves of his aerial. In 1894 Oliver Lodge improved detection, and thereby the range of transmission, using his "coherer" (see July 1974 issue).

1902 brought the magnetic detector. This was based on Rutherford's discovery (1895) that a superimposed high frequency signal applied to an electromagnet makes it more sensitive to a.c. signals (the same principle used in HF bias techniques in todays tape recorders). Figure 2 shows how Marconi developed the principle in his magnetic detector. A continuous band of iron wires passed through two coaxial coils. One connected to the antenna, the other to the headphones). Behind the coils were magnets which kept the band steadily magnetised until a signal is present at the antenna. On receipt of a code pulse the changing magnetic field around the band induced an audible signal in the headphone coil.

THERMIONIC VALVES

Marconi did not play a dominant role in development of the thermionic valves that were soon to replace the magnetic detector. That achievement went to Sir Ambrose Fleming who pioneered the diode or two-element thermionic valve.

In the years closely preceeding 1904, Edison had discovered an effect that he could not explain. His incandescent, carbon-filament lamps blackened with use. To investigate the problem he added a second plate inside the glass envelope (as shown in Fig. 3a). He found, to his surprise, that current flowed between the filament and the plate, when the latter was wired to the positive terminal of a battery, but not when reversed. History has it that he did not realise the implications of this finding, but he had in fact constructed the first thermionic valve rectifier. The effect became known as the Edison effect. Ambrose Fleming recognised the useful properties of Edison's device. He went on to improve its performance and apply it to the detection of coded-radio signals. It also enabled analogue, (continuously varying) voice signals to be transmitted and detected with greater simplicity than any then-existing method. At last a really satisfactory rectifier was available.

The valve era of electronics was born. Fleming's diodes (see Fig. 3b) were adopted immediately for weak signal rectification.

But that was not the end of the development for yet another discovery was the rectifying property of a pressure contact made between a crystal, such as galena, and a fine wire. This is, of course, the "cat's whisker" detector mentioned in the previous article in this series. Undoubtedly, this was the forerunner of the point-contact type of semiconducting diode and the junction-diodes of today.

Today, thermionic valves find little place in new designs but they are still used in high-frequency or high-power equipment — we will describe their operation later in this series.

Let us now turn to the second great problem of those days — that of amplification.

ELECTRICS may be said to be the application of electricity to passive components (or electric motors etc) where signal amplification is not necessary (eg an electric drill, house wiring etc).

Electronics, in the broadest sense, covers applications requiring the use of active devices (transistors, vacuum tubes, integrated circuits) for controlled signal amplification, eg, speed control, radio, television etc.

No clear cut definition is possible, however, for a relay amplifies (small signal in coil controls large signal through contacts) and thus may be considered as either an electric, or an electronic device. Further, the humble crystal set contains no active devices, nor source of energy other than that received by the aerial, yet it, is considered part of the electronic discipline.

Nevertheless, our definition is close enough.

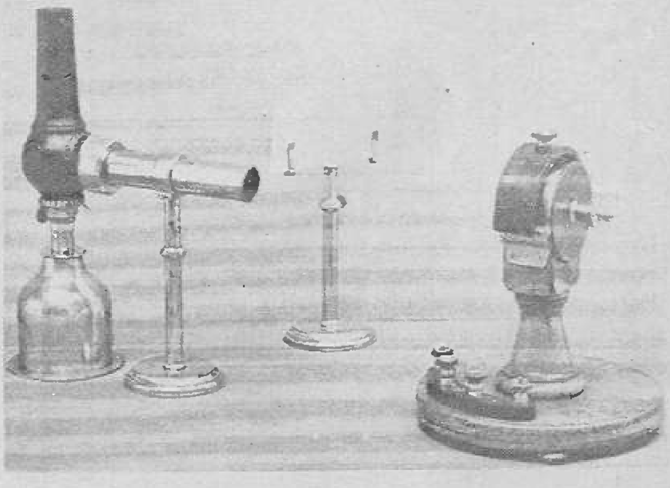


Fig. 1. Kelvin's galvanometer (1858). The oil lamp, at left, provided a light beam that was deflected by a mirror mounted on the coil of the galvanometer at right. The deflected beam moved across the calibrated scale at centre.

AMPLIFICATION

The ability to rectify ac signals into a dc form was a great step toward establishing an electronic discipline. But more significant again was the final break-through when a thermionic amplifier valve was devised in 1907. To fully appreciate how useful it is to be able to amplify small signals routinely, we need to look at the methods available to designers before this time.

We have discussed in earlier parts how an electronic system is basically a means of communicating one physical effect of the natural world from one place to another, electronic circuitry providing the most convenient energy transmission medium for most purposes.

Many of the physical effects to be transmitted are too small to be sensed by our normal physiological senses. The need might be to hear the noises of insects, to see the behaviour of biological cells, to hear and see each other when out of normal range or to see minute movements. In each of these, and many other examples, the energy level of the original signal is inadequate satisfactorily to operate our detectors and some means is needed to amplify the effect. We also refer to this as adding gain to the system. Electrical scientists and engineers prior to 1912 had a tough time, for gain was just not to be had without the application of ingenuity and cunning.

EARLY DEVICES

In 1858 Thomson invented the mirror galvanometer as mentioned above. That provided gain by using the optical lever principle, but it did not provide electrical amplification,for the output form was a displacement, not an electrical quantity.

Mechanical levers were often used to provide increased displacement amplitude. In seismology, minute movements of inertial mass were transformed into considerable deflections of a stylus, by using levers and long arms. Shaw and Laws (around 1900) measured the magneto-strictive length changes of nickel with their 6-lever "electric micrometer": the micrometer screw was turned until a contact was made.

Early designs of gramophones and recorders usually managed with one input or output trumpet but the Columbia quadruple-disc "gramophone" of 1904 had four trumpets to provide enough signal to cope with an audience of 20,000 people. One design of early telephone mouthpiece used two trumpets to couple the speech vibrations to no less than 12 microphone units!

Prior to the discovery of the amplifying valve the dominant electrical gain device was the electro-mechanical relay. We have already met the relay in an early practical exercise. Today their form has little changed from the first unit devised by Wheatstone in 1837, it was used to operate a bell.

Today, relays can be made much smaller and with great reliability but the principle remains unchanged.

Relays can only produce digital signals, the contact is either open or closed. Because of this, whilst relays are invaluable in dot-dash type telegraphy, they are useless in voice-telephone work.

Nevertheless, the relay principle played a vital part in early electrical developments for, as well as being able to amplify signal levels, they provided the means of driving equipment — automatic feeds for arc-lamps, clock rewinders, alarm releases, printing telegraphs and step-by-step telephone exchange selector switches. Provided digital operation sufficed, relays could easily provide stable gains of a million or more. Brown's signal regenerator of 1899 used a relay, to sense the level of incoming poor-quality pulses from underwater cables, and hence to gate out clean levels thus repeating the original pulse signal.

All manner of methods were tried to obtain amplification of analogue (continuously varying) electrical signals. Probably the most successful before the thermionic valve was Shreeves' electromechanical telephone repeater unit, but it came too late (1910) to help the art. Shreeves' device consisted of a nicely packaged telephone receiver ear-piece mechanism driving a mouthpiece mechanism as a combined single unit. The mouthpiece used a method whereby a dc bias current is modified by the audio-frequency signals of the earpiece. Gain was, thereby, introduced by controlling the rate at which power flowed from the biassing power source into the output circuit. The input energy only had to decide the *rate* of output power flow; it did not have to *provide* it. (This, as was pointed out earlier in the series, is the definition of an amplifier).

THE VALVE AMPLIFIER

In 1907 Lee de Forest conceived the idea of introducing a perforated metal plate, (Fig. 5) between the filament and plate of the Fleming diode valve — this was the first triode valve. They were known as "Audions" and by 1912 were in use as amplifiers.

Their operation is quite straightforward. A voltage of the correct polarity (anode positive) will cause a current to flow between the filament (cathode) and the plate (anode) if the grid is left unconnected. Signals connected to the grid either allow or prevent this action depending upon their polarity and magnitude — as shown in Fig. 5. A small varying signal voltage applied to the grid controls the flow of a large current in the anode circuit, thus obtaining gain (by producing a signal larger than that fed in).

Early "Audions" were not particularly good amplifiers but they could be cascaded to provide increasing signal. They were also incapable of carrying much current to begin with. By 1922, however, 5 kW valves had been developed and by 1930, 1000 kW valves existed along with peanut-sized units for radio

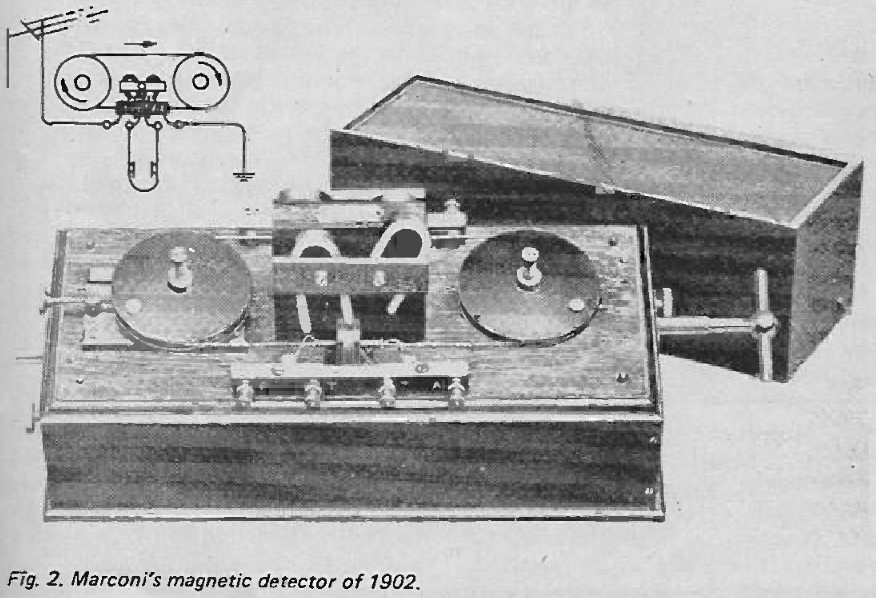


Fig. 2. Marconi's magnetic detector of 1902.

ELECTRONICS —it's easy!

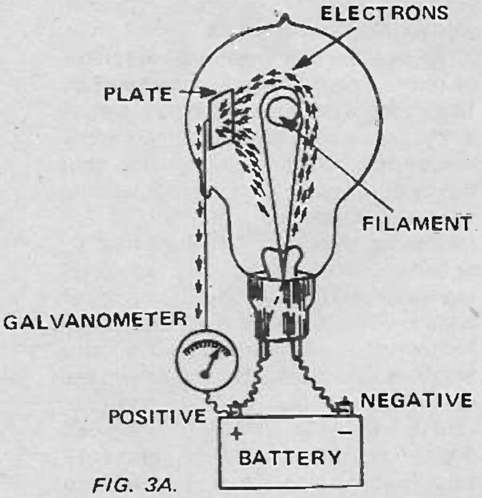


FIG. 3A.

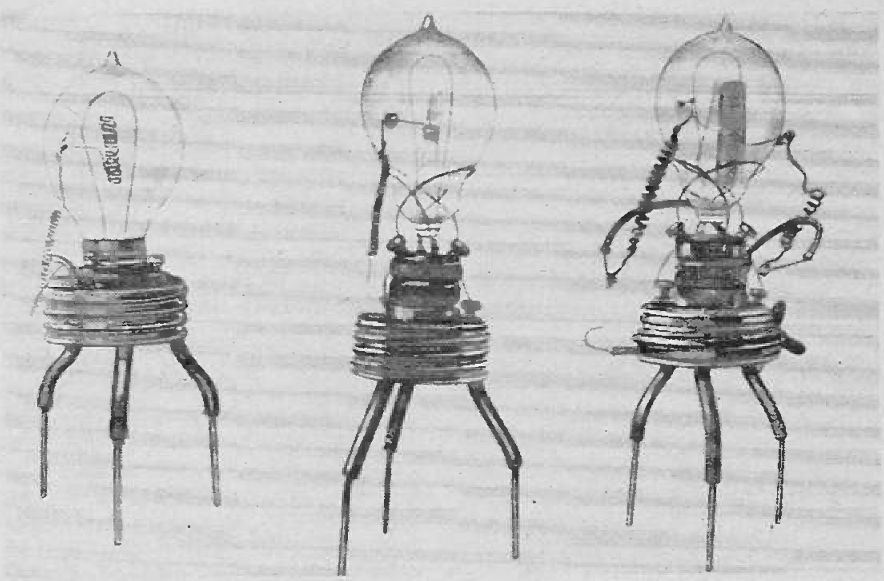
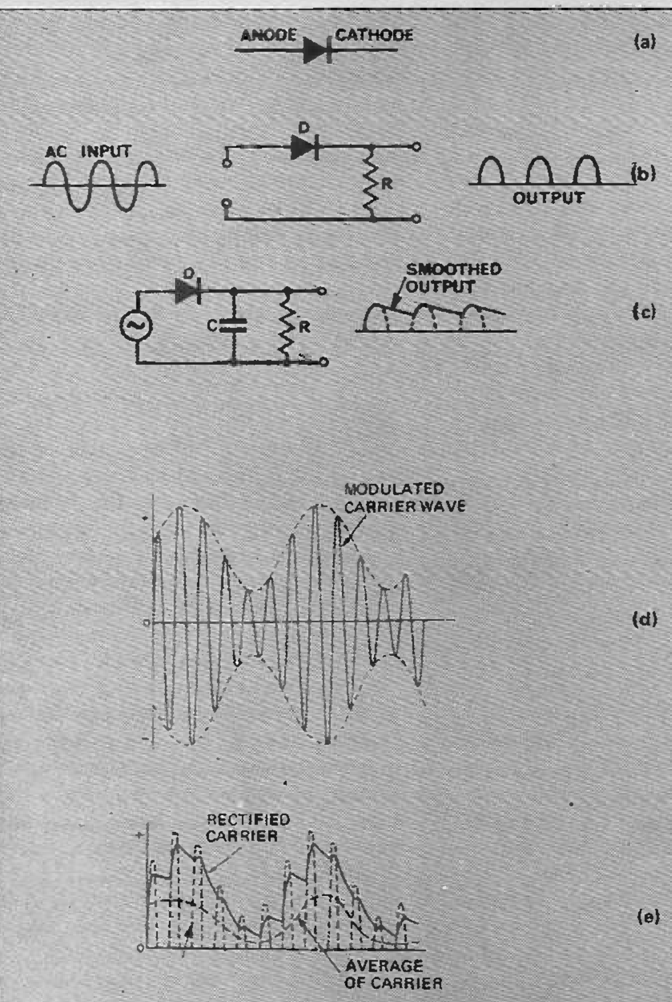


FIG. 3B.

Fig. 3a. The Edison effect (b) Three of the actual diode valves used by Fleming in 1904.



RECTIFICATION — THE ONE WAY VALVE

A diode, as we have seen earlier, acts as a one-way valve for current flow. The symbol for a diode is shown in Fig. 4a. The two leads of the diode are named *cathode* and *anode*, and the diode will only conduct when the anode is more positive than the cathode.

One major application of diodes is in the conversion of ac to dc. When sine waves are applied to a diode circuit (Fig. 4b), the negative half-cycles will be blocked. The diode will only conduct when the anode of the diode is positive with respect to its cathode. The result will be pulses of current which may then be smoothed into a steady, direct current by the action of a capacitor (Fig. 4c).

This process, of converting ac to dc, is called RECTIFICATION, and a diode constructed for this purpose is called a RECTIFIER.

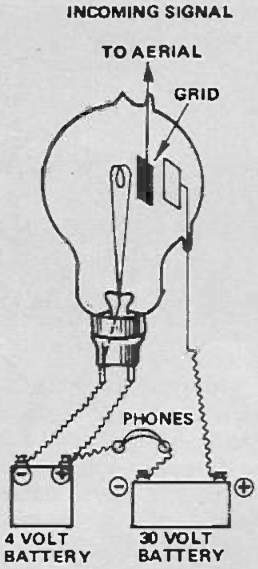
As most electronic apparatus requires a source of smooth dc power, and as the mains power supply comes to us as ac, the process of the rectification is fundamental to modern electronic systems.

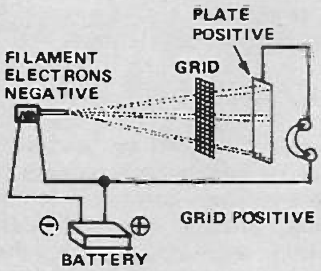
Further, if an ac waveform, modulated as shown in Fig. 4d, is applied to the circuit of Fig. 4c and the time constant of CR is chosen to be much longer than the period of the carrier signal but short compared to the minimum period of the modulation frequency, the circuit of Fig. 4c will effectively demodulate, or detect, the signal thus recovering the original modulation as shown in Fig. 4e, such a circuit is called a DETECTOR circuit.

Diodes may also be used to protect equipment against reversed connection of the power supply, to protect against excessive input voltages and for a whole host of other applications.

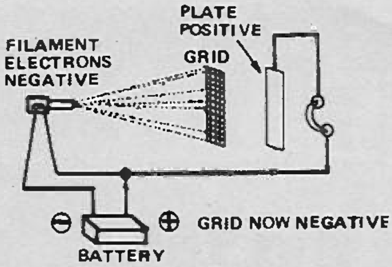
receiver work.

The German designed Loewe multiple-valve receiver of 1930 was especially interesting for it contained, in a single glass envelope, three triodes along with the resistors and capacitors needed for the three gain stages. Perhaps this was the first integrated circuit! The advent of valves gave considerable impetus to the development of electronics for they gave designers a new dimension of freedom. It became reasonably easy to build amplifiers, oscillators, digital circuits (the digital computer), measuring instruments (the first vacuum tube voltmeter was probably that originated at Cambridge University by Mallin in 1922), battery eliminators, successful television — the list is virtually endless.





THE BOMBARDMENT OF THE PLATE BY ELECTRONS



SHOWING HOW THE GRID PREVENTS THE ELECTRONS FROM REACHING THE PLATE

Fig. 5. The triode value, invented by Lee De Forest, and a schematic of how it works.

TRANSISTORS

Valve technology continued to improve, but by the early 1950's the shortcomings of valves – excessive size, power dissipation and cost – were becoming an intolerable barrier to further progress. Early digital computers filled many rooms of a building, portable radio sets needed large batteries etc. A new development was needed, and in 1947 the first practical transistor amplifying element was produced to fill the waiting need. The idea had been around for several decades but the necessary production technology had not been available.

This development initiated the so-called solid-state era that we now enjoy. Today, transistors are used by the hundred and even thousand in modern integrated circuits. We now are truly at a systems level, for electronic designers today think more in terms of the *capability* of given circuit blocks than about how to interconnect separate, discrete elements.

The foundation element of active circuit system blocks is the amplifier. In articles that follow we shall discuss this vital component assembly considering it as a black box that behaves in different ways depending upon how passive components are connected around it. Our study of amplifiers will include a brief introduction to the thermionic valve amplifier: it will be brief because the technology is now outdated. Nevertheless, it still is used in many measuring instruments and electronic devices and, the principles involved align with those used in solid-state amplifier circuitry. It will also help those trained in valve technology to better appreciate the operation of transistors.

The course will then describe the necessary basics of semiconducting amplifier components without undue explanation of semiconductor theory – that will be left to added reading, for a thorough knowledge of the physics of semiconductors is not necessary for an appreciation of the electronic discipline.

ELECTRONICS—in practice

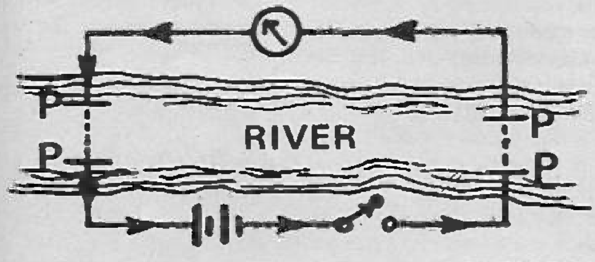


Fig. 6. In 1842 Morse demonstrated wireless electrical communications using the ground as "wires".

ELECTRICITY flows through the ground with ease. In 1842 Morse showed that he could communicate across a river in New York without wires. He used the principle shown in Fig. 6. The plates P were made of copper and were deeply sunk into the mud. He established that the current flowing across the river was proportional to the plate size, and to the distance between the plates on each side. (The current paths do not short out!) Lindsay signalled across the 1.5 km width of the river Tay, Scotland, in 1854 by this means. After this, many attempts were made to bridge larger distances but as the method is very inefficient little came of such effort.

This intriguing technique is easily demonstrated using the circuit of Fig. 7. It uses a buzzer oscillator similar to that shown in Part 4. It is left to you to experiment with plate size and spacing. The idea is not restricted for spanning water only – it works for continuous ground. ●

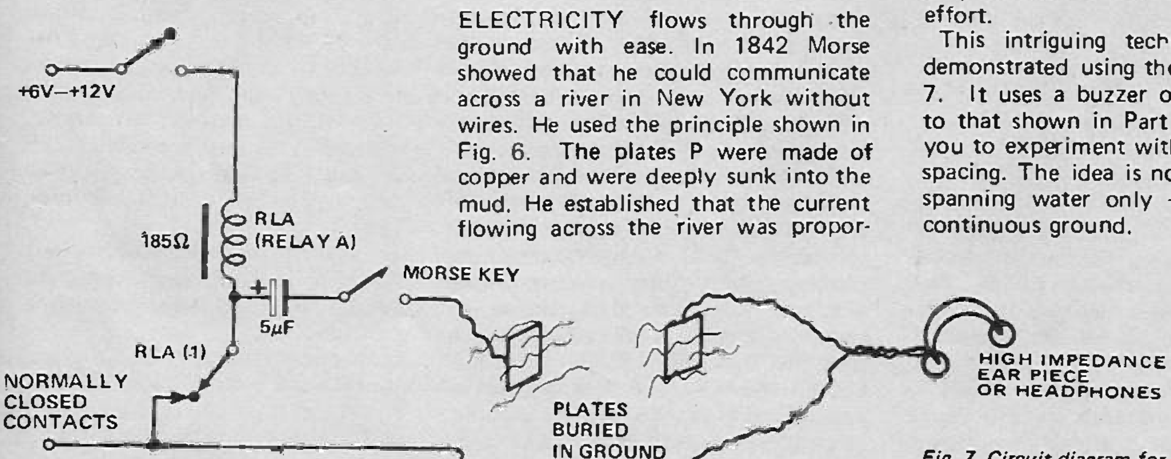


Fig. 7. Circuit diagram for a wireless communication link. (the term wireless not to be confused with the name formally given to radio). The relay acts as a simple buzzer.

Electronics Tomorrow by John Miller-Kirkpatrick

HERE'S A LITTLE PROBLEM for those of you with a reasonable 8 digit calculator, you can work it out without a calculator but its not so much fun. Let us assume that all of the coal supplies of England and Wales for a certain period would fill an area of 843ft by 843ft in a pile 100ft high (assume square edges). The supplies from Scotland for the same period would fill an area of 131ft by 19ft in a pile 5ft high. The first part of the problem is to work out how many cubic feet of coal we have. The second part of the problem is to find a possible solution to our present fuel crisis. In case you haven't got a suitable calculator the answer is given at the end of this article.

If the above problem was read out to you at normal speaking speed then you would probably have trouble understanding it and would not be able to write down all of the details. On the other hand the human brain can assimilate information at about 3–4 times the normal speaking speed, thus four times as much information could be packed into a lecture if only the lecturer could speak that fast. If the lecture was recorded and played back at four times normal speed then a very squeaky voice would result and intelligibility not speed would be the problem. Similarly if an audio-typist was trying to type the transcript of the lecture by replaying the recording at one quarter of the spoken speed she would only hear a low rumble. What is needed is some form of filter to take out the squeak or rumble and thus leave the speech intelligible - they call it VSC, Variable Speech Control.

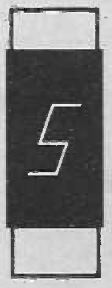
VSC works on the principle that there is a lot of redundant space in normal speech with long vowel sounds and long gaps between words. To speed up recording by two VSC simply cuts out half of the incoming signal and records the other half. If you have a tape recorder with a pause button you can try this yourself by recording a talk from the radio and pressing the pause button for one second every two, when played back the speech will be at a tone level that is understandable and if you listened to the original talk your brain will tend to fill in the gaps from memory and thus effectively recreate the whole talk for you in half the time that it took in the first place. If the sample rate is in the order of 25–50mS instead of 1 second then the resulting speech will be even more understandable and will not rely on memory to fill in the gaps. Let us try to give an example - the phrase 'The cat sat on the mat' takes about two seconds to say, if we wish to cut it down by 50% and we sample at one second rate we will get 'The cat smat'. Now if you remember the original then the result makes sense but if someone said 'the cat smat' to you you would run a mile. If we sample at a faster rate we would tend to get something more like 'Th ct st n th mt' although it would tend to run together more to give 'Thctst nthmt'. Similarly to make the phrase last 4 seconds we have to put in gaps to give 'Th-e-c-at--s-at--on-n-th-e--m-at' this is simply the same sort of system working in reverse instead of taking out samples we are putting in samples or gaps.

The whole system is now being processed in IC form with some prototype ICs in the USA, the block diagram of these chips is shown in fig. 1. A ramp generator provides a continuously variable sweep input to the voltage controlled period generator (VCPG). The sweep's slope can be varied from positive to negative by the potentiometer, the output drives a shift register driver with a square wave having a geometrically incrementing period. Thus the speed of the motor is connected to the rate at which the sampling period increases or decreases. Before the ramp overdrives the VCPG a comparator sends a signal to blanking logic which with the zero-crossing system causes blanking of the output to overcome the problem of switching causing 'pops'. During the next 512 transitions of the VCPG the counter prevents the amplifier from unblanking thus allowing the sample to be dumped, the next detected zero-crossing causes unblanking and allows the next sample to pass. The ratio of time compression or expansion depends on the clocking rate and can be varied from less than one half to up to three times normal speed.

Various methods of VSC with pitch control are possible and whichever one is used eventually the advantages to students, blind persons, dictating systems, speech therapists, etc are going to be enormous. Of course it wouldn't mean that you could do a three year university course in one year, but they could teach you three times as much, I sometimes feel glad that my student days are over.

A NEW FORM OF BCD SWITCH

A couple of months ago we told you about the Emihus clock chip as used in the Digitronic II clocks. Although the chip has alarm functions the alarm time is set with BCD decade switches which normally cost about £2.50 each and four are required. This put the cost of this approach to alarm setting out of the reach of most applications and leaving it to large one-off expensive projects. When writing that I did



not know about an existing product that has since been brought to my attention. There are two variations upon the BCD theme, both at much less than half of the price of a normal BCD decade switch.

The first system is a Dual In Line BCD switch based on a sliding action over 10 ratchet positions. At each position of the slider small levers cause one or more of four sprung contacts to close. The sequence of closure of these contacts gives a true BCD output from the common input pin. The decimal number associated with the output is displayed by a rather ingenious system on the face of the unit in standard seven segment format in digits 0.4" high, white on a

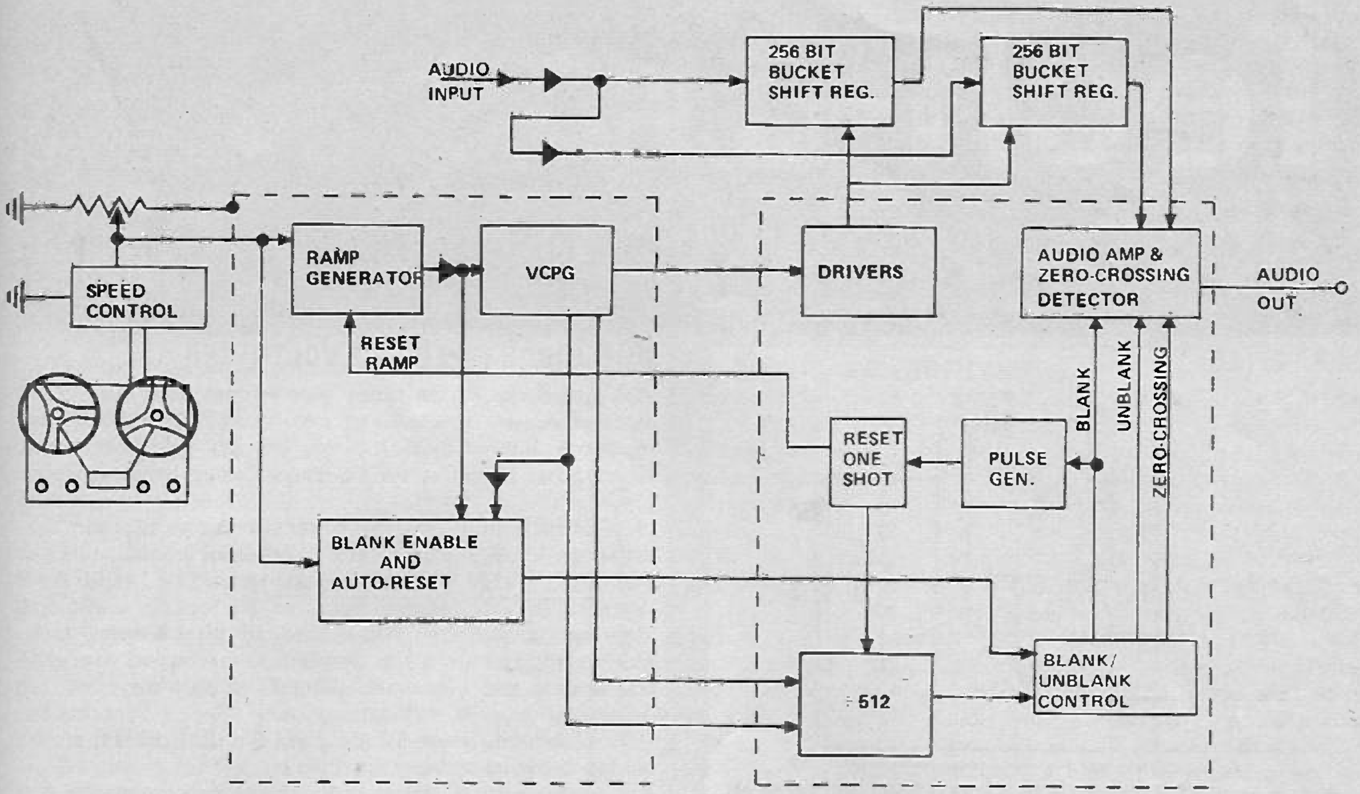
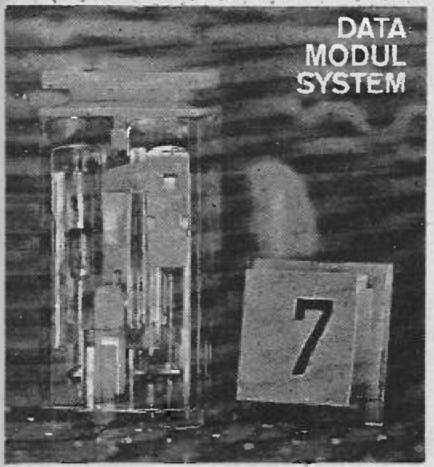


Fig. 1. Block diagram of the Variable Speech Control, a system which can slow or speed up speech without altering the frequency. This diagram shows the IC's which are being developed in the USA and how they control the tape recorder and the audio signals.

black background. Three types are available at present, the GDS1 for surface panel mounting, the GDS2 for behind panel mounting with a cutout for display and actuating lever, and the GDS3 for PCB mounting



applications. The one-off prices are £1.15 each for GDS2 and £1.11 each for GDS1 and GDS3.

The second system is a programmed switch system, part-way between a switch and a hard-wired code. Although these are suitable for setting on an alarm clock they are intended for preset applications. The Data Module system is based on a set of four miniature lever switches connected to a common line. The programming is done with a small plastic keytop with four "arms" beneath it, depending on the presence or absence of these arms the four lever switches are closed or opened thus setting up a BCD code for the unit. The keytops are interchangeable with each other so that the code for any unit may be changed within a few seconds. If a group of these units are used together then a complete program may be set up in a similar way to a ROM (Read Only Memory). By using a plastic screen to hold the keytops a complete ROM can be programmed in seconds or any one unit can be changed without taking the others out of service. There are various types of unit available (all using the same keytops). They can be used as BCD output units, BCD input units, with or without logic isolating diodes and in other codes than BCD. The BCD output switches can be used for presetting counters such as the 74192 decade counter, the BCD input switches can be used as very cheap comparators to compare the output of a BCD counter and give a logic change when the counter contents are equal to the unit program (i.e. keytop). If you would like data or quantity prices above 100 units please contact Data Precision (Equipment) Ltd, London House, Duke Street, Woking, Surrey. The units are bring used by Bywood for digital count-down then count-up clock for timing applications in TV and Radio broadcasting. They are using both the BCD input and BCD output versions and are making them available to anybody requiring small quantities.

PROBLEM ANSWER

The calculator answer to the first part

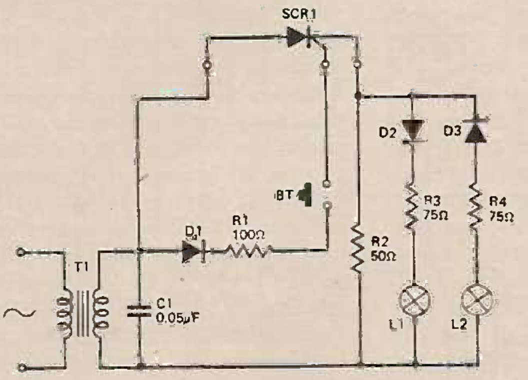
is 711077345

the answer to the second part requires using the total supplies figure (the answer to the first part) and the "turn-over" for the period!

Are there any more applications of upside down calculators? A small prize for the best original one received, send to Electronics Tomorrow, E.T.I., 36 Ebury Street, London SW1W 0LW (before sending in such a problem, check 799 + 879^2 and if that was your answer subtract 769933 to find out if you win).

Tech–Tips

SCR TESTER



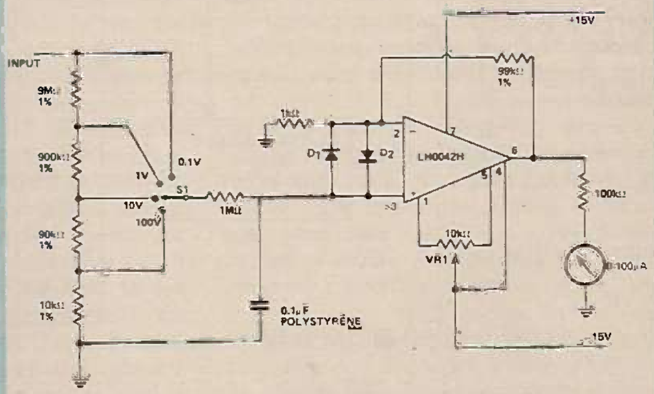
With a good SCR, lamp L1 (6.3 volt 0.25A) will come on, and stay on, only whilst push button BT is depressed. If Lamp L1 comes on before the push button is pressed the thyristor defective — most probably due to an internal short.

If both lamps turn on simultaneously then the SCR is completely short circuited.

The same circuit may be used to test power diodes rated at 500 milliamp or more. In this case of course a good diode will light lamp L1 and a shorted one will light both lamps. If neither lamp lights the diode is open circuit. The polarity of a good diode will be indicated by which lamp turns on.

Diodes D1-D3 should be capable of carrying 300 mA and transformer T1 should have a 25 volt 300 mA secondary.

SIMPLE HIGH IMPEDANCE VOLTMETER

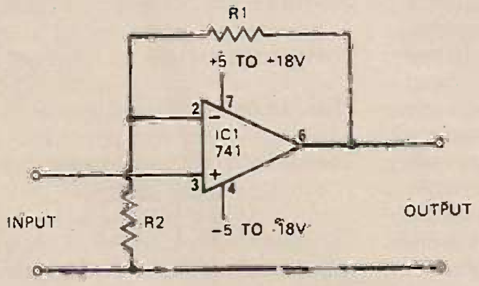


The circuit shown can be used as a high impedance voltmeter with ranges having full scale deflections of 0.1V, 1V, 10V and 100V. The range is selected by the input potential divider connected to S1.

The meter is set to zero by means of the potentiometer VR1 when no voltage is applied at the input. D1 and D2 are low leakage silicon protective diodes, whilst the LH0042H is a relatively low cost FET operational amplifier manufactured by the National Semiconductor Company.

The circuit consumes only about 20mW of power and can be supplied from batteries. Further ranges can be added by including appropriate additional resistors in the input circuit and additional positions in the switch S1.

HIGH INPUT IMPEDANCE AMPLIFIER



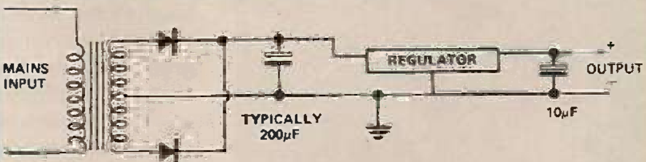
The circuit shown, using one op- amp and two resistors has a high input impedance (500 nanoamps input current) and a gain which may be programmed by R1 and R2.

$$G = \frac{R1 + R2}{R2}$$

Thus for G = 1 R1 = 0, R2 is not used
for G = 100 R1 = 100k R2 = 1k.

The frequency response decreases with increasing gain, eg. for G = 1 the amplifier is flat to 800 kHz, for G = 100 the response drops to 6 kHz.

PROTECTING I.C.'s AGAINST SHORTS



When experimenting with integrated circuits, constructors often employ a normal mains power pack or a battery which can give a large current on a direct short in the output circuit. Such accidental shorting can occur very easily during preliminary experiments with integrated circuits and some of these shorts will probably result in the destruction of one or more devices.

This problem can be virtually eliminated by the use of a power supply containing a voltage regulator device with 'fold-back current limiting'. That is, the power unit will supply up to a certain value of current, but when a direct short occurs, the current 'folds-back' to a much smaller value. As soon as the short is removed, the device returns to normal operation.

The SGS-Ates fixed voltage regulators types TBA625A (5V), TBA435 (8.5V), TBA625B (12V) and TBA625C (15V) are ideal for this application. They can supply up to

ETI is prepared to consider circuits or ideas submitted by readers for this page. All items used will be paid for. Drawings should be as clear as possible and the text should preferably be typed. Circuits must not be subject to copyright. Items for consideration should be sent to the Editor, Electronics Today International 36 Ebury Street, London SW1W 0LW.

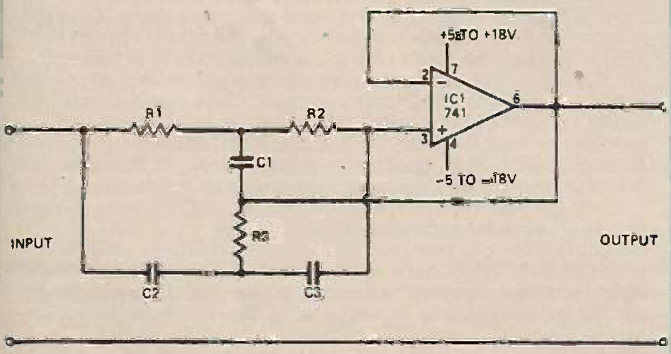
130mA at the voltage concerned, but on directly shorting the output, a current of only about 40mA will flow. Very few integrated circuits can be damaged by such small currents. These devices are in a TO-5 circular transistor type case with only 3 leads and are priced at less than £1 each.

If one is using a circuit which requires more than 130mA, one may use the SGS-Ates TDA1405 (L129) 5V regulator, the TDA1412 12V regulator or the TDA1415 (L131) 15V regulator. These are in small plastic TO-126 packages which have a hole for bolting the device to a heat sink. They can provide over 600mA, but the short circuit is of the order of 100 to 200mA. Naturally one obtains less protection than with the lower current devices, but nevertheless the protection is adequate for many circuits.

The circuit for the use of the devices described is shown. It is important that the 10μF capacitor on the output side should be soldered as near to the regulator as possible to avoid instability.

As an added bonus, the use of these regulators will remove almost all of the hum from the power supply line and will often allow a much smaller smoothing capacitor to be used. The hum at the output is usually a few mV. The L123 device can be used if a variable output voltage is required, but more components are required in the external circuit to provide fold-back current limiting than with the fixed regulators mentioned.

REJECTION FILTER



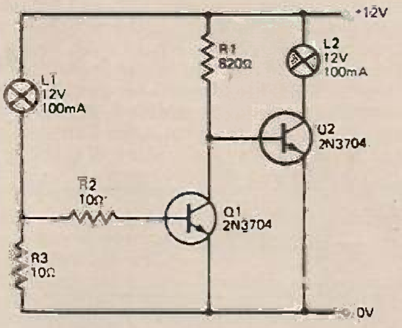
This narrowband filter using the 741 operational amplifier can provide up to 60 dB of rejection. Setting resistors equal to 100 k and capacitors equal to 320 pF the circuit will reject 50Hz.

Frequencies within the range 1 Hz to 10 kHz may be rejected by selecting components in accordance with the formula'—

$$F = \frac{1}{2\pi RC}$$

To obtain rejections better than 50 dB resistors should be matched to 0.1% and capacitors to 1%.

BACK-UP FAILURE LAMP



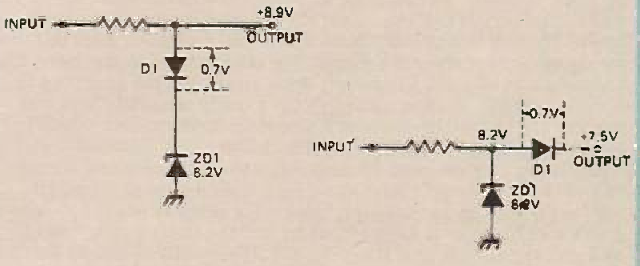
A signal lamp used to indicate failure of a vital piece of equipment is subject to failure itself.

This circuit provides a back up lamp which only comes on if the first lamp fails. As long as L1 is intact Q1 is saturated and Q2 is OFF. If L1 fails Q1 turns OFF, Q2 turns on, and lamp L2 is illuminated thus indicating the fault and the failure of L1. The values shown are for 12 volt 100 mA lamps.

If other lamps are to be used the supply should be the same as the lamp nominal voltage and the following values should be used:—

LAMP	R1	R3	
6V	50 mA	22 ohm	820 ohm
6V	450 mA	2.7 ohm	220 ohm
12V	250 mA	3.9 ohm	330 ohm
24V	50 mA	22 ohm	820 ohm

DIODE ADJUSTS ZENER VOLTAGE



A silicon diode when forward biased has a constant voltage drop of 0.7 volts. A germanium diode has 0.2 volts.

This characteristic may be used to trim a Zener reference voltage as shown. A silicon diode in series with the Zener will raise the output voltage by 0.7 volt, and in series with the supply it will be reduced by 0.7 volt. Make sure that the diode used will carry the required current.

DX MONITOR

Compiled by Alan Thompson

I wonder who was the first magazine publisher to have the idea of describing an issue which appears in mid-October as being the "November" copy? Anyway, so far as a DX feature-writer is concerned, it certainly causes a lot of problems and the particular one which concerns me, at this moment, is the fact that I promised you an Asian Expedition in this issue. What I quite forgot was that I should be putting this article together in mid-September and that the schedules of international broadcasters for period D(1974), staring on 3rd November would'nt be finalised - let alone be available - some 6 weeks earlier. So, the great Asian Expedition will be in our next issue as Asian DX is a combination of listening to high-power outlets very far away and the off-chance of logging some low-powered stations when conditions are good. The Far Eastern DX Season will be properly in swing in a month's time and, if you are a newcomer to this form of DXing, you won't miss more than a few openings by having to wait a month for the detailed run-down. Should you want to make a start without the full details, then, the favourite band is the 60 metre one (running from 4750 to 5075kHz approximately) and the best times will be from about 1600 - 1800 GMT and, again, from about 2200 GMT until round about midnight. The main stations worth looking out for are those of India and Pakistan, Singapore, Malaysia and Indonesia.

Do you remember that, in the September 1974 issue, I said that Radio Ghana might be heard on 4980kHz throughout the evening? Do you also remember that, in the October issue, I said that as soon as I had written the September copy they decided to move to 4825kHz? Yes: you've guessed it! As soon as the October copy was past the stage of alteration Radio Ghana resumed operations on 4980kHz. At the moment, the score stands at Radio Ghana 2 v Alan Thompson 0!

Back in the March 1974 issue, pp 28-29, we carried an "E.T.I. Product Test" for the "Hamgear PM IX Calibrator" – and a very nice piece of equipment it is! Over the last few weeks I've had the latest product of the "Hamgear" stable sitting in my shack and causing the inevitable chaos of any interloper - cables running here and there, because the basic system works very well (thank you!) and any new item of gear has to be fitted in amongst all the other items, and finding any flat space always means a problem for me. Fellow-DXers (and any radio amateurs whose eyes have strayed to this space) will, I know, sympathise! Anyway, the newcomer has the type number P.M. IIFB and is a combined pre-selector and frequency calibrator, selling at £29.50, plus postage of 30p (the price includes V.A.T.). Basically, it is a souped-up version of the P.M. IIB pre-selector (well-known amongst DXers for the fact that it lives up to its claim to give an overall 32dB gain over the range 1.5 to 32MHz) combined, in one unit, with an improved P.M. IX which now has calibrator outputs at 1MHz, 500kHz, 250kHz, 100kHz, 50kHz, 10kHz and 5kHz (and, of course, at multiples thereof, which make them useful up to, at least 100MHz at which point I stopped testing). An editorial scribble says "That's what ICs do for you!": frankly, I can't see what the internal combustion engine has to do with this mains-powered unit (or, I wonder, does he mean 'integrated circuits'? Surely, he can't - he once suggested that the only sort of valve I knew anything about was the sort used in bicycle tyres!). Fooling aside: this is a really attractive unit and worked a treat with an ancient Communication receiver which I retain especially for testing out all manufacturers' "swans". That receiver - now some 30 years old - sits glowering in a corner of the shack and could have done with a re-alignment about 10 years ago when it was retired: however, I swear it wears a vicious smirk every time it is dragged out to test the latest young "swan" and one can almost hear it saying: "I'll bring this so-and-so down a peg or two". After working with the P.M. IIFB for a few weeks, "old faithful" was heard to mutter "There ain't no peace for the ancient: O.K. it *is* FB!" If you want details, send a stamp to Hamgear Electronics, 2 Cromwell Road, Sprowston, Norwich NOR 65R.

From the electronic to the administrative, now. The European DX Council represents quite a large number of the DX Clubs of Europe and, back in May, they held their 1974 Conference at Canterbury. The Conference - three days of discussions on all aspects of DXing: discussions which are often continued on an informal basis far into the early hours of the following day - moves from centre to centre, year by year, and in 1975 it will be held in Denmark. The chief administrative officer of the Council holds the title of Secretary-General and it issues quite a number of publications of interest to DXers, as well as a monthly newsletter with discussions of various DX questions and news of what the EDXC Clubs have been getting up to. The new Secretary-General – the second from the U.K. I had the honour of holding the office several years back - is Ian Foster, 25 Briar Way, Slough, Bucks., from whom you may obtain details of the Council's aims and work. The EDXC Publication Service issues a list of all the Council's publications and an International Reply Coupon sent to EDXC Publication Service, D-6 Frankfurt 71, P.O. Box 71 02 71, West Germany, will bring you an up-to-date list of what the Council has to offer.

Quite a number of DX MONITOR readers tell me that they are regular listeners to my DX programme, broadcast in Deutschlandfunk's English Service, despite the fact that it can be hard-to-hear during the high days of summer (that's the season when we are supposed to have high temperatures and very little rain, just in case you have forgotten!). Starting on 7 Ocotber 1974, Deutschlandfunk's English Service will be going on the air at a new time which should afford much better reception in the U.K. The new time, Monday-Saturday, will be 1840-1930 GMT (which means 7.40 to 8.30 p.m. British Summer Time until the end of October), but the frequency remains 1268kHz, or 236.5 metres. My DX programme - called DX CIRCLE - will be going on the air at about 1900 GMT and the first programme at the new time will be on Wednesday 9 October, and thereafter every alternate Wednesday at that time. Hope you will be listening and if you want a QSL card and pennant then send me a Reception Report for DX CIRCLE, to the address shown below.

In your letters I am often asked whether I can recommend a DX Club, and I am not very keen to do this as they come in all sorts of guises and what suits one will be anathema to another. However, for Medium-Wave DXing, the major British Club is undoubtedly "Medium Wave Circle", 7 The Avenue, Clifton, York YO3 6AS: if you write, please don't forget to enclose reply postage. So far as short-wave DXing is concerned, the major problem with DX Clubs is that the majority of them only issue their bulletins at monthly intervals and this means that a lot of the information they contain is out-of-date by the time it appears in print. However there isn't very much you can do about this, and the DX Club which covers the greatest range of interests, in Europe, is probably the Danish Shortwave Clubs International (DSWCI). DSWCI has a British representative and you can send enquiries to Noel R. Green, 14 Marsden Road, Blackpool, Lancashire FY4 3BZ: again, reply postage should be sent as DX Club finances are a constant headache to their Treasurers!

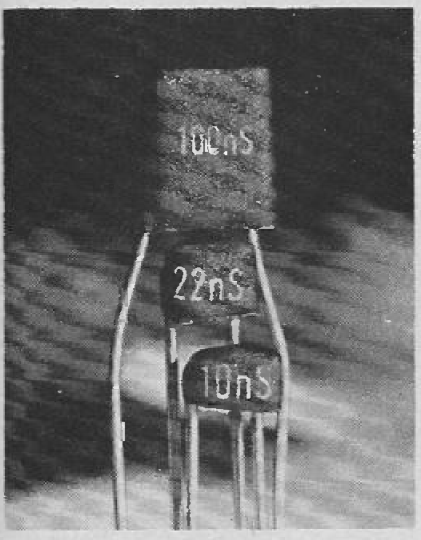
Over the past few years, more and more DX Clubs have changed to being "restricted membership" ones. There are all sorts of reasons for this, one being the fact that the amount of time taken to run a small Club is much less than that taken by a "giant" with several hundred members. Advanced DXers - say those who have already managed to hear 75 countries on the short-wave broadcast bands - might be interested in becoming subscribers to "BAND-SPREAD", a DX bulletin I edit, which appears every 14 days so that its information is as up-to-date as possible. I am afraid that membership is restricted to the active, *contributing*, DXer and charges are on the high side with the use of first-class mail 26 times a year. If you'd like more details, then send me a 9" x 4" stamped and self-addressed envelope, and if you would like a sample copy of a recent issue enclose 10p in postage stamps. At the moment, there are a few vacant places on the membership role but early enquiry is advised. My address is Alan Thompson, 16 Ena Avenue, Neath, West Glamorgan SA11 3AD, and I shall be very glad to have any queries about DXing that you care to send along: once again, please enclose reply postage and, preferably, a stamped, self-addressed envelope as it does save a lot of time in answering your queries.

Next month, the Asian Expedition, I promise! And, hopefully, the reappearance of a 'photo at the head of the page. The previous batch of negatives and prints having disappeared "in transit", let's hope that the replacements prove to have been worth waiting for, hi! ●

 Continued from Page 9

MINIATURE CERAMIC CAPACITORS

A new range of ceramic capacitors by Siemens are stocked by Jermyn Distribution. Designated the B37448/9 series, they are initially available in values from 10nf to 200nf at 40V d.c.



Utilization of parallel plate construction results in a capacitor of narrow profile suitable for high density component packaging in electronic equipment. Whilst primarily a radial component, because of its 26mm leads of 0.6mm diameter, the B37448/9 also lends itself to axial applications, for example in RF circuitry. Typically the 10nf version measures 6mm wide x 4mm high x 2mm thick, and is priced at £2.90 per 100.

UNMOUNTED LEDs

Ferranti are offering a range of unmounted LEDs in red, green, yellow and infra-red. They are available in dice or seven-segment display forms. Dice are available in two sizes, 0.015 and 0.018 inches square, and the seven-segment display in 1.2mm high characters.

Few 'device' manufacturers offer unmounted LEDs - the ready packaged form is more usual.

For those interested in the construction we have the details. The green-emitting diodes are produced from diffused epitaxial layers of gallium-arsenide-phosphide and infra-red emitting from gallium arsenide. Individual dice are passivated with silicon nitride for long-term stability and a distributed contact is used to provide uniform brightness over the emitting area. The positive connection is on the emitting face and consists of bonding pads of aluminium deposited on silicon nitride (to facilitate assembly using ultrasonic or thermo- compression wire bonding). The n-type contact consists of a gold/germanium alloy. The dice are normally supplied in slice form with scribing line demarcation.

COMPUTERISED SURVIVAL PREDICTOR

The chances of a patient's survival after a cardiac arrest can now be predicted with greater certainty using a computerised device called the London Hospital Survival Predictor.

The system uses a Digico Micro 16 minicomputer and data from a retrospective study of all patients who have been treated since 1965.

In the event of a cardiac arrest, the possibility exists of impairment of the oxygen supply to the brain, which, depending on the period of the arrest, could result in varying degrees of brain damage. In severe cases, the damage is irreversible.

Up to 16 channels of the brain's electrical activity are monitored to permit an assessment to be made of the area or extent of brain damage. Previously these channels were graphically recorded but now information can be assessed more readily using the computerised method.

Numerical values are applied to the pieces of graphical information on the basis of the studies of previous patients. Then the data can be fed to the Micro 16 computer, which makes its prediction in the form of a meter reading.

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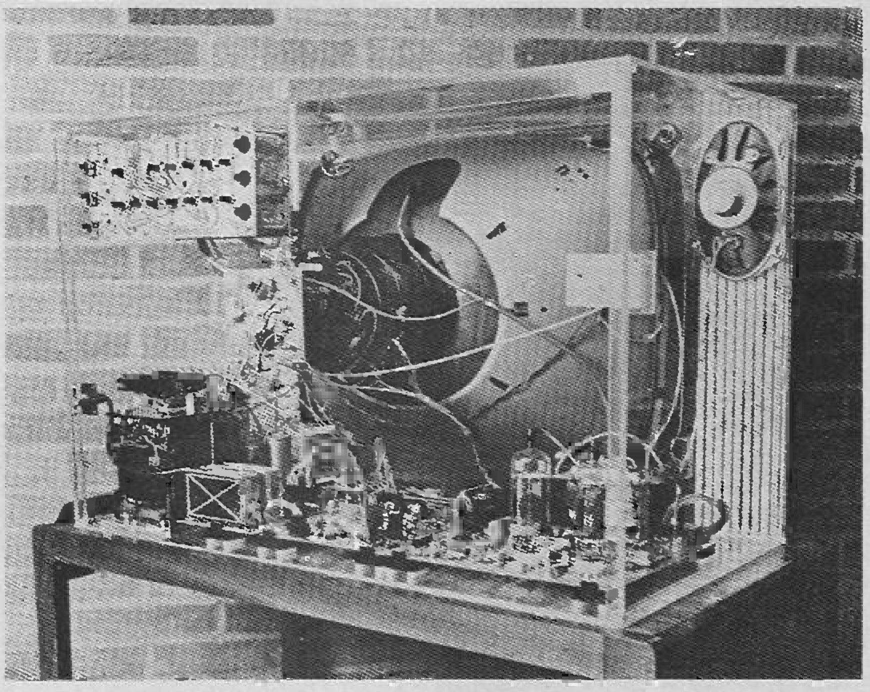


COLOUR TV KIT

The FC 400 is a PAL colour TV receiver kit launched in Britain by Forgestone. It uses ready-made coils, a pre-aligned varicap tuner module and i.f. box, nine ICs and a ready made inter-unit wiring loom. The cabinet is not supplied.

Component positions are marked on ready-made, drilled, tinned printed circuit boards. These can be mounted horizontally or vertically, according to the constructor's choice, and facilitates easy access to components for testing and service. The power supply gives full isolation and regulated LT supplies.

An illustrated step-by-step instruction manual provides full circuit details, setting-up procedures and technical description. The project is backed by a technical advisory service to help constructors who may have problems.

The kit can be supplied for a range of tube size from 19 to 26in. It covers all u.h.f. channels within the range 21 to 69 and can be made to receive v.h.f. Bands I and III with an alternative tuner head. The pre-aligned i.f. module is suitable for U.K. systems using the CCIR 6MHz standard, but alternative 5.5MHz units can be supplied.

All components are guaranteed and are supplied by Forgestone Components for approximate cost of around £200, depending on the tube size ordered, and this includes carriage, packing, V.A.T. and the handbook. If desired the packages making up the kit will be supplied individually.

The meter reading is the difference between the two operational amplifier outputs. When the two outputs contradict each other, the meter reading is centre-scale. When the op-amps agree, and they usually do, a clear positive or megative indication is given.

The computer sums 13 variables, comprising 11 EEG features and two clinical features - response to stimulation and time. The program was developed from a pattern classification system produced at Southampton University and it is said to be an adaptive learning program which tries to force various classes of data into separate multi-dimensional clusters. In doing so it finds by its own experience which variables are not useful in forming each separate cluster, and also computes suitable scaled factors for each variable. As each stage of the learning program process proceeds, the "usefulness" factors are assembled in determining the weight to be assigned to each factor, so that there is a separate set of "usefulness" factors for each constant.

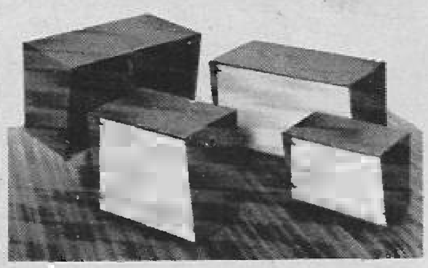
Low "usefulness' factors come off the bottom of the list one at a time - as it does that it renders an optimum cluster shape to determine whether or not an improvement in the result has been made. As each factor is removed from the bottom of the list it is tested against further data sets, until an optimum solution is reached, different typically for each data class.

Initially, 50 variables were under consideration, but experience has shown that the 13 which are now employed provide the information which is required.

The London Hospital experts stress that before the machine could be used in other hospitals the staff would require some special training in its use.

INSTRUMENT CASES

West Hyde Developments have introduced these new textured Acrylic finish cases.



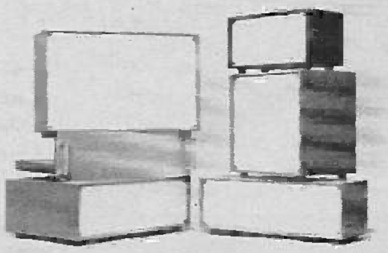
The cases have low-reflectivity dark matt blue textured surfaces. They are manufactured in 21-gauge Zintec steel and have a folded eyebrow, which not only enhances their appearance, but provides extra strength.

Panels for these cases are supplied in either 21-gauge Zintec steel, painted white, and with a special easy-to-mark-out strippable coating, which is removed after drilling or punching out OR, except in the case of the 191010, in PVC-coated aluminium. The 1277 panel can also be supplied in black. The cases (including four 2BA screws and four non-slip loose feet) and panels are supplied separately.

The six cases are 755, 975, 867, 1277, 16127 and 191010.

Of the six cases, the 755, 975 and 1277 sizes can also be supplied with both case and panel unpainted. The code numbers refer to the dimensions (755 is 7"x7"x5"). Prices for the 755 are £3.96 for the case, 87p for the white Zintec panel or £1.09 for the white PVC coated aluminium panel; all plus VAT and 30p postage and packing. For the 1277 the prices are: £5.15, £1.35 and £1.59, all plus VAT and 40p postage etc.

West Hyde Developments Ltd., Ryefield Crescent, Northwood, Middx, HA6 1NN.



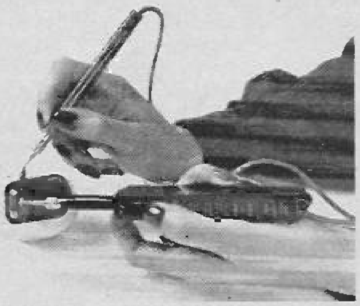
We have news, too, from Daturr Ltd of their new range of small instrument cases. Designed to be suitable for both "one-off" prototype or series productions, the series .03 cases come in six front panel sizes and three depths.

Construction is in steel, with reinforced corners and a choice or steel or aluminium front panels. Particular attention has been paid to achieving clean styling combined with mechanical strength. Plastic feet are standard and plug-in chassis are available for each size of case.

Prices range from £5.78 to £6.46.

CIRCUIT TESTER

A new circuit tester that checks for voltage and circuit continuity is now available. Press information says the pocket-sized tester (6½inches long) can be used on circuits of between 3V and 600V, a.c. or d.c. (Before buying one for high voltage use we suggest you study the photograph carefully!) It is powered by two standard 'pen-light' batteries and uses solid state circuitry. Indication, of voltage or continuity, is by an LED. The normal function is the voltage check and the tester returns to this function on release of the continuity check push button.



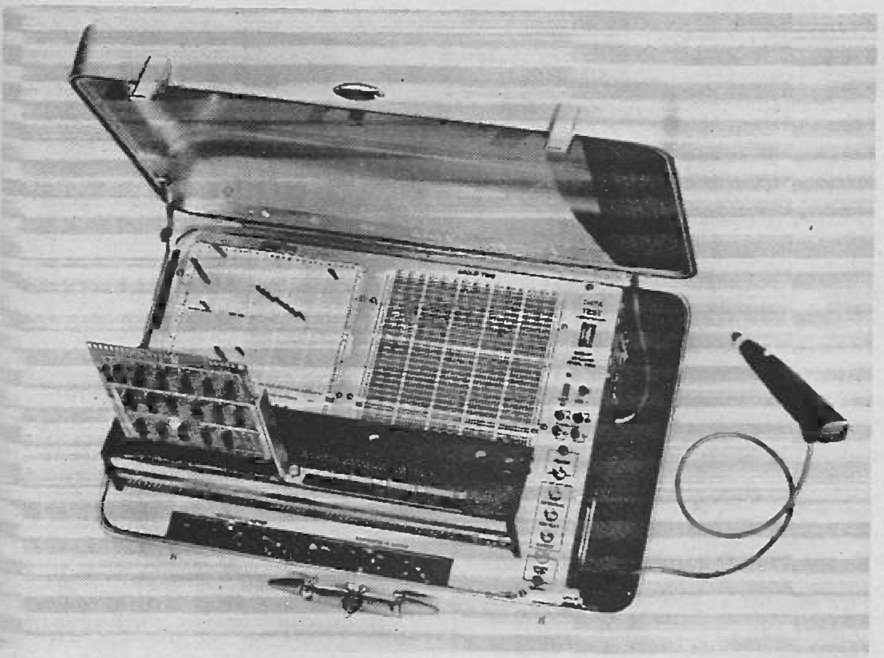
The polarity of components such as diodes or transistors can be identified by simply checking for continuity. The red probe indicates the positive lead and the black the negative, when the LED indicator glows.

The tester can be used for testing logic circuits without risk of damage to components. This is because the current drain from the test circuit is in the order of microamps, due to the high input impedance of the tester in the voltage position. The testers will be sold by British Central Electrical Company for £10.00 each.

256 CHARACTER SELF-SCAN DISPLAY

Walmore Electronics can supply the 40832-PD2 a Burroughs 256 character alphanumeric self-scan display panel which has been arranged so that it can be mounted up to seven feet from the device electronics.

This enables the depth of the display to be dramatically reduced to less than one inch, giving new scope to the



equipment designer.

The panel measures 11.8 x 5.1 inches and displays eight rows of information. Each row is made up from a matrix of gas filled display cells at 0.04 inch centres. Each matrix is 222 cells long by seven high and is separated by 0.136 inches from its neighbours. The remote drive electronics will accommodate a variety of 7 x 5 dot matrix character generators providing the designer with a choice of character sets and styles. The maximum capacity of the display is eight rows of 32 characters (using the standard inter-character spacing of two cells).

Power supply requirements of the display and electronics are at +5V±5%, 890mA; +30V±5%, 40μA and -237V at 80μA.

TESTER IN A SUITCASE

A new automatic circuit tester has been introduced in the UK by Intertrade Scientific Ltd. Although the Datatester 2000 can be easily carried by a service engineer, it can be used to test systems, subsystems, modules, circuit boards and circuits of great complexity.

The Datatester 2000 tests logic boards containing up to 1000 MSI integrated circuits. It will find wide applications in remote terminal site diagnosis, small to medium sized plant and/or departmental repair, field maintenance or computer facility service and repair. Using it, a service engineer can test a complete installation, and in a short time isolate the fault to a single component.

For precise fault diagnosis of this type a hand-held high impedance probe is used to test any point on the circuit board. The probe indicators include a four digit readout, relative logic level indicator, end-of-test indicator, "start" push button and a set level control. The tester uses a new method known as the Transition Count Technique. This involves analysing a logic pattern by counting the number of times the pattern changes from a logic '1' to a logic '0', and from a 0 back to a 1. Assuming the circuit is exercised by the same input stimulus for each test, the output pattern and therefore its count will be the same for each test.

These "signatures" are unique to the circuit under test and very simple to use. Signatures are initially gathered using a known 'good' circuit board. Not just the primary output but all outputs of logic devices on the board are noted. In this way the signatures can be used for both GO/NO GO testing as well as for fault finding. In addition to testing modules and circuit boards the user can test cables, memories and backplane.

The unit is capable of testing all types of device, including TTL, DTL, CMOS, and MOS-LSI with either synchronous or asynchronous logic, including common port systems. The 2000 contains four programmable power supplies, which permit testing of cards within the range -30 to +30 V d.c. Programming is by fixed resistors or potentiometers mounted on the removable test module, and can easily be altered. The test module provides a simple interface to the card under test, and only one module per connector type is usually required.

TEXAS WIN BASIC CALCULATOR PATENT

The USA's Texas Instrument company have just been granted a basic patent for a 'miniature electronic calculator'.

The patent (3.819.921) was first applied for in Sept 1967 and relates to personal-sized battery-powered calculators which have their main circuitry in a single LSI (large scale integrated) chip.

As most small calculators are now built this way, Texas' basic patent could well have far-reaching implications for other manufacturers.

The announcement has caught Texas' competitors completely by surprise. Texas say that now the patent has been granted they intend to inforce it by granting licencing arrangements to other manufacturers.

Industry observers feel that Texas may well be able to enforce their patent protection and that retroactive agreements may in fact have to set up.

IMPORTANT SINCLAIR SCIENTIFIC OFFER

At the time of going to press, this offer has been open for about 10 days.

The response has been so massive that the 21 days quoted for the delivery will probably be exceeded on some orders. Readers whose orders fall within this category will be advised by post.

We have received nearly 100 orders from readers without the coupon or with cheques which are made out wrongly. These orders have not been processed and readers will be contacted to obtain the correct payment as soon as possible.

We apologise to all readers who were unable to purchase the October issue. We did print quite a number of extra copies but to the best of our knowledge, the issue was a sell-out within the first week in most areas.

ERRATA

In future, to enable readers to find errata quickly, corrections will always be the last item in News Digest.

Basic Power Supply. October 1974. Page 53.

ZD1 should be 13V, 400mW, not 18V as shown in both the circuit and the parts list. The type number shown is however, correct.

MINI-ADS

FOR FURTHER INFORMATION
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01-730-2139

MANUFACTURERS PRINTED CIRCUIT BOARDS
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0.47μF	(1 3/8"x¾")	71p	4.7μF	£1.30	£1.05	85p
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1.0μF	(2"x¾")	91p	15.0μF	£2.75	£2.15	£1.80
2.0μF	(2"x1")	£1.22p	22.0μF	£3.50	£2.90	£2.55

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BC147/8/9	10p	BC547	12p	BFY51	20p
BC157/8	12p	BC558A	12p	BFY52	20p
BC182/182L	11p	BF194	12p	OC71	12p
BC183/183L	11p	BF197	13p	2N3055	50p
BC184/184L	12p	AF178	30p	2N3702/4	11p

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If you have no trouble obtaining ETI from your newsagent, that's the obvious place to get it. However five out of the last six issues have been sell-outs and early analysis of the reader questionnaire has shown that one in three readers has trouble in buying ETI.

If you are one of those having trouble, why not take out a subscription? Normally you receive your copy a few days before our official publication. Note also that although the cover price of ETI is now 25p, we have not raised our subscription rates for the time being.

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NOVEMBER 1974 . . . .