

everyday electronics

NOV. 71
15 p

**A NEW MAGAZINE
BRINGING A FASCINATING
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THEORY SIMPLY EXPLAINED



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IN THE
No. 1!
ISSUE**

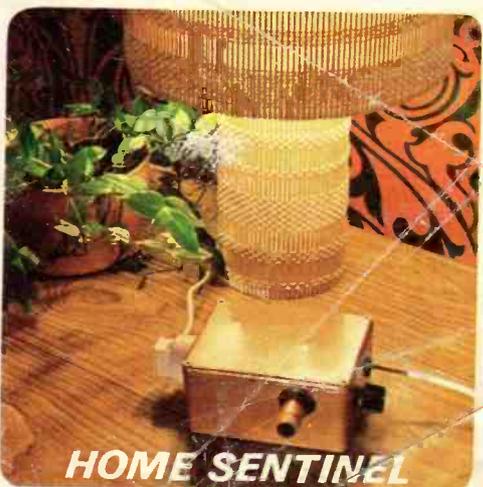
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**RECORD
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Hi-Fi for the Enthusiast

M. L. Gayford

This is not just another collection of electronics and circuit theory. It is about hi-fi. For those who want a really fine sound quality from their equipment—record player, radio, tape or television. Every aspect of room acoustics, amplifiers, pick-ups and loudspeakers is analysed and explained to help produce the best results. The strong emphasis on commercially available equipment will ensure that the high standard of home listening obtainable comes at the right price.

£2.00 net Illustrated

Pick-Ups: The Key to Hi-Fi

J. Walton

Now that recording is predominantly in stereo, the author has introduced material dealing with pick-up "compatibility" requirements for this second edition of his book, besides general revision. Of the first edition *Hi-Fi News* said: "It can be highly recommended as a first-class introduction to the subject of high-quality record production."

Second edition 90p net Illustrated

The Electronic Musical Instrument Manual: A Guide to Theory and Design

Alan Douglas

A comprehensive work for manufacturers, students of electronics and electricity, and musicians themselves. Aware of the difficulties and criticisms surrounding these modern instruments on the borderline of science and art, Douglas does much to reconcile the two points of view.

Fifth edition £2.90 net Illustrated

Transistor Electronic Organs for the Amateur

Alan Douglas

The availability of cheap transistors facilitates the construction of inexpensive and compact electronic organs for the amateur. For the first time, this book presents not only a detailed explanation of everything to do with transistorized organs. It is written in a simple style especially for the amateur constructor, and profusely illustrated with clear diagrams.

Second edition £1.10 net

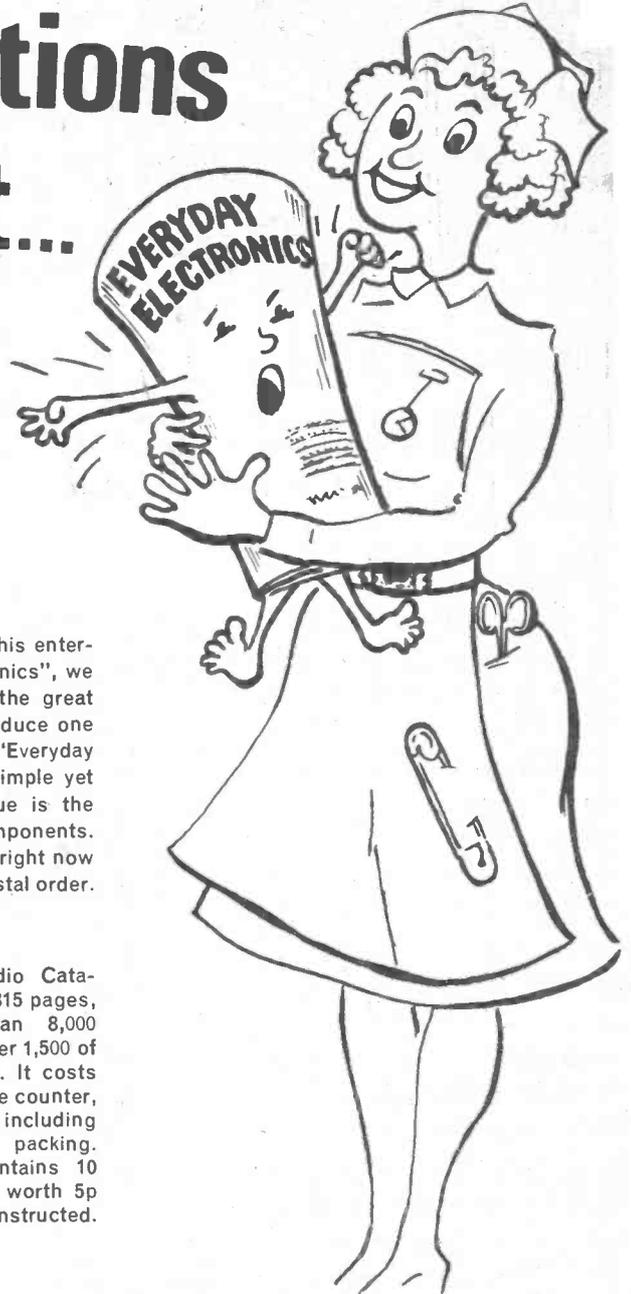
Further details of these and other Electronics titles may be found in our new catalogue (T4) available from:



Pitman Publishing
39 Parker Street
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Congratulations Mr. Bennett...

on a welcome addition to the family!



In tendering our congratulations to Editor Fred Bennett and his enterprising colleagues, on the safe delivery of "Everyday Electronics", we at Home Radio would add that we too have experienced the great satisfaction of producing a lusty, lively infant. In fact we produce one every year—the Home Radio Components Catalogue. Just as "Everyday Electronics" will be essential reading for all interested in simple yet exciting electronic projects, so the Home Radio Catalogue is the essential "Enquire Within" for choosing and ordering components. You can continue browsing through the magazine later . . . right now fill in the coupon below and send it off with your cheque or postal order.



The Home Radio Catalogue contains 315 pages, lists more than 8,000 components, over 1,500 of them illustrated. It costs 50 pence over the counter, or 70 pence including postage and packing. Every copy contains 10 vouchers, each worth 5p when used as instructed.

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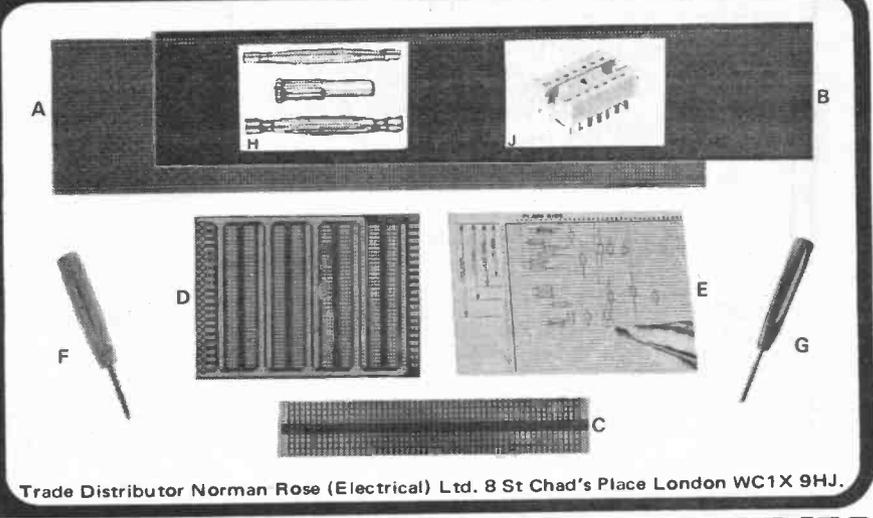
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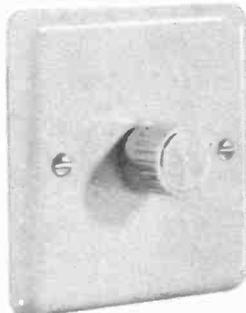
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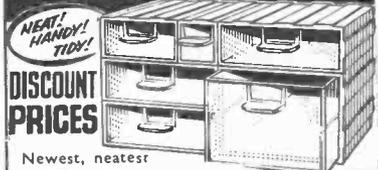
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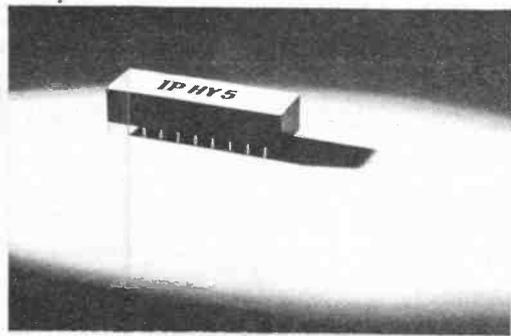
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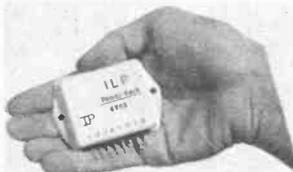
HY40 is HI-FI POWER ILP are POWER PROUD

In addition to the P.C. board and manual supplied with the HY40 we now include the five remaining components, at minimal cost, needed to complete the assembly of a High Performance Power Amplifier.

By merely combining two HY40s with a Stereo Preamplifier (2 x HY5) and simple Power Supply (PSU45), premium quality stereo may be obtained for a very modest outlay.

The free manual supplied with the HY40 gives clear, easy build instructions for Power Supply; volume, bass, treble and balance controls, together with inputs for Ceramic and Magnetic Pick-ups, Tape, Tuner and Auxiliary functions.

Internally the HY40 is based on conventional and proven circuit techniques developed over recent years.



OUTPUT POWER British Rating 40 WATTS PEAK, 20 watts RMS continuous.

LOAD IMPEDANCE 4–16 ohms

INPUT IMPEDANCE 22Kohms at 1Khz.

INPUT SENSITIVITY 300 mV for maximum output.

VOLTAGE GAIN 30db at 1KHz.

FREQUENCY RESPONSE 5Hz-60KHz \pm 1db.

TOTAL DISTORTION less than 1% (typical 0.1%) at all output powers.

SUPPLY VOLTAGE \pm 22.5 volts D.C.

SUPPLY CURRENT 0.8 amps maximum.

PRICE: including comprehensive manual, P.C. Board and FIVE EXTRA COMPONENTS:

MONO £4-40 **STEREO** £8-80 all post free.

A WORLDS FIRST TO JOIN THE WORLDS BEST

The HY5 is a unique and revolutionary concept in High-Fidelity pre-amplifiers. Thanks to the latest techniques, all feedback and equalization networks are, for the first time, combined into an integrated pre-amplifier circuit.

Simply by adding volume, treble, bass potentiometers and only three stabilizing capacitors, which are supplied, your HY5 is complete and ready for use.

The HY5 provides equalization for almost every conceivable input. This years developments in equalization technique enables precise correction for both output voltage and frequency response for any crystal or ceramic cartridge. Yet another feature of the HY5 is its inbuilt stabilization circuit, allowing it to be run off any unregulated power amplifier supply.

The HY5 contains a balance circuit which, when linked by a balance control to a second HY5, forms a complete stereo preamplifier.

Specifically and critically designed to meet exacting Hi-Fi standards, the HY5 combines extremely low noise with a high overload capability. When used in conjunction with the HY40 and PSU45 forms a completely integrated system.

INPUTS

Magnetic Pick-up (within \pm 1db RIAA curve) 2mV.

Tape Replay (external components to suit head). 4mV.

Microphone (flat) 10mV.

Ceramic Pick-up (equalized and compensatable) 20 – 2000mV variable.

Tuner (flat) 250mV.

Auxiliary 1 250mV.

Auxiliary 2 2–20mV.

OUTPUTS

Main Pre-amp output 500mV.

Direct tape output 120mV.

ACTIVE TONE CONTROLS

Treble \pm 12db.

Bass \pm 12db.

INTERNAL STABILIZATION

Enables the HY5 to share an unregulated supply with the Power Amplifier.

SUPPLY VOLTAGE

15–25 volt.

SUPPLY CURRENT

20mA approx.

OVERLOAD CAPABILITY

better than 30db on most sensitive input infinite on tuner and auxl.

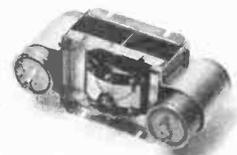
OUTPUT NOISE VOLTAGE 0.5mV.

PRICE

Mono £3-60

Stereo £7-20

POWER SUPPLY PSU45



The PSU45 is specifically designed to supply, simultaneously, your HY40 (in mono or stereo format) and one or two HY5s.

Spec.

PSU45 \pm 22.5 volts, 2 amps simultaneously.

PRICE: £4-50 including Postage and Packing

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28watts, r.m.s. 40Hz to 40kHz \pm 3dB



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There are two stereo amplifiers—the R100 for ceramic cartridges, the R101 for magnetic and ceramic. Both incorporate FETs (FIELD EFFECT TRANSISTORS), just like top-priced units. FETs give you more of the signal you want, and almost none of the background hiss you don't. Both units have a jack socket to plug in headphones and there's a separate output for tape recorder. Filters (an unusual feature in this price range) and tone controls give a wide range of bass and treble adjustment which compensate for input deficiencies and domestic acoustic conditions.

PRICES SYSTEM 1

Viscount III R101 amplifier	£22.00+90p p&p
2 x Duo Type II speakers,	£14.00+£2 p&p
Garrard SP25 Mk. III with MAG.	
cart ridge plinth and cover	£23.00+£1.50
	p&p
Total	£59.00

Available complete for only £52.00+£3.50 p&p

SYSTEM 2

Viscount R101 amplifier	£22.00+90p p&p
2 x Duo Type III speakers	£32.00+£3 p&p
Garrard SP25 Mk. III with MAG.	
cartridge, plinth and cover	£23.00+£1.50
	p&p
Total	£77.00

Available complete for £69+£4 p&p

SYSTEM 3

Viscount III Amplifier R100	£17.00+90p p&p
2 x Duo Type II speakers, pair	£14.00+£2 p&p
Garrard SP25 Mk. III with CER. diamond	
cartridge, plinth and cover	£21.00+£1.50
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Total	£52.00

Available complete for only £49.00+£3.50 p&p

SPEAKERS Duo Type II

Size approx 17" x 10½" x 6½". Drive unit 13" x 8" with parasitic tweeter. Max. power 10 watts. 3 ohms. Simulated Teak cabinet. **£14 pair+£2 p&p.**

Duo Type III Size approx 23½" x 11½" x 9½". Drive unit 13½" x 8½" with H.F. speaker. Max. power 20 watts at 3 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. **£32 pair+£3 p&p.**

SPECIFICATION R101

14 watts per channel into 3 to 4 ohms. Total distortion @ 10W @ 1kHz 0.1%. P.U.1 (for ceramic cartridges) 150mV into 3 Meg. P.U.2 (for magnetic cartridges) 4mV @ 1kHz into 47K. equalised within \pm 1dB R.I.A.A. Radio 150mV into 220K. (Sensitivities given at full power). Tape out facilities; headphone socket, power out 250mW per channel. Tone controls and filter characteristics. Bass: +12dB to -17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to -12dB @ 15kHz. Treble filter: 12dB per octave. Signal to noise ratio: (all controls at max) R101—P.U.1 and radio—65dB. P.U.2. -58dB. R100 same as R101 but P.U.2 (for crystal cartridges) 450mV into 3 Meg. Cross talk better than -35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx 13½" x 9" x 3½".

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+	10%	1Ω-3.9Ω	E12	1-0p 0-8p
+	5%	4.7Ω-1MΩ	E12	1-0p 0-8p
+	10%	1Ω-10Ω	E12	8p 8p

Quantity price applies for any selection. Ignore fractions on total order.

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0.5 watt 5% Iskra resistors 5 off each value 4.7Ω to 1MΩ.
E12 pack 325 resistors £2.40. E24 pack 650 resistors £4.70.

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SEMICONDUCTORS

AC126	12p	BFY52	22p	OC81	12p	2N3055	72p
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AF115	20p	BYZ10	20p	IN4002	10p	2N3705	15p
AF117	20p	BYZ13	20p	IN4003	11p	2N3706	12p
BC107	10p	OA85	7p	IN4004	12p	2N3707	18 1/2p
BC108	10p	OA91	5p	IN4005	13p	2N3708	10p
BC109	10p	OA202	7p	IN4006	13p	2N3709	11p
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1 7/8 x 2 1/2	75p	57 1/2p
1 7/8 x 3 1/2	100p	75p
1 7/8 x 5 (plain)	—	75p
1 7/8 x 3 1/2 (plain)	—	52 1/2p
1 7/8 x 2 1/2 (plain)	—	37 1/2p
2 1/2 x 5 (plain)	—	17 1/2p
2 1/2 x 3 1/2 (plain)	—	15p
Pin insertion tool	47 1/2p	47 1/2p
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Standard screened	18p	2.5mm insulated	8p
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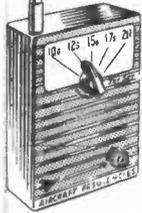
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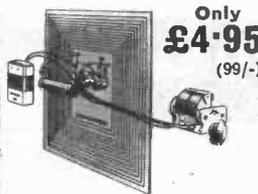
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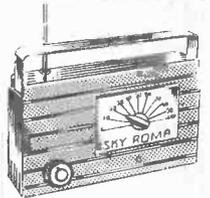
BRAND NEW FULLY TRANSISTORISED PRINTED CIRCUIT METAL DETECTOR MODULE. Ready built and tested—just plug in a PP3 battery and it's working. Put it in a case, screw a handle on and YOU HAVE A PORTABLE TREASURE LOCATOR EARLY WORTH ABOUT £20! Extremely sensitive—penetrates through earth, sand, rock, wood, dirt, water, etc.—EASILY LOCATES COINS, GOLD, SILVER, WATCHES, JEWELLERY, NUGGETS, METALLIC ORE, HISTORICAL RELICS, BURIED PIPES, KEYS, NAIL-IN-TREES, ETC., ETC. Signals exact location by "beep" pitch increasing as you near buried metallic objects. PRINTED CIRCUIT SEARCH COIL so stable and sensitive it will detect certain objects buried SEVERAL FEET BELOW GROUND! GIVES CLEAR SIGNAL ON ONE COIN! You could even pay for your holidays with two or three days electronic beachcombing—it's almost like having a licence to print money! Unclaimed treasure now exceeds the combined wealth of all nations. ORDER NOW WHILE PRESENT STOCKS LAST—TREMENDOUS DEMAND EXPECTED AT THIS REMARKABLY LOW PRICE. DEMONSTRATIONS DAILY. ORDERS DESPATCHED IN STRICT ROTATION. SEND NOW £4-95 + 30p carr. (99/- + 6/-) etc. (High quality Danish Stethoscope headphones £2-75 (55/-) extra if required).

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Can be built in one evening

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SOOTHE YOUR NERVES, RELAX WITH THIS AMAZING RELAXATRON

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£2-25
(45/-)

CUTS OUT NOISE POLLUTION—SOOTHS YOUR NERVES! Don't underestimate the uses of this fantastic new design—the RELAXATRON. Anyone from 9 years up can follow the step-by-step, easy-as-A-B-C, fully illustrated instructions. (We built ten prototypes and everyone worked first time) no soldering necessary. 76 stations logged on rod aerial in 30 mins.—Russia, Africa, USA, Switzerland, etc. Experience thrills of world wide news, sport, music, etc. Eavesdrop on unusual broadcasts. Uses PP3 battery. Transistorised (no valves). Size only 3" x 4 1/2" x 1 1/4". As tremendous demand anticipated, send only £2-25 (45/-) + 17p (3/6) p. & p. for all parts incl. Cabinet, screws, instructions etc. (Parts available separately).



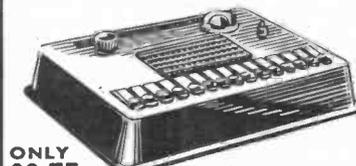
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OC44	0-13	AUY10	1-25
OC45	0-13	25034	0-25
OC71	0-13	2N3055	0-63
OC72	0-13		
OC73	0-17	Diodes	
OC81	0-13	AA442	0-10
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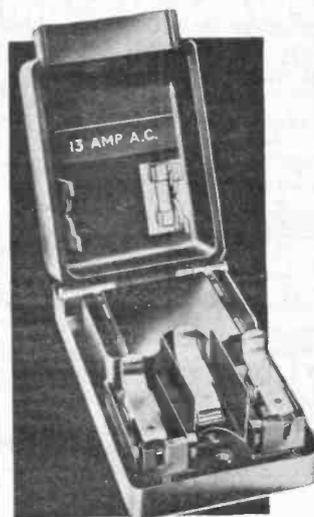
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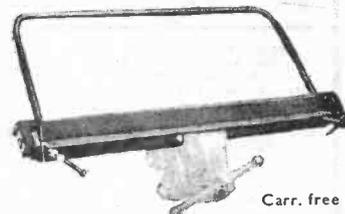
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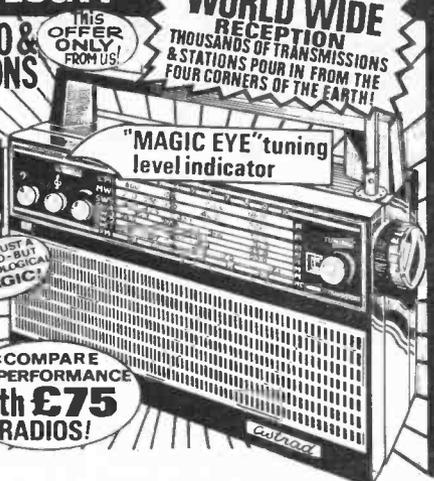
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Q16 High fidelity loudspeaker

The Q16 employs the well proven acoustic principles specially developed by Sinclair in which a special driver assembly is meticulously matched to the characteristics of the uniquely designed cabinet. In reviewing this exclusive Sinclair design, technical journals have justly compared the Q16 with much more expensive loudspeakers. Its shape enables the Q16 to be positioned and matched to its environment to much better effect than is the case with conventionally styled enclosures. A solid teak surround with a special all-over cellular foam front is used as much for appearance as its ability to pass all audio frequencies without loss.

This elegantly designed shelf mounting speaker brings genuine high fidelity within reach of every music lover.

Specifications:

Construction: Special sealed seamless sound or pressure chamber with internal baffle.

Loading: up to 14 watts RMS.

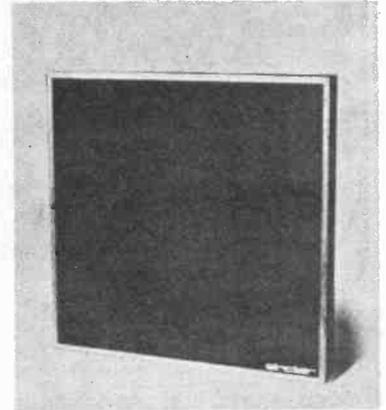
Input Impedance: 8 ohms.

Frequency response: From 60 to 16,000 Hz. confirmed by independently plotted B and K curve.

Driver unit: Special high compliance unit having massive ceramic magnet of 11,000 gauss, aluminium speech coil and special cone suspension for excellent transient response.

Size and styling: 9½ in. square on face x 4½ in. deep with neat pedestal base. Black all over cellular foam front with natural solid teak surround.

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Britain's smallest radio

Considerably smaller than an ordinary box of matches, this is a multi-stage AM receiver brilliantly designed to provide remarkable standards of selectivity, power and quality for its size. Powerful AGC counteracts fading from distant stations; bandspread at higher frequencies makes reception of Radio 1 easy. The plug-in magnetic earpiece provided, matches the Micromatic's output to give wonderful standards of reproduction. Everything including the special ferrite rod aerial and batteries is contained within the minute attractively designed case. Whether you build a Micromatic kit or buy this amazing receiver ready built and tested, you will find it as easy to take with you as your wrist watch, and dependable under the severest listening conditions.

Specifications:

Size: 36 x 33 x 13 mm (1.8 x 1.3 x 0.5 in.)

Weight: including batteries, 28.4 gm (1 oz.)

Case: Black plastic with anodised aluminium front panel and spun aluminium dial.

Tuning: medium wave band with bandspread at higher frequencies (550 to 1,600 KHz).

Earpiece: Magnetic type.

On/off switching: By inserting and withdrawing earpiece plug.

Kit in pack with earpiece, case, instructions and solder **£2.48.**

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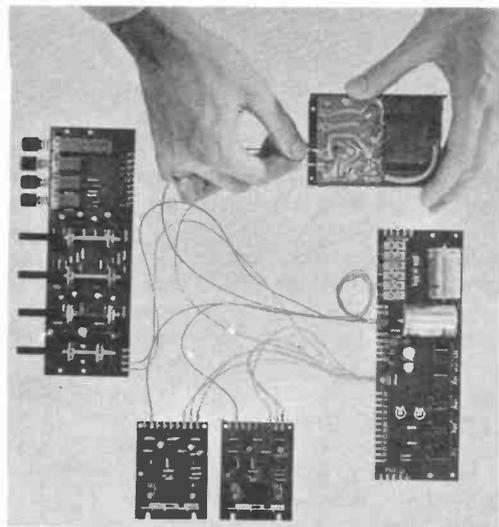
E.E. 1A

Sinclair Radionics Ltd., London Rd. St. Ives
Huntingdonshire PE17 4HJ.
Telephone St. Ives (048 06) 4311

sinclair

Everyday Electronics, November 1971

Project 605 the new simple way to assemble Sinclair high fidelity modules



For several years now you have been able to assemble your own high fidelity system to world beating standards using Sinclair modules. We have progressively improved these technically but hitherto the method of assembly at your end has remained the same — there has been no alternative to a soldering iron. Now for those who prefer not to solder, there is an alternative — Project 605.

In one neat package you can now obtain the four basic Project 60 modules plus a fifth completely new one — Masterlink — which contains all the input sockets and output components you previously bought separately. Also in the Project 605 pack are all the inter-connecting leads, cut to length and fitted at each end with plugs which clip straight onto the modules, eliminating soldering completely. The pack contains everything you need to build a complete 30 watt stereo amplifier together with a clear well illustrated Instruction Book. All you have to do is to arrange your modules in the plinth or case of your choice and then clip them together — the work of a few minutes.

Your hi-fi system will, as we said, match the finest in the world and you can add to it at any time to increase power or extend the facilities. For example a superb stereo FM Tuner unit is obtainable for only £25.

Guarantee If within 3 months of purchasing Project 605 directly from us, you are dissatisfied with it, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail. Air-mail charged at cost.

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Telephone: St. Ives (04806) 4311

Everyday Electronics, November 1971

Specifications

Output — 30 watts music power (10 watts per channel R.M.S. into 3 Ω).

Inputs — Mag. P.U. — 3mV correct to R.I.A.A. curve 20–25,000 Hz ± 1dB. Ceramic pick-up — 50mV. Radio — 50 to 150mV. [Aux. adjustable between 3mV. and 3V.

Signal to noise ratio — Better than 70dB.

Distortion — better than 0.2% under all conditions.

Controls — Press buttons for on-off, P.U., radio and aux. Treble +15 to —15 dB at 10 kHz. Bass +15 to —15 dB at 100 Hz. Volume, Stereo Balance.

Channel matching within 1dB.

Front panel — brushed aluminium with black knobs.

Project 605 comprises Stereo 60 pre-amp/control unit, two Z-30 power amplifiers, PZ-5 power supply unit, the unique new Masterlink, leads and instructions manual complete in one pack. Post free

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everyday electronics

PROJECTS...
THEORY.....

EVERYDAY ELECTRONICS really does mean electronics for everyone. Yes, *everyone*.

TWO GOOD REASONS

There are two very good reasons for launching this new popular technical magazine:

- (1) Electronics is far too important, far too exciting a subject to leave to the commercial interests alone.
- (2) Without the enterprise of the private designer and constructor, many valuable electronic gadgets and equipments having everyday uses would never see the light of day.

OUR PURPOSE

Our main and essential purpose is to broaden and extend even further the existing interest in a fascinating creative hobby. This we shall endeavour to achieve by providing popular, novel and useful designs capable of being built by any quite modestly equipped person in his own home. In particular, we shall concentrate on those applications of electronics which have not, so far, been effectively exploited commercially. Thus readers of EVERYDAY ELECTRONICS will often find themselves in an enviable position in the eyes of their friends by possessing some attractive and desirable item of electronic equipment that cannot be purchased ready made, at any price.

EVERYDAY ELECTRONICS designs will offer the widest range of applications and services possible, while keeping always within the bounds

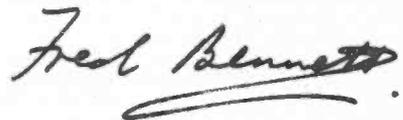
of the *relatively simple*, and *uncomplicated* kind of circuit to which we shall be limiting ourselves.

REWARDING

EVERYDAY ELECTRONICS will show how easy and enjoyable it can be to become involved in this most vital, most dynamic technology. Those having no previous knowledge of electronics will receive special attention and consideration in our pages. The creative hobby of do-it-yourself electronics, whether adopted purely as a means of recreation, or with more serious intent—as for example an extension of academic studies—will be found both absorbing and rewarding.

FREE WIRING BOARD

With every copy of this No. 1 issue we are presenting free one piece of Printed Wiring Board. Experienced constructors will immediately recognise its worth. For newcomers to this hobby the free sample board will provide an immediate initiation into one of the most popular methods employed in electronic circuit construction, both by industry and in private circles. Fully illustrated instructions explaining the use of this board are contained within this issue: and two of this month's projects can be built from this very sample. As we said, we intend to make it easy for *everyone*!



Our December issue will be published on Friday, November 19

EDITOR F. E. BENNETT • ART EDITOR J. D. POUNTNEY • M. KENWARD • P. A. LOATES
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.....EASY TO CONSTRUCT
.....SIMPLY EXPLAINED

VOL. 1 NO. 1

NOVEMBER 1971

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Beginners...

The Teach-In Course of Instruction in basic circuit theory combined with practical demonstration is a must for those without any previous knowledge of electronics. Enrol now. And don't forget, regular attendance is essential! Regrettably, we cannot guarantee any supply of back numbers in the future.

Everyday Electronics, November 1971

Meet us at the
AUDIO FAIR
Stand 4
Olympia, London, 26-30 Oct



**Ward off the
unwanted
intruder!!**

HOME SENTINEL

By Gordon M. Harvey

Your home can be "occupied" electronically whilst you are away.
No elaborate setting up or wiring up required.

THE dictum that "An Englishman's home is his castle" would banish the word house-breaking from our language if only it were true. Unfortunately, there are no moats or drawbridges with "semis" so Mr. Average has to look to the home's impregnability with insurance or electronics.

Most popular burglar alarms usually involve spinning a web of wire round doors and windows, the breaking of the loop through unlawful intrusion triggering a bell alarm. The shortcomings of this arrangement are the labour of looping and the usual inadequacy of sound output of the bell alarm.

A simple deterrent like the sign "Beware of the dog" might warn off a daylight intruder but at night what better than a bedside, or hall, lamp; a sentinel that switches itself on at dusk and off at dawn to suggest occupation when the house is tenantless, particularly during summer vacations.

LIGHT SENSITIVE CELL

The transducer PCC1 in Fig. 1 is a light dependent resistor (l.d.r.) whose response to incident illumination produces a change in its conductivity or resistance. In complete darkness this resistance has a very high value which drops with

increasing illumination. Both PCC1 and potentiometer R1 form a voltage divider.

Suppose the wiper of the potentiometer (R1) were fixed, then obviously the voltage that appears at the base of TR1 will vary with the amount of light falling on PCC1.

ELECTRONIC SWITCH

The succeeding stage TR1, TR2 and Zener diode D1 make up a variable sensitivity electronic switch. With light incident on PCC1 a large part of the line volts appears across R1. With R1 adjusted so that the turn-on base/emitter voltage of TR1 is about 650 millivolts this transistor conducts. Since this type of transistor saturates around 750 millivolts it is possible to control the conduction of the first stage for a particular ambient light level, by varying the "Set Level"

Approximate cost of components

£

4.00 excluding lamp

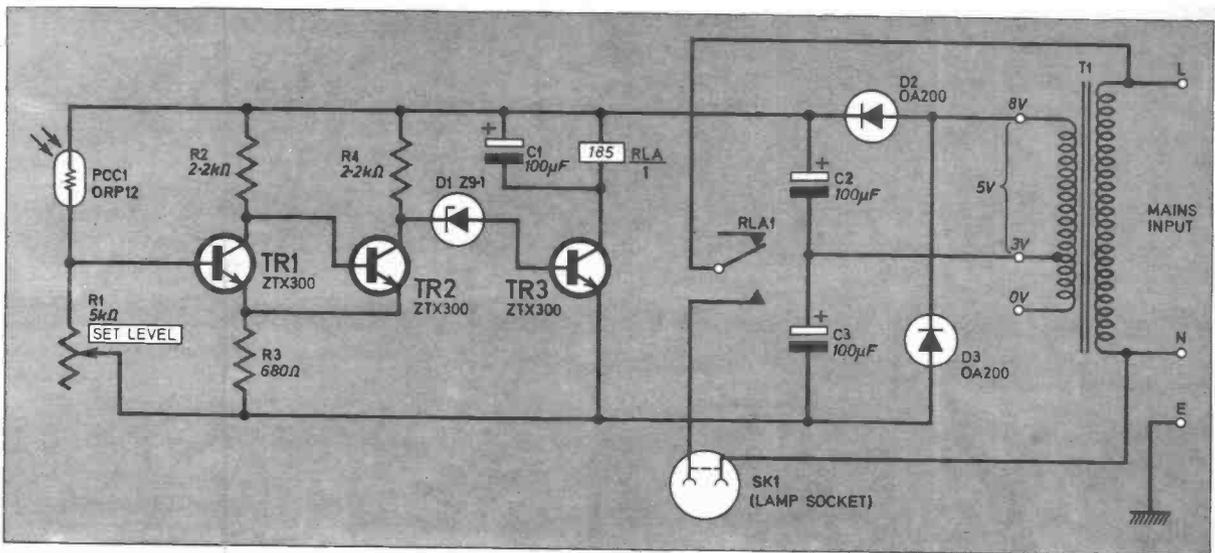


Fig. 1. Circuit diagram of the Home Sentinel. Relay is shown in position with the cell illuminated.

control R1 within these millivolt limits.

With TR1 set for least conduction the voltage at the collector is high enough to switch TR2

hard on. The voltage at the collector of this transistor then exceeds the breakdown voltage of the Zener diode D1 (9.1 volts), and TR3 conducts with consequent operation of the relay.

This is not the condition required however. The relay must be off until light to the cell is interrupted so the Set Level control is adjusted until the relay armature "falls out" with an audible click.

With no light to the cell, its resistance soars, TR1 is cut off, its collector voltage rises and the relay operates.

SENSITIVITY

Because variations in the Set Level voltages are very much magnified at the Zener diode it is possible to set the sensitivity for all kinds of ambient light conditions.

POWER SUPPLY

Since the sentinel will be expected to operate over long periods, batteries were ruled out, particularly since the total current drawn with the relay switched is in the region of 40mA.

The transformer T1 is a readily obtainable Friedland bell transformer. From Fig. 1 it can be seen that the secondary voltage tap used is 5V. Since this is inadequate for relay tripping a two-diode voltage doubler was used to raise the line volts.

One end of the selected secondary winding is taken to the common connection of C2 and C3 so that all of the transistor circuitry is fed from the two series capacitors.

Although the ripple on the line voltage is high (a characteristic of diode doublers) there will be no adverse circuit effects.

The capacitor C1 is included to prevent any relay chatter caused by such influences.

Components....

Resistors

- R1 5kΩ lin carbon potentiometer
- R2 2.2kΩ
- R3 680Ω
- R4 2.2kΩ
- All ±10% ½ Watt carbon

Capacitors

- C1 100μF elect. 15V
- C2 100μF elect. 15V
- C3 100μF elect. 15V

Diodes

- D1 Z9-1 9.1V 250mW Zener
- D2, D3 OA200 (2 off)

Transistors

- TR1-TR3 ZTX 300 Silicon npn (3 off)

Light Dependent Resistor

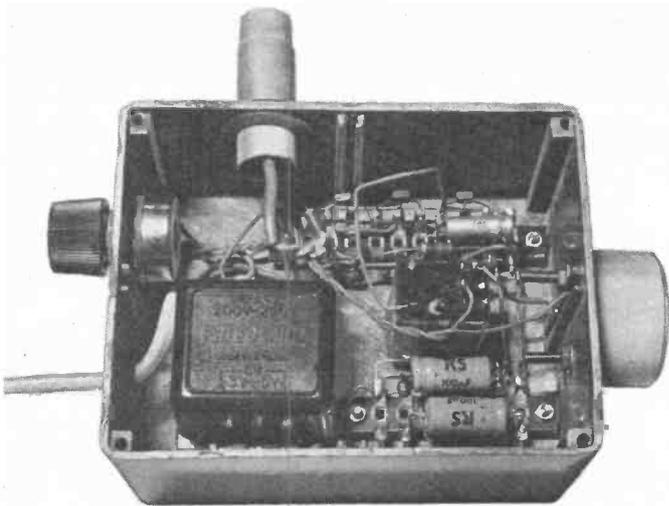
- PCC1 ORP12

Relay

- RLA PC2 CBB/12 6/12V operated. 185ohm coil.

Miscellaneous

- T1 Friedland bell transformer 240V Primary, 0-3-5V Secondary (Woolworths)
- SK1 2 pin lamp socket, 2A, 240V with plug to suit, grommets—½in and ¼in internal diameter (see text), 2in x ½in diameter plastic tube, tag strips, solder tag, nuts and bolts, 3 core mains lead, 3 pin mains plug with 2A fuse, 4¼in x 3¼in x 2½in diecast box



CONSTRUCTION

Most of the small component circuitry is mounted on two tag strips as shown in Fig. 2. When mounting the semiconductors be quick with the soldering iron or use a heat shunt and do not bend the leads of the electrolytics too close to their bodies.

With the tag boards assembled the 4 $\frac{3}{4}$ inch x 3 $\frac{3}{4}$ inch x 2 $\frac{5}{8}$ inch diecast box should be drilled. There is nothing electrically critical in the arrangement of the parts in the box, simple drilling details of the prototype are given in Fig. 3.

When cutting the hole for the light cell, start by making a hole of about $\frac{1}{2}$ inch diameter. Carefully shape this with a half-round file to take a $\frac{1}{2}$ inch centre diameter rubber grommet. This grommet must firmly retain a 2inch length of plastic tube which in turn retains the light cell at the box end.

The tube itself can be a lip salve or lipstick container, obtainable from any chemist. This tube provides some directional sensitivity to the Sentinel.

First bolt on the tag strip component assemblies using insulating bushes to prevent contact to case of any of the tags. Feed the three-core mains lead into the box using a $\frac{1}{4}$ inch internal diameter rubber grommet to prevent cable chafing.

Wire the transformer before assembly, making sure there are no bare wires to the power supply tag strip.

Araldite proved an effective fixative for the relay.

LIVE WIRE PRECAUTIONS

When baring the leads to the lamp socket SK1, make absolutely certain that no wire is touching the chassis. If a three-pin plug, fused at 3 amps, is used at the supply and the box suitably earthed as shown there is no likelihood of danger.

Finally, assemble and wire R1 and the cell. Do not push the latter hard into the tube or you

might fracture the leads. Remember, any spurious effect back-lighting on the cell will be cancelled by the lid when this is finally fitted. The entrance to the tube should be coated with matt black paint or Indian ink.

TESTING

Temporarily place the lid on, then sight the cell tube towards a bright source of light—a window, a lamp, etc. Now rotate R1 until the relay armature is heard to pull in. Next gradually back off the Set Level control at the same time passing your free hand across the cell.

It should be possible to switch the relay as the light entering the tube aperture is momentarily blocked. A little bit of experiment with the control and more removed hand waving will demonstrate the sensitivity of the device.

SETTING UP

For switching on and off a table lamp at dusk and dawn, first site the sentinel with the cell pointed directly at the nearest window. To simulate the switching condition there is the simple expedient of opening and closing the curtains and adjusting the Set Level control for correct working.

Since the relay contact ratings are 2 amps at 240 volts. A mains lamp with a bulb up to 200 watts can be used with complete safety. ▣

COMPONENT REFERENCES

Given below is a list of component references used in circuit diagrams and components lists appearing in EVERYDAY ELECTRONICS. The list does not cover all designations, only those used in this issue.

In general, we are following the latest British Standards recommendations (as per BS 3939), but there are a few exceptions.

B	battery
C	capacitor
D	diode
LP	lamp
LS	loudspeaker
M	motor
PCC	photo conductive cell (l.d.r.)
R	resistor
RL	relay (RLA relay "A" having one set of 1 contacts—"RLA1")
RPH	replay head
S	switch
SK	socket
T	transformer
TR	transistor

No more fights with the Snap Sequence Indicator!
Press your button first and your opponent is blocked.
Can be used for reaction testing games and quiz games.

IN some games, such as snap and question games, it is necessary to know which person or team is first. If recognition of pairs or readiness to answer is declared by voice, it is not always clear who was first.

The device described here was built to avoid this difficulty. Its simple electronic circuit is arranged so that when one person has pressed a button, a later response by the opponent is blocked; and an indicator lamp shows who was first. The circuit automatically returns to its original condition when the push-buttons are released, and hence is ready for the next turn.

CIRCUIT OPERATION

The complete circuit is shown in Fig. 1. Transistors TR1 and TR2 act as switches for LP1 and LP2 that are in the collector circuits of the transistors.

One push-button is operated by each player and S3 is the on/off switch. Normally S1 and S2 are open and the transistor bases are held off and no collector current flows.

If S1 is now pressed, connecting R1 to the base of TR1, this shifts TR1 into conduction so that the indicator lamp LP1 lights. Almost the whole supply voltage is dropped across LP1, so that the supply voltage between the negative line and TR1 collector, R3 junction is very small. If S2 is now closed, TR2 will not be turned on since its base will not be taken positive enough. Hence LP2 will not light.

Should S2 be closed first, LP2 lights and LP1 cannot be lit.

Push-buttons S1 and S2 are bell-pushes, suitably placed for each competitor. The button is pressed and held down, to show recognition of pairs or readiness to answer. LP1 and LP2



SNAP!

Sequence Indicator

By F.G. Rayer AIERE.

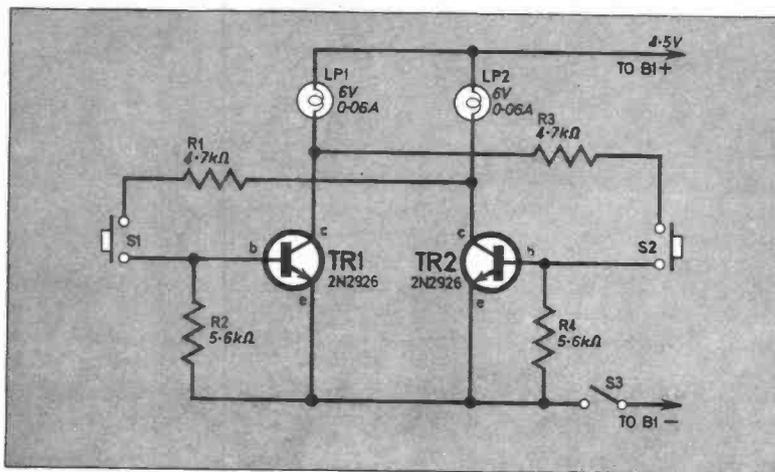


Fig. 1. Complete circuit diagram of the Snap Sequence Indicator.

Approximate cost of components



1.00 plus case

are low-consumption bulbs (0.06A 6V) which limit collector current to a low value.

When both pushes are released, the circuit returns to the normal condition.

CONSTRUCTION

The limited collector current means that small silicon transistors may be used and hence all components except the lamps and switches may be mounted on part of the Veroboard enclosed in this issue. Fig. 2 shows the layout and wiring and the following article explains how to use the Veroboard.

The complete unit is housed in a small box,

ours was a wooden box made up for the job but almost any small box will do. Holes are cut for the two indicator lamps (LP1 and LP2), the on/off switch S3 and the wires to S1 and S2.

The Veroboard mounting hole can be marked off inside the case through the board before components are mounted and the hole drilled ready to take the Veroboard. The lamps, switch and grommets, for the leads to the push switches, can be fitted and the battery can be mounted. The finished board can now be mounted, making sure that the mounting screw does not short any components. Fibre or nylon washers under the board will prevent the nut from touching any strips. The connecting leads can be cut to the required length and the remaining components connected up.

PUSH BUTTONS

Each push-button is a surface-mounted bell-push of the inexpensive type which does *not* take an internal bulb. The pushes are mounted on small wooden blocks.

Components....

Resistors

- R1 4.7kΩ
- R2 5.6kΩ
- R3 4.7kΩ
- R4 5.6kΩ

All $\frac{1}{4}$ W $\pm 10\%$ carbon except where stated.

Transistors

- TR1 2N2926 Silicon npn
- TR2 2N2926 Silicon npn

Lamps

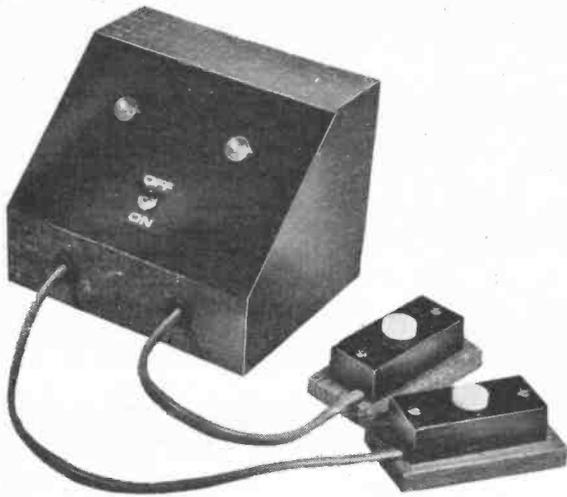
- LP1 0.06A 6V bulb and holder
- LP2 0.06A 6V bulb and holder

Switches

- S1 S.P.S.T. push button (bell push)
- S2 S.P.S.T. push button (bell push)
- S3 S.P.S.T. toggle (on/off)

Miscellaneous

- B1 4.5V torch battery
- Veroboard: 6 holes by 7 strips 0.15in. matrix (part of this month's give-away)
- P.V.C. covered connecting wire (7 strand coloured)
- 9 B.A. fixings. Grommets. Case (approx. 5in. x 4in. x 4in.)



For team games, leads to S1 can run to two or more pushes connected in parallel, and leads to S2 similarly to the required number of pushes.

Always check for dry or badly soldered joints, incorrect wiring and polarities before testing, as it is all too easy to damage a transistor if it is wired up wrongly or the supply is connected wrongly.

CASE

A suggested case is shown in Fig. 3. This can be made of wood, varnished, painted or covered in cloth. Fig. 4 shows how the board is connected to the components mounted in the case and to S1 and S2.

The wires used to connect the circuit to S1 and S2 are twin core mains or bell wire. Small notches can be cut in the sides of the bell pushes so that the wires can be fed out.

In the prototype the battery was soldered to the leads but small paper clips can be used as connectors if soldered to the wires. This makes for easy replacement of the battery.

If a metal case is used it is a good idea to cover the metal area under the component board with insulation tape.

GAMES

The device can be used in any game where a score is obtained for the first correct answer. Questions may be put by a "question master" armed with general-knowledge, arithmetic, or other questions and answers suited to the age of the contestants.

For snap games, which are really a test of the competitor's speed of reaction, cards may be dealt by the competitors, or by a third person.

Reaction can be to any prearranged "sign"—a specific number on a thrown dice, head or tail of a coin, a flashed light, buzzer, etc. In all cases mistakes have to be counted as a penalty. □

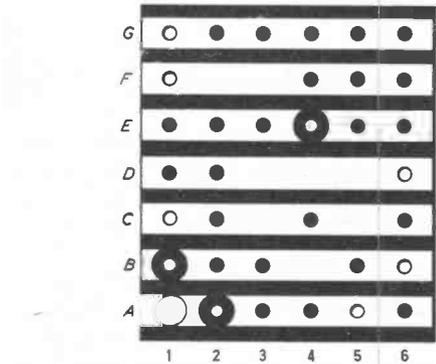
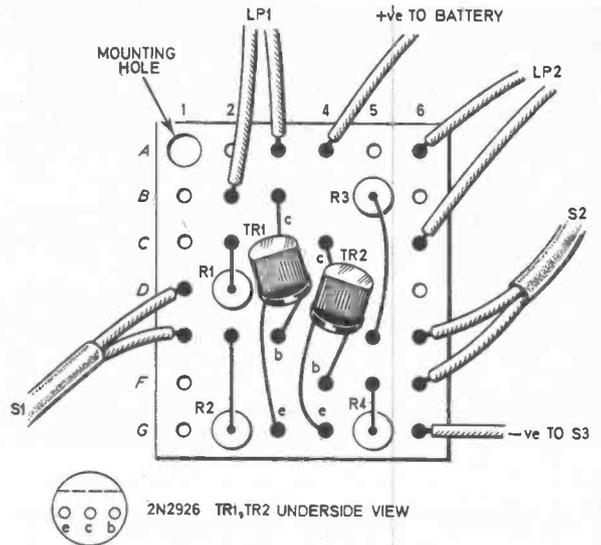
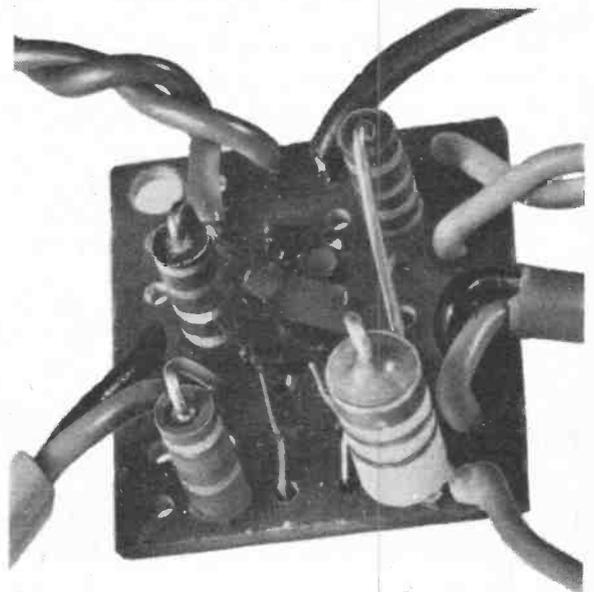


Fig. 2. Veroboard layout and wiring diagram showing both sides of the board and connecting wires.



CONSTRUCTIONAL
SNAP!
 DETAILS

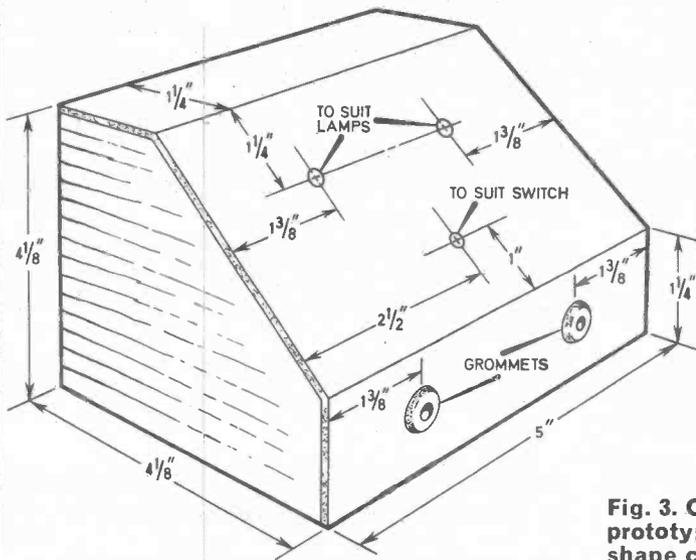
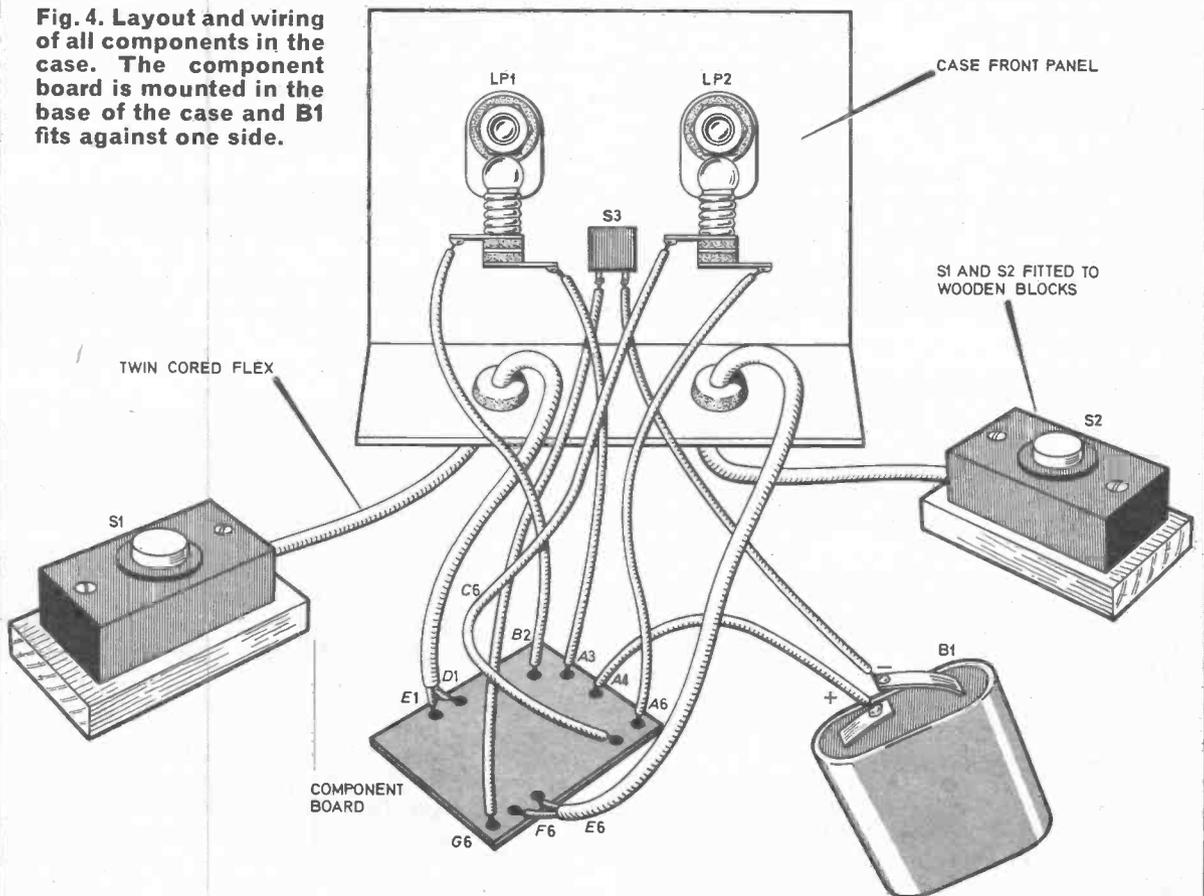


Fig. 3. Case details, this is the design of the prototype case made in wood. Almost any shape case could be used provided that all the components will fit inside. The back of the case should be removable to facilitate battery replacement.

Fig. 4. Layout and wiring of all components in the case. The component board is mounted in the base of the case and B1 fits against one side.



USING PRINTED WIRING BOARD

The piece of printed wiring board given away free with this issue can be used to make two of the projects featured. This article shows you how to use the board.

THE series of photographs shows how to use the printed wiring board (Veroboard). These show the *Snap Sequence Indicator* being constructed. A picture showing the cutting of the board is featured in (a) although some constructors may prefer to use the board as it comes. If you are going to construct both the *Snap Sequence Indicator* and the *Windscreen Wiper Control*, both in this issue, you will need to cut the board as indicated.

Once this is done drill any mounting holes or special holes for component mounting as required and clean-up the board where necessary using a file and large drill to take off the burrs (b). The component and wiring diagrams in the relevant article show both sides and have numbers and letters in line with the holes for easy hole identification, when referring to the unit wiring diagram. The underside view shows the breaks in the strips and the filled-in holes indicate where wires pass through the holes. Comparing the top and underside views will soon make this apparent.

Now that the board is mechanically shaped the breaks in the copper strips must be made in the correct places (c). This can be done with a spot face cutter (sold especially for the job) or with a metal twist drill of say $\frac{3}{16}$ inch diameter held in the hand as shown. Check carefully that the breaks are right across the strip and in the correct place.

FITTING COMPONENTS

Next mount all the components (except any transistors and diodes) and wire links on the board, holding them in place by their leads, bent over as shown (d). Check that all components are mounted in the right positions and that any polarities are correct, e.g., on electrolytic capacitors. Now cut off their leads so that only a small part is bent over to hold the components (e) and solder this part to the copper strip (f).

If you are new to soldering we suggest that you look at the *Teach-In* beginner's series and follow the soldering exercises before attempting to build any electronic devices.

Having soldered the components in position, check the joints and make sure that no solder has linked two adjacent copper strips. Next cut some lengths of p.v.c. covered stranded wire for the connected wires. It is helpful to use different

Photographs showing how to use Veroboard.

- (a) Cutting board.
- (b) Cleaning up cut edge and deburring holes.
- (c) Making breaks in strips.
- (d) Mounting components—all except semi-conductors.
- (e) Cutting leads.
- (f) Soldering leads.
- (g) Soldering in the transistors.
- (h) The completed board.

colours for each wire for identification purposes, keeping red and black for battery positive, and negative and blue, brown and green for mains neutral, line and earth wherever possible.

Try and estimate the connecting lead lengths required from the layout drawings and photographs and cut them with plenty to spare. Strip about $\frac{3}{16}$ inch of the insulation of one end of each wire, using strippers or a pen knife. Twist the strands together and tin the ends. Push the tinned part through the required hole, bend the end over and solder the wire to the strip as before. Check the positions and the soldered joints as you did with the components and twist any pairs of wires together.

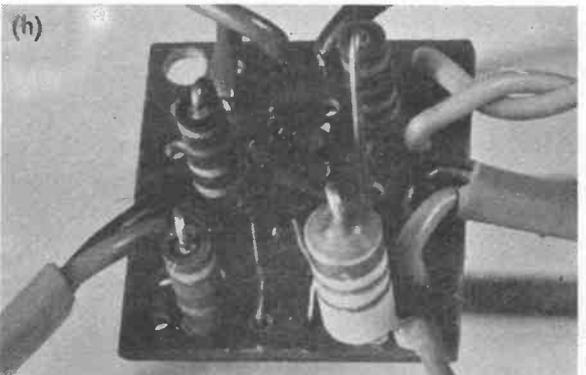
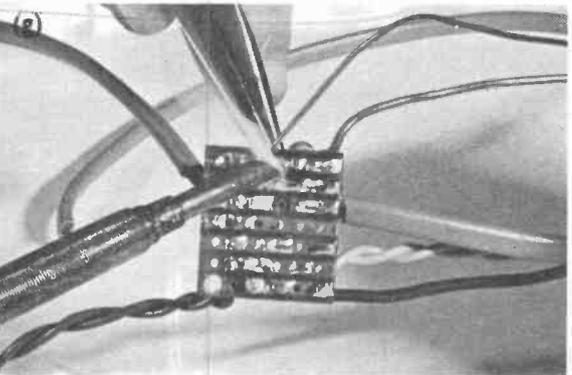
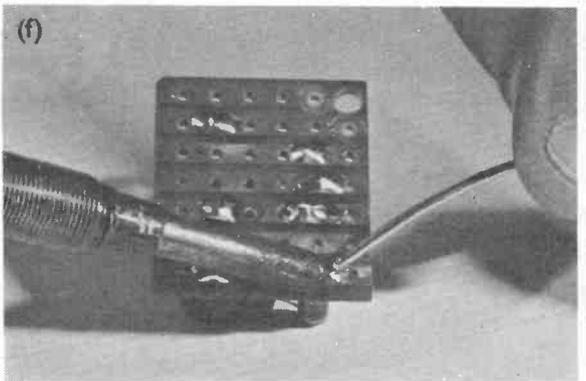
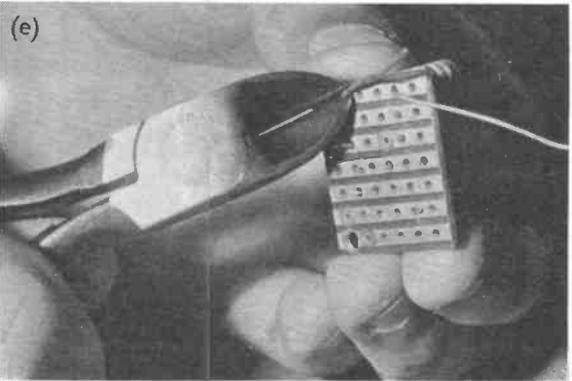
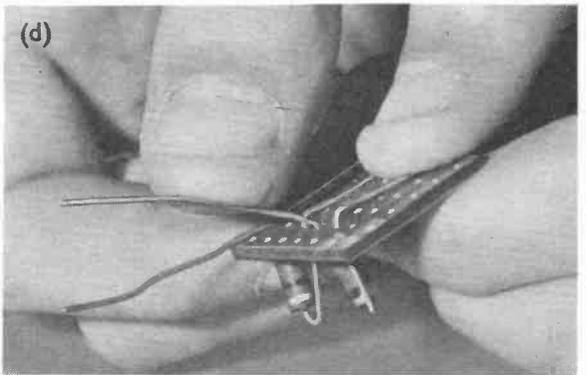
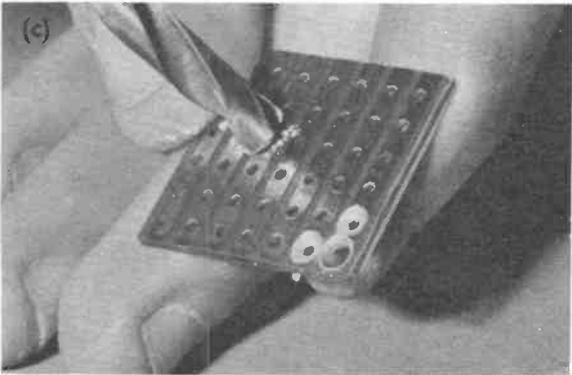
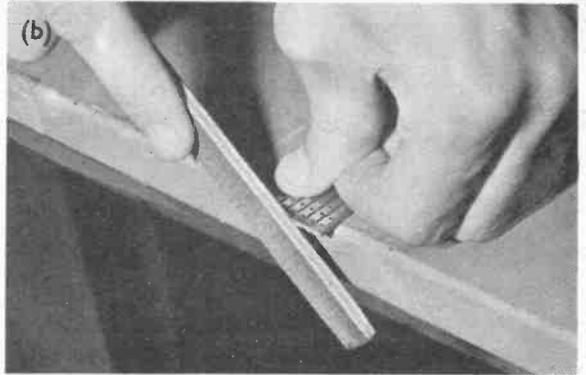
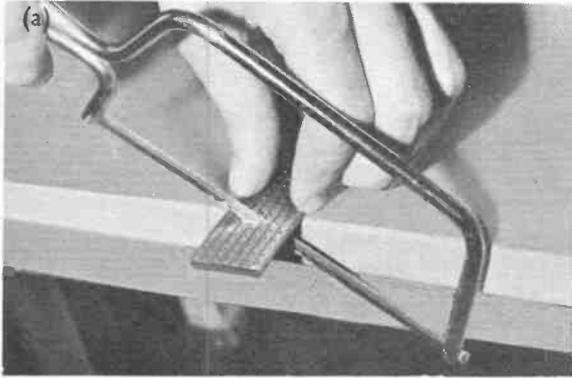
SOLDERING SEMICONDUCTORS

Finally, the transistors and diodes can be mounted and the board checked carefully. When mounting germanium transistors and diodes you must always use a heat shunt to protect them from the heat of the soldering iron and it is wise to carry out this practice when mounting silicon devices also.

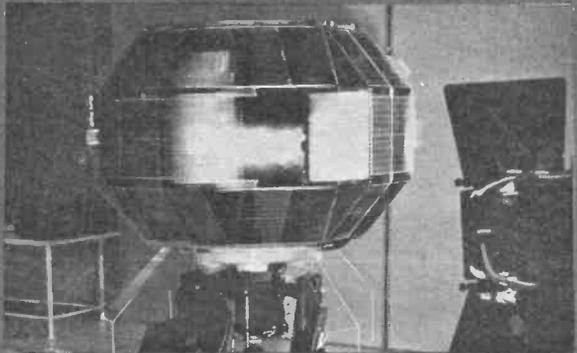
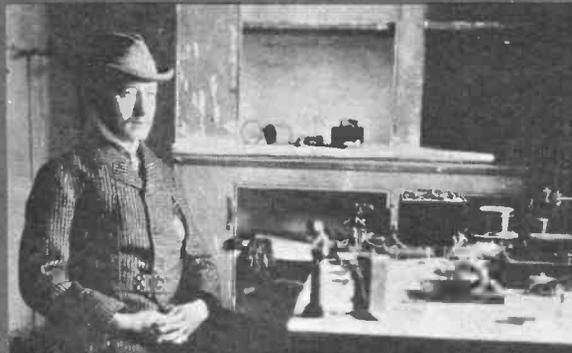
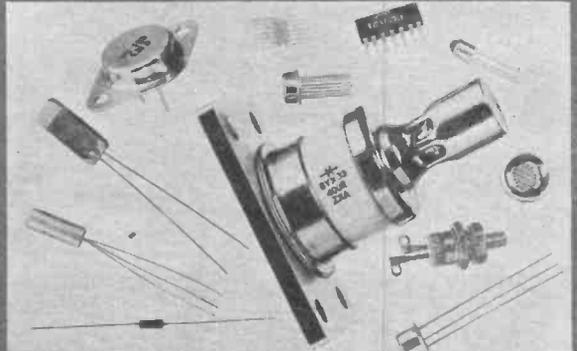
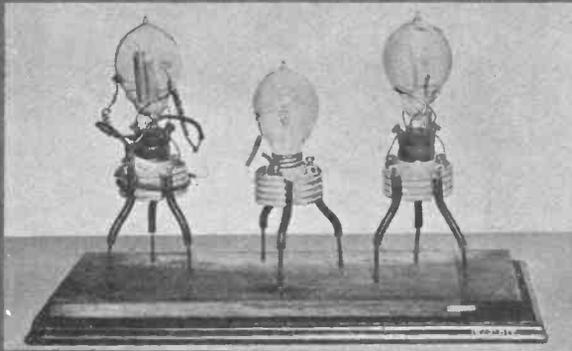
The heat shunt, which can be a pair of long nosed pliers or a proper shunt sold for the purpose, is held between the component and the joint to be soldered, on the lead to which the soldering is being carried out (g). Keep the shunt on the wire until the joint has cooled down before transferring it to the next lead to be soldered.

Transistors and diodes are mounted on the board and soldered in the same way as other components—checking position and polarity before cutting the leads and checking joints after soldering.

Once all the components and flying leads are mounted (h) it is advisable to check the whole board against the circuit diagram, checking each joint of every component and making sure that no components link with any components or wires that they are not meant to. □



electronics



PAST & PRESENT

By Prof. G.D. Sims, OBE, PhD (Southampton University)

The rapidity of development of electronics and its associated industry has been almost without parallel in technological history. This article reviews the growth of the subject and describes some of the innovations to be expected in the future.

Top left: Some of Fleming's experimental diodes from around 1900. It was from experiments with such diodes that he discovered the rectifier effect about which he wrote to Marconi "it may become very useful" (Marconi)

Top right: A selection of modern semiconductor devices. The large diode in the centre is capable of passing 250 amp—compare this with Fleming's experimental diodes on the left (Mullard)

Bottom left: G. Marconi posing at Signal Hill, Newfoundland, in 1901 with the instruments with which he received the first wireless signals across the Atlantic from Poldhu, Cornwall.

Bottom right: The first all-British technology satellite, Black Arrow, X3, shown recently under test to confirm the solar cell power output and the power conditioning system (Marconi)

IN the year 1883 Thomas Edison had become interested in the blackening of the envelope of electric lamps resulting from a carbon deposit thrown off from the filament. He was carrying out some experiments with a metal plate interposed between the glass envelope and the filament in an effort to minimise the trouble. In the course of the work he connected the plate to the positive terminal of the filament supply and noted that a small current passed in the plate circuit. He also observed that when the plate was connected to the negative terminal no current flowed. Little did he realise how near he was to a discovery which was to revolutionise life in the centuries to come.

REMARKABLE SOCIAL CHANGES

To say that electronics has revolutionised our way of life is no understatement: radio and television, the ability to communicate by telephone or radio with all parts of the world, the ability to travel safely in aircraft or at sea, the computers which deal with so many routine tasks and a hundred and one other things besides, have all combined to produce the most remarkable social changes in our way of life since the beginning of the industrial revolution.

A SCIENCE-BASED INDUSTRY

In the U.K. alone the electronics industry employs more than 400,000 people and thus is one of the major industries in the country. As one would expect in an advanced science-based industry it employs a very high proportion of highly qualified manpower, indeed more than 14.7 per cent of all the graduates employed in the manufacturing industry in this country are employed in the electronics industry, while 10.3 per cent of the nation's qualified technicians are concerned with various aspects of electronics.

Even this understates the position though, for we are continually widening the range of applications of electronic technology. More and more industries are standing in need of people with "electronic" skills. We find electronics becoming of increasing importance, for example in the medical field, in automobile engineering, in watch and clock manufacture, and even in the toy industry. Every one of these user industries also needs people with suitable interests and appreciation of what can be done with electronic devices and circuits.

In this article we shall look at the history of these developments and try to give some picture of electronics today and in the future.

THE THERMIONIC VALVE

Let us return to Edison's experiment. The phenomenon that he had observed and others like it had excited the interest of J. Ambrose Fleming (then Professor of Electrical Engineering at University College, London) and in a

paper given to the Royal Society in 1890 Fleming appeared to have solved the mystery. More significantly, however, he had observed that by feeding the lamp from an alternating current supply, rectification (the process of converting alternating to direct current) had occurred.

Fleming, however, was a very busy man and also perhaps one who did not always see the immediate applications of the things on which he was working. Fourteen years, therefore, elapsed before he filed his momentous 1904 patent with which the thermionic valve found its first public announcement.

The actual detector on which he performed the experiments which were the subject of the 1904 patent, was one of these earlier valves mentioned in 1883 which he had stored away over the intervening period. He observed that the direct current, which passed through the valve was related to the amount of radio frequency power applied to it, and hence was born the rectifier principle, which remains one of the corner-stones of electronics even today.

In a famous letter to Marconi he wrote of his discovery and added as an afterthought "I have not mentioned this to anyone yet as it may become very useful!" Little did he know . . . !

ENTER THE TRIODE

Somewhat later, Dr. Lee de Forest found that by interposing a grid between the filament and the plate in the valve he could control the amount of current flowing. This was a key development for the valve could scarcely be considered as a versatile device at all, until the current could be controlled.

The first successful triode valves thus operated around 1906 and the first really useful oscillators, based on these principles, followed in 1913 as a result of almost simultaneous discoveries in Britain, Germany and the United States of America.

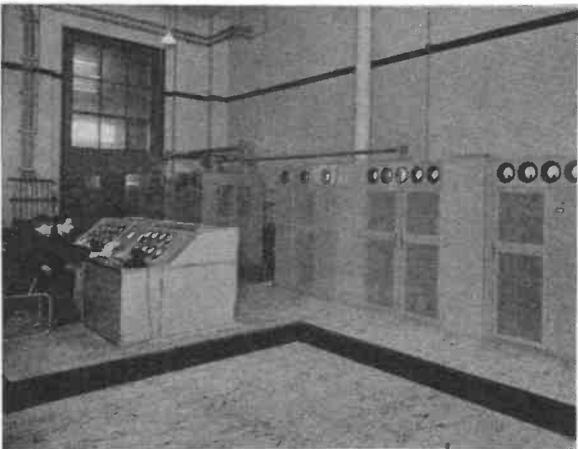
With the thermionic valve we had the ability to amplify small radio signals and the principle of amplification is still fundamental to almost all electronics systems—for whether we are trying to amplify a small signal transmitted from a distant point to a level at which we can receive it intelligently, or whether we are trying to pick up a signal, for example from a weak radio star (for many stars, both visible and invisible, emit radio waves) or from an artificial satellite, the principle is the same.

WIRELESS COMMUNICATION

As early as 1900 Marconi had conceived the idea of trying to establish wireless communication between England and the Continent of America. He did not at that time, of course, use thermionic valves as Fleming had not yet invented them, though Fleming, nevertheless, acted very much as Marconi's adviser in the



The television transmitting antenna, used for the first ever public television service in 1936, at the B.B.C.'s Alexandra Palace station (Marconi)



Original 1936 television transmitter at Alexandra Palace. The equipment cabinets and console look reasonably modern even by today's standards (Marconi)

design of his transmitter (which incidentally needed a 25 h.p. oil engine to drive it!).

With the possibility of wireless communication established, therefore, and with the necessary "electronic tools" now available, the development of radio communications was inevitable.

The first world radio broadcast took place in 1910 and included a performance by Caruso

from the Metropolitan Opera House, New York. The "Titanic" disaster of 1912 first brought to the attention of the public the potential use of radio at sea; and the first celebrity broadcast in England on June 15th of 1920 by Dame Patti Melba commanded a fee of a thousand guineas, an astronomical sum of money at that time! Later in 1936 the first serious television service was established in England by the B.B.C., and much of the pattern of future development was thus determined.

Up till this point and a little beyond, electronics had been a mixture of scientific curiosity and amusing diversions, for although it had brought about the demise of the Victorian musical evening, by providing an alternative source of entertainment, its other social effects had not been of great significance!

It is true that radio at sea had made steady headway and that the inclusion of periodically spaced amplifiers in telephone cables had made trunk telephone services possible, but we had not yet encountered the major developments which were to fashion the shape of electronics as we know it today: the transistor was as yet undreamed of and the computer had yet to make its impact.

COMPUTERS

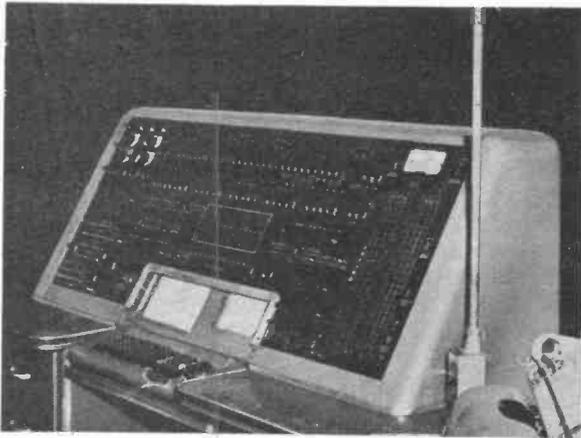
Although the first computer, Babbage's analytical engine, was designed in 1834, it was never built, for difficulties with finance and, in particular, the enormous cost of cutting the gear wheels which constituted the "thinking" part of the machine were prohibitive. It was only the ability, which electronics gave us, to produce systems which could "think" which made the computer a practical possibility.

Modern computers almost invariably work in the binary system of arithmetic. In place of the ten figures necessary in the decimal arithmetic system only two are needed, a 0 or a 1, and these can be simply represented in electronic terms by using an "electronic switch" so "biased" as to either allow a pulse of current to flow, or to inhibit it.

Clearly a system which can differentiate between two symbols must be capable of making a decision between them and can therefore make the "yes" or "no" decisions to which all of our thinking processes can in the last resort be reduced. We shall return to the subject of "machines which can think" later and also to the more general use of the "digital" electronics which they involve.

A SPACE PROBLEM!

The first electronic computers to be built used thermionic valves and it soon became apparent that powerful as even the early computer was, the time would soon come when we needed machines of even greater capability.



The world's first commercial data processing computer, completed in time for the 1950 U.S. Government population census. Large racks of equipment not shown in this photograph house the computer, the console being the data input and control point. (Univac)

To build these with valves presented problems—moreover it had been calculated that, for example, a valve machine, which could perform the sort of complex operations which the brain does, would require so many valves that the heat dissipated in them would require something of the size of the Chicago River to carry away waste heat. Further the machine concerned would be something like the size of the City of Chicago anyway.

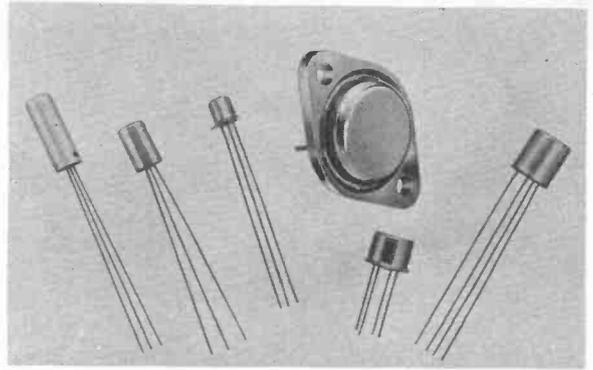
Clearly such a machine could never be produced. The thermionic valve had many disadvantages—it needed relatively high voltages; it tended to be unreliable because its hot cathode had a limited life; it used a lot of power and because it was often inefficient, it wasted a lot of energy, and it was moreover bulky and fragile. Not only, therefore, was it expensive to run but the problem of disposing of the waste heat in a large system was considerable.

Was there another solution? There was, but we had to wait until 1950 for it to be found!

THE TRANSISTOR ERA

Semiconductors were, in fact, used as long ago as 1906 by Pickard, who found that the contact between a galena crystal and a tungsten whisker would produce rectifying action. However, it was only after the Second World War that transistor action was first observed by Bardeen and Brattain at the Bell Laboratories in the United States of America. Using three-point contacts on a semiconductor they found that they could produce amplifying effects similar to those produced in thermionic valves.

Here at last seemed to be the answer to all of the problems which the valve presented—the transistor was not only small and dissipated very little power, but it would work off low voltages—no longer did we need 250V power



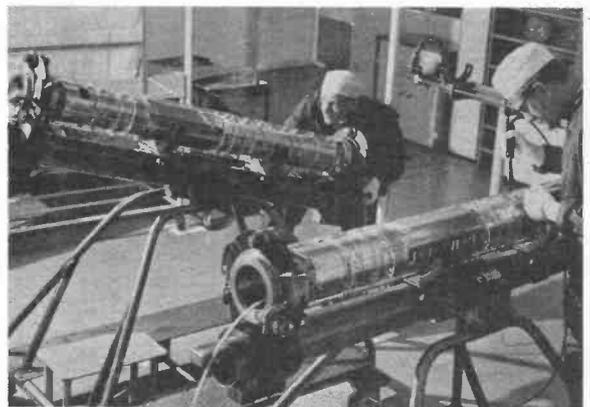
A selection of semiconductors, the development of which was to mean the demise of many valves. Small size, reliability and low voltage operation are the advantages of semiconductors (Mullard)

supplies, 6V would be quite adequate.

The technological problems concerned with transistor manufacture were not easy to overcome; the purity required of the semiconductors was challenging, and in the early days only germanium could be prepared to a standard which would allow transistor action to take place.

Further it was soon realised that the point contact transistor was not sufficiently robust for use in practical systems and the formidable task of developing the junction transistor was embarked upon. This device in due course became both reliable and robust and very soon suitable techniques were found for the purification of silicon which was a much better material in which to fabricate devices than germanium.

Not only did the use of silicon enable active devices with better rectification characteristics to be made, but these devices operated reliably over a much wider temperature range. Almost imperceptibly we were approaching the threshold of yet another revolution.



Submerged repeaters being finally assembled. In 1962 when this picture was taken, the transistor had made improvements to our communications systems by its employment in equipments such as these repeaters (S.T.C.)



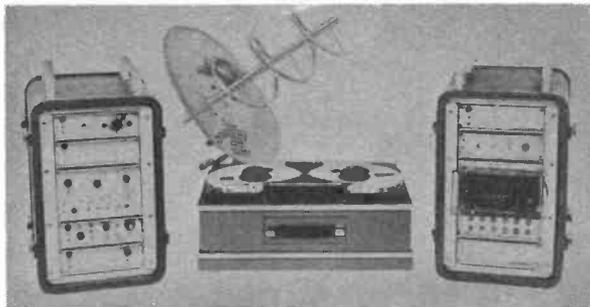
The first automatic colour television camera introduced in September 1970. Lengthy alignment and colour balancing routines necessary with previous cameras have been replaced by fully automatic corrections made by a miniature computer built into the camera channel (Marconi)

TRANSISTOR PROBLEMS

Transistors could do all that valves would do (for low power applications at any rate) and they were, moreover, possessed of the advantages which we have already enumerated—small size, low voltage operation and longevity. Surely the electronic engineer could ask no more!

For a while he was content and the new properties were used to realise bigger and faster computers, to produce more compact instrumentation, artificial satellites, and in due time to improve our telephone systems and communication systems generally. The transistor radio made its appearance to the joy of some and the annoyance of many!

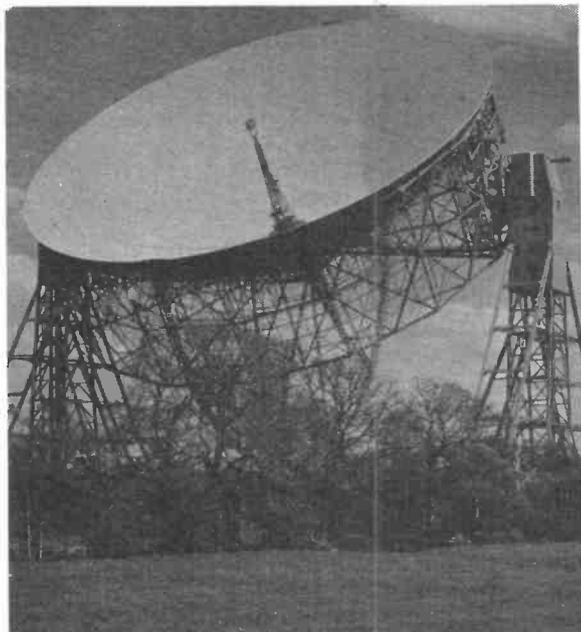
But another problem soon became apparent; if one was going to use a single transistor in a system it was no great problem but the transistor had tempted, and enabled, us to construct practical systems (computers particularly) with



The latest ship-borne telemetry receiving equipment for receiving and processing of missile performance. The units shown are, from left to right, receiver, tape recorder and helical receiving antenna and the data monitoring cabinet (EMI)

enormous numbers of devices all working together. Here we encountered another difficulty, for statistics were operating against us, and unless the mean lifetime of the individual devices was very long indeed, there was always a statistical probability that the most complex systems would never work because it was always probable that at least one device would be on the point of failure before the system was switched on!

We needed even higher reliability than had yet been obtained even with the best transistors. Further we were beginning to be worried by the problems which arose from the failure of the wiring connections between components.



Jodrell Bank radio telescope; electronics plays a major role in improving our knowledge of the universe. From radio signals emitted by extra terrestrial bodies scientists can learn a great deal about their make up and history (Manchester University)

A SOLUTION

How then could we possibly reduce the numbers of connections which we had to make and which were causing our complicated systems to fail? How could we take advantage of the peculiar properties of silicon, which had made the planar transistor possible, to this end?

Acknowledgement

Photographs kindly provided by well known members of the electronics industry, as indicated in the captions.

The electronics story is continued and brought up to date in the second and concluding part of this article next month

Everyday Electronics, November 1971



ELECTRONIC CIRCUITS -
..... IN THEORY and PRACTICE

TEACH-IN

... FOR BEGINNERS

By Mike Hughes M.A.

1

INTRODUCTION: TOOLS & SOLDERING

THE purpose of this series is to give the absolute beginner a gentle introduction to both the theoretical and practical aspects of electronics. There will be no unnecessary high-falutin mathematics but where essential, simple equations will be given and explained with practical examples of their use. Most important, each stage of theory will be designed around a special table top breadboard—the EVERYDAY ELECTRONICS Demo Deck, the construction of which will be described next month. Only commonplace components will be used, and at all times the Teach-In series will be cost conscious.

Unfortunately, like all hobbies, electronics requires some degree of expenditure. Many people are put off by stories of vast costs, but this is not necessarily a correct impression. If the experiments are carried out carefully it is possible to re-use the components several times and beginners are recommended to start by purchasing the bare minimum of tools and to make the Demo Deck.

The series is designed to run for approximately twelve months and, therefore, can be used in much the same way as a formal course. Each month the components required for the following month will be given, this will save time for those ordering by mail.

By the end of the series those who commenced as absolute beginners should be capable of understanding most of the projects to be described in this magazine. In fact there will probably be occasions when the reader may see articles on other pages which he will feel quite capable of undertaking while this series is

running. This is obviously to be encouraged, because the only real way to learn about electronics is to obtain practical experience.

TOOLS

There are four essential tools which ought to be bought right at the outset (the cost of these can then be lost in the mists of time!). These are: a small insulated handle screwdriver, a pair of pliers, a pair of side cutters and an electric soldering iron. It is worthwhile spending a reasonable amount of money getting the correct tools of the right quality.

All these tools come in different shapes, sizes, qualities and prices. Different people will have different ideas as to what is best, but we will now specify as precisely as possible what one will need to carry out projects described in this series. One will need occasional recourse to a drill, hammer, file and hacksaw, but it will be assumed that these are already to hand.

A useful screwdriver, to start with, ought to have a blade width of $\frac{1}{8}$ inch and a blade length of about 3 inches. Most important, the handle should be insulated to a minimum of 1,000 volts. It is also very useful to have a slightly larger screwdriver with a $\frac{3}{16}$ inch shaft and 4 or 6 inch blade.

Tapered nose pliers are essential. It is pointless buying anything other than the small tapered variety. The jaws should be about $1\frac{1}{2}$ inches long and the overall length of the pliers about $4\frac{1}{2}$ inches. It is not essential to have insulated handles. Make sure that the pivot is strong and that there is no sideways play in the

jaws; also that good steel is used preferably with a rust resistant plating.

Side cutters are a tool that most beginners think about last of all and yet, apart from the soldering iron, they are one of the most used tools. Because of this and as they are a cutting tool, it is worth paying a little more and getting the highest quality. Like the pliers they ought to be small (about 4½ inches in length) of good quality hardened steel and preferably plated. The cutting edges should be about ½ inch long. Again insulated handles are not essential. The photograph below shows some suitable tools.

SOLDERING IRON

There is no such thing as a general purpose soldering iron, and the experienced amateur will probably have accumulated two or three different types to cover various applications. To start with, however, a conventional electric heating element type having a power consumption of about 25 watts at 230 volts ought to be purchased. The bit ought to be not more than ⅛ inch in diameter. Make sure it is a reputable make and that the bit can be changed—these wear out faster than you think! Do not contemplate any success with an iron of much higher power or the type that has to be heated on a gas stove! Another useful, but not essential, item is a good soldering iron stand.

If someone is contemplating buying you a present you might be tempted to suggest an instant heating soldering gun; this type is not to

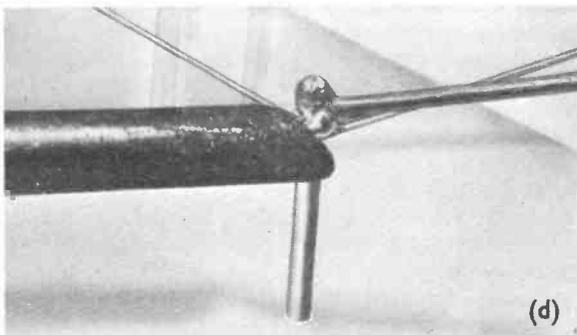
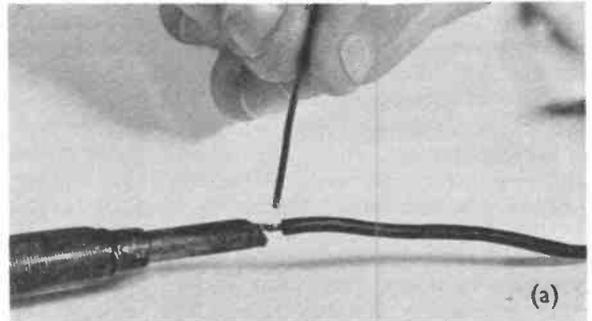
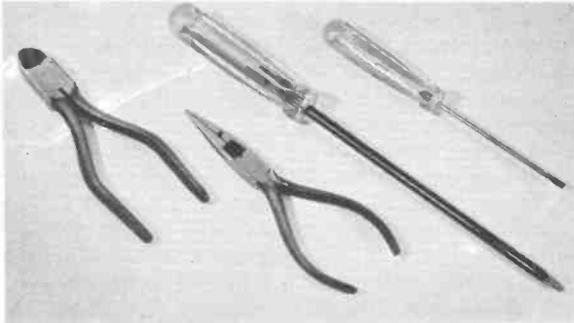
be recommended for constructional work. Although they are admirable for intermittent use in servicing, they are often much bigger and heavier than you imagine and usually get extremely hot when used continuously.

We cannot classify solder as a tool but it is always alongside the soldering iron. It is important that you use a self-fluxing solder which contains cores of resin flux, not *acid flux*. This can be bought in small and large reels but as solder contains a large proportion of lead it is expensive; nevertheless, it is cheaper in the long run to buy a large reel. You may not have much choice in the thickness you can buy, but life is made easier if you use a fairly thin gauge—22s.w.g. is excellent, but the more common 18s.w.g. is quite adequate.

SOLDERING

Everyone thinks he knows how to solder just as everyone thinks he knows how to dig a garden—but compare the results of your digging with that of a professional. As soldering is used to such an extent in electronics it is worth dwelling a little on the practical aspects.

The function of a soldered joint in electronics is twofold: it has to provide satisfactory mechanical support for the part and at the same time make a good electrical connection. Surprisingly enough, a great deal of metallurgical theory goes into the formulation of the correct type of solder for a given application but in most cases in electronics we are joining together



either copper, tin, gold or silver coated wires and components, and for these materials the most common solder contains 60 per cent tin and 40 per cent lead.

The principle behind soldering is similar to the dissolving of a solid material in water. If solid copper is placed in liquid (i.e. melted) solder it will dissolve and when the solder re-solidifies the resulting alloy will hold the dissolved copper in what is called a "solid solution". After a few months use, a soldering iron bit shows this effect quite dramatically by dissolving away.

TINNING

A good soldered joint is made by first "tinning" both surfaces to be joined (a). This means that starting with two bare copper wires we must allow solder to dissolve some of the surface copper of each wire and then solidify producing a graded alloy. This is done by heating up the copper with the soldering iron and touching the solder on the copper—only a small amount is needed. If the surface of the copper is dirty the solder will not make good thermal contact and hence will take some time to melt, and when it does melt will not "wet" the surface, it will form a ball, like water on dust (b).

Unfortunately, copper oxidises very easily when heated and hence even though the copper might have been clean to start with, the copper oxide formed during soldering might prevent a good wetting of the joint. To prevent this oxidation we have to use a flux and this is con-

tained in cores running through the length of the solder, so that as the solder is applied to the work exactly the right quantity of flux is applied.

TEMPERATURE

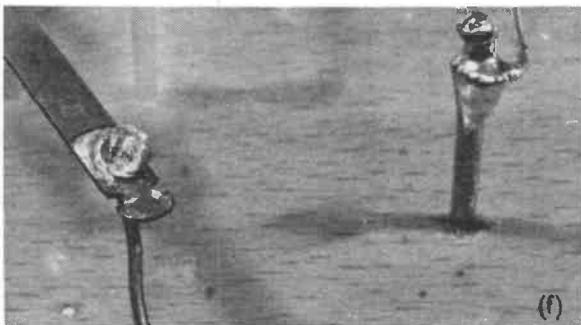
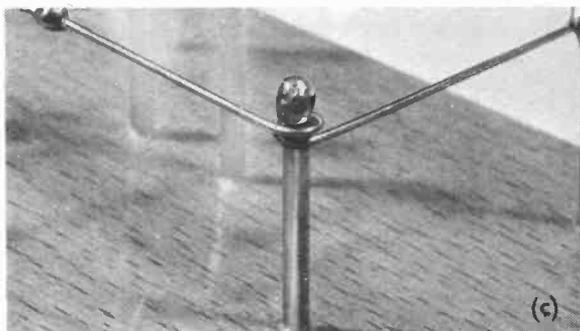
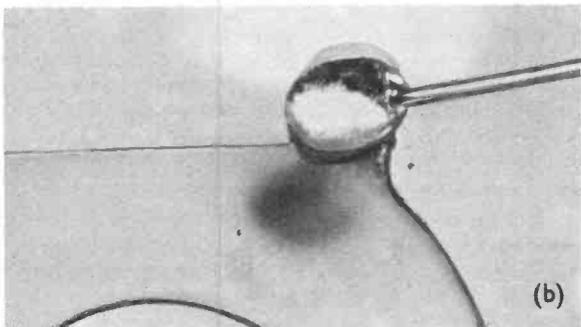
The melting temperature of 60/40 solder is approximately 188 degrees Centigrade, therefore it is essential that the soldering iron temperature is in excess of this.

One can check, within broad limits, the temperature by the appearance of the solder on the bit. If it is of a pasty consistency, then the temperature is too low. If the flux spits and smokes excessively as the solder is applied to the bit, and after about a minute the shiny surface of the solder goes dull (this is due to the formation of oxides of the tin and lead), then the temperature is too high. The bit must be thinly tinned, but should not carry superfluous solder.

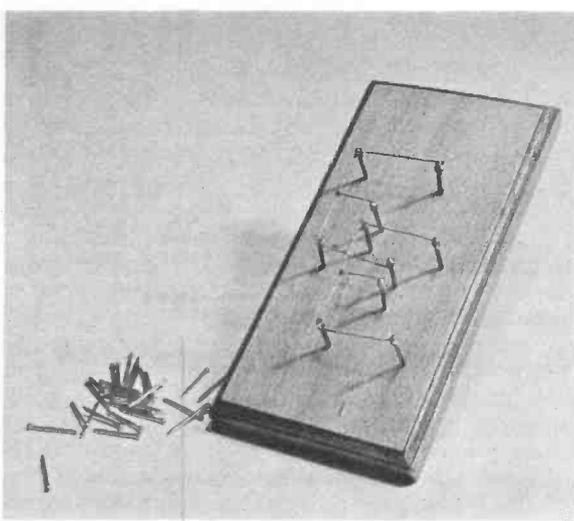
Smoke is bound to be given off while soldering is in process, this is due in the main to the resin flux burning off. For this reason it is essential that, to obtain a good joint, the solder is applied to the work while the work is being heated with the iron. Never carry solder on the bit of the iron to the work because by the time it gets to the job all the flux will have burned off and you will get a dry joint.

THE JOINT

Once both surfaces have been tinned they should be placed in contact with each other—preferably allowing as large an area of contact



Photographs showing soldering technique. (a) Tinning the end of a p.v.c. covered copper wire. (b) This joint has not soldered properly because the tag was dirty and did not tin. (c) A wrapped joint ready for soldering—tin the parts first before wrapping. (d) Soldering the joint. Apply the solder to the joint, not the iron. (e) A good finished joint. (f) Two bad joints. The dry joint on the left can be a result of burning off the flux or moving the joint. The wrapping of the joint on the right is too loose and solder is bridging the gap. If you get joints like these, desolder and start again.



as possible; it is worth twisting wires together at this stage, or wrapping them round the object to which they will be attached (c). The soldering iron, carrying a small amount of solder to help thermal contact, is then touched on the area to re-melt the solder on the surface and at the same time a small extra amount of cored solder is applied (d) which runs into the joint (e).

Never use solder to fill a gap between objects (f). By itself solder is very weak and the more solder there is between surfaces to be joined so the weaker the joint. Never move the joint before the solder has solidified as this will result in a dry joint (f), of crystalline appearance.

Quite often you will find that wires or component leads have already been tinned. But it is advisable to clean these surfaces by scraping and then re-tin them so that you have a fresh alloy that will bond quickly.

Sometimes leads instead of being tinned are gold plated (particularly on transistors). It is best *not* to tin the gold surface. Gold does not oxidise, is most soluble in solder, and is usually only plated in very thin layers. These last two points provide a problem. Because gold dissolves so easily in solder it is very easy to remove all the plating from the wire, this will result in a bad joint.

Many electronic components can be destroyed by excessive heat and to overcome this problem ensure that you do not apply the soldering iron for a longer time than is necessary. Funnily enough, there is more danger of overheating a component if you use an iron having a low temperature. A high temperature applied for a short time is less damaging than a lower temperature for a long time. Here again is a good reason for keeping surfaces clean. When in doubt use your pliers as a heat shunt by gripping the component lead on the component side of the joint which is being heated—it is possible to buy special clips for this purpose.

AN EXERCISE

It is a little difficult to give an interesting

project this month but why not go out and spend some time buying your tools and at the same time buy a small (4 oz) reel of 22 s.w.g. tinned copper wire and get a handful of small coppered nails from a hardware shop. The type used for hardboard are suitable.

Hammer the nails about $\frac{1}{4}$ inch into a piece of wood, tin the top ends and proceed to use the tinned copper wire to interconnect them. Twist the wire once round each nail and test the strengths of good and bad joints. Whilst doing this exercise try and keep all the kinks out of the wire and where you want to go round corners use pliers to give a nice sharp right angled bend. It is a good idea to make up a shape or letter using the nails and wire. The photograph shows our prototype that was used for the illustrated soldering guide.

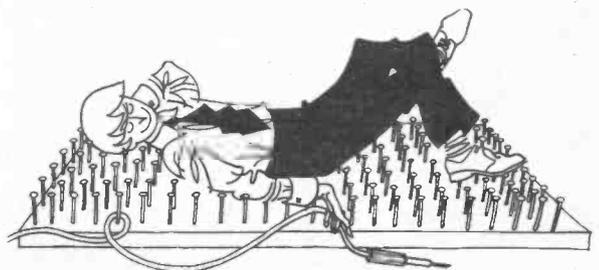
Next month we shall be dealing with the electric current, and will also be describing how to make the Demo Deck. All experiments in this Teach-In series will be described in relation to this board which in its simplest form can be made for approximately £1.30. Those who are more seriously interested in learning are advised to make the complete unit—this can cost £6 but will last for many years.

The electronic components required are:

1 RS Components Ltd. perforated board (0.25inch matrix), 1 gross RS Components small turret tags, 2 six-way and 1 four-way 5 amp insulated plastic terminal blocks, 6 terminals with insulated bushes (with 4mm sockets for banana plugs), 2 MES panel mounting lamp holders with coloured lenses, 1 One milliamp meter (SEW MR38P or similar), 1 $3\frac{1}{2}$ inch diameter 35 ohm RS Components loudspeaker, 1 each of 100ohm wirewound 5,000ohm carbon 25,000ohm carbon, 500,000ohm carbon potentiometers (all linear), 2 $4\frac{1}{2}$ volt screw terminal bell batteries.

All these components are readily available and if ordered during this month will permit work to start as soon as you have next month's edition of EVERYDAY ELECTRONICS.

If you do not want to spend so much money on these components you can start with the perforated board and turret tags and buy any additional components later.





WE know readers will have problems from time to time concerning component and equipment buying, we have met them ourselves. This regular feature is intended to help readers in advance of their problems, wherever possible. We will chat about components specified that are not so easily obtainable and tell you where to buy them. We will also put you in the picture about general component trends and of course, all new products that we feel will interest you.

When it comes to ordering the components you want, the article in this issue entitled *Component Buying and Supplying*, will help.

Prices

The cost of components for constructional projects given in the relevant article is based on suppliers' current catalogue prices. Because of price fluctuation and variation between suppliers, some projects may cost more to build, whilst, with careful buying, others could cost less.

The price is given as a **guide only** and does not always include the cost of the case or the parts to make the case; this will be stated in the price box.

Catalogues

There is one simple way in which you can help yourself avoid searching through pages of ads or hunting around all the shops in your area—and that is to buy a catalogue or two. There are a few large firms in and around London that produce very good catalogues

for around 50p and we would suggest that you buy at least one.

Record Player

One constructional project in this issue that provides a good example of variation in price is the record player. Taking the deck and cartridge, we have noticed that there are very large variations in the price of these items, so don't just rush out and buy.

It may prove difficult to get a 13.14V secondary mains transformer; again those catalogues will help, but if you cannot find one use a heater transformer with two 6.3V 0.5 amp secondaries and connect them in series to give 12.6V—this will be adequate.

Windscreen Wiper Control

Main problem on the wiper control is likely to be the price of the GPO 3,000 relay. Buy a used one and take off some of the contacts, it is easy enough—but you should leave one set on each side to balance the pressure. Again on the wiper control, for the suppression capacitor C4 values of 0.5 μ F to 1 μ F are suitable but the component must be rated at 400V d.c. or more.



Snap Sequence Indicator

No problems—we hope—with components for the *Snap Sequence Indicator*. Woolworths or an electrical shop are the best places to buy the push buttons. If you don't fancy making the case, G. W. Smith and Co (Radio) Ltd sell some good ones—shown above—for about £1. (6.5in. x 4in. x 4in.). These are a fairly new addition to their range and should prove useful for many of our projects.

Home Sentinel

Once again, few buying problems should be encountered with

components for the *Home Sentinel*. The diecast box provides a good sturdy case—this does not have to be exactly the same size as indicated but it cannot be much smaller or you won't have room for all the parts.

Teach In

The Demo Deck—to be described next month—will, we are sure, be very useful to both the beginner and the more accomplished experimenter and it should be a project worth spending a little time and money on. Some of the parts detailed in this issue are marked R.S. Components, this is the name of the company that produce them, not a retailer. The firm used to be called "Radiospares" and many of the retail shops may still use this name. Any shop can order parts from them and the delivery should be by return post.

Veroboard

You will probably not be able to buy the small pieces of Veroboard such as that given away with this issue, so a larger piece must be purchased and cut to size.

The 0.1 inch board used for the record player could prove expensive as you may have to buy a piece measuring 17 inches by 3 $\frac{3}{4}$ inches and costing nearly £1.

Incidentally, the cost of the large piece was taken into account when estimating the cost of the record player.

New Products

For those just starting electronic construction, a must is a good soldering iron and we have recently been sent information on a new small iron from Antex. This 15 watt iron—shown below—has a new ceramic enclosed element which is insulation tested to 2,000 volts a.c.; this should make the iron very safe to use.

A range of four general purpose bits are available ranging in size from $\frac{3}{32}$ inch to $\frac{1}{4}$ inch; the $\frac{1}{8}$ -inch size will probably be most suitable for our type of work and this should be asked for when buying. Two general purpose models are available, the CCN 240 and CCN 220, these are for 230-240 volt and 220-230 volt operation respectively, price for both models is £1.80.



Record Player

Good quality at a reasonable price. The mono reproduction is good enough for classical records as well as "pop", and you can fit a single play quality turntable or an autochanger.

By E.Pusey



THIS article describes a simply constructed record player using the Plessey SL403D integrated circuit audio amplifier. The internal circuitry is therefore very simple indeed, and is able to be driven directly from a standard ceramic cartridge fitted to the Garrard record deck used. An internal loudspeaker is incorporated in the design although a socket is provided to allow an external speaker to be used if desired.

RECORD PLAYER AMPLIFIER

The circuit diagram of the amplifier is shown in Fig. 1. This amplifier has a typical output power of 3 watts r.m.s. into a 7.5 ohm load with a pre-amplifier input of 250 millivolts r.m.s. The pre-amplifier (incorporated in the integrated circuit) is used at full gain—to offset the loss in the tone control network (20dB at mid band frequencies). The tone control network is an "insertion loss" type between the pre and main amplifiers.

To drive the main amplifier a maximum swing from the pre-amplifier of 2.5 volts r.m.s. is required. A potential divider R3, R7 (Fig. 1) in the d.c. feedback path is used to raise the normal pre-amplifier output from around 1 volt r.m.s. to the required 2.5 volts r.m.s.

The pre-amplifier input is fed from the mid-point of R3, R7 and the feedback is bypassed at audio frequencies by C8. The tone control characteristics are shown in Fig. 2.

POWER SUPPLY

The amplifier design is such that only a very simple unregulated power supply is required; Fig. 3 refers.

Transformer T1 should be capable of supplying 13 to 14 volts r.m.s. at 0.5 amp minimum. The smoothing capacitor C13 is shown in Fig. 1 and must be connected as shown in the printed board layout near to the integrated circuit to provide adequate amplifier de-coupling.

Specification . . .

Output power 3W r.m.s. into 8 x 5in internal speaker

Distortion 0.5 per cent*

Frequency response 20Hz to 18kHz**

Optional external speaker facility

Choice of Garrard record decks

9TAHC stereo/mono cartridge

Bass and treble tone controls

* Measured at 400Hz, 3W r.m.s. output

** At 3db down points—3W r.m.s. output

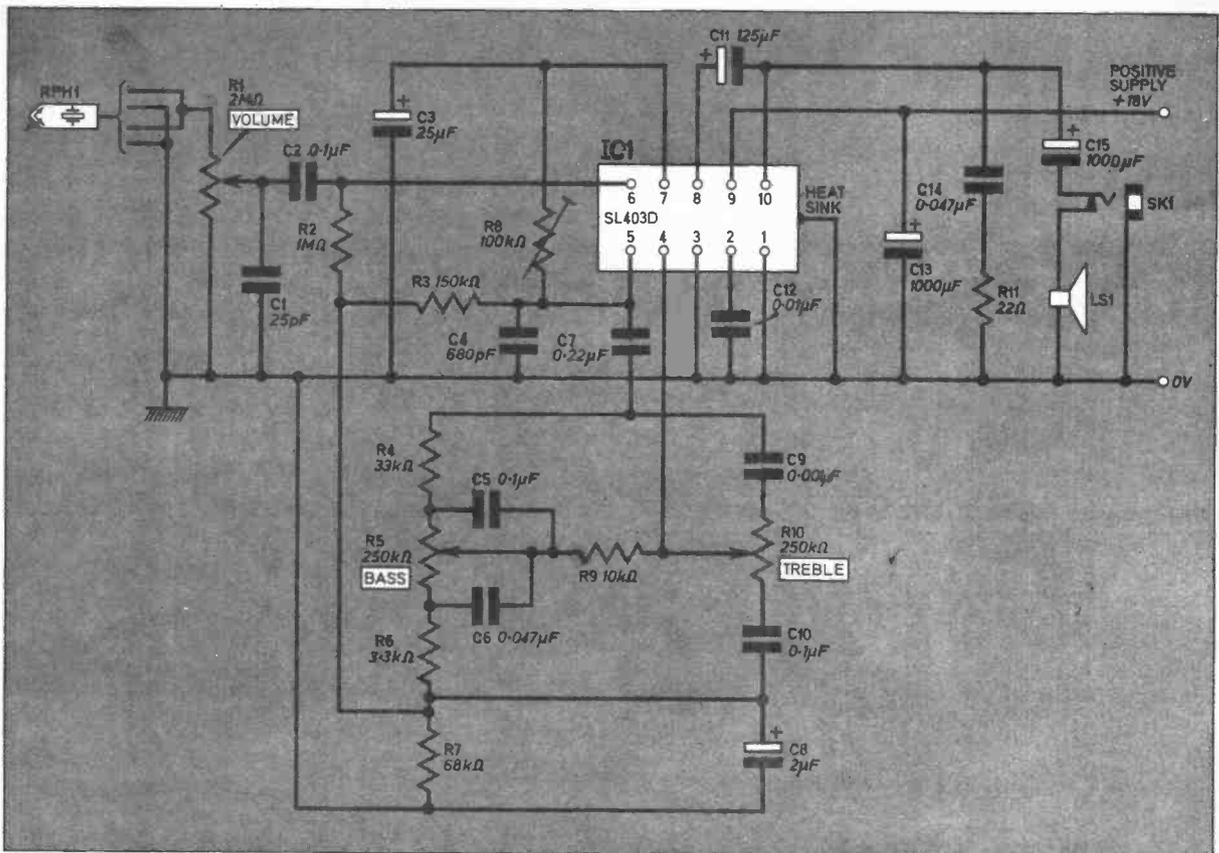


Fig. 1. Circuit diagram of the Record Player amplifier using a single integrated circuit.

Components....

Resistors

- R1 2 MΩ 1W log carbon potentiometer
 - R2 1MΩ
 - R3 150kΩ
 - R4 33kΩ
 - R5 250kΩ 1W log carbon potentiometer
 - R6 3.3kΩ
 - R7 68kΩ
 - R8 100kΩ lin skeleton preset potentiometer
 - R9 10kΩ
 - R10 250kΩ 1W log carbon potentiometer
 - R11 22Ω
- All $\frac{1}{2}$ W $\pm 10\%$ carbon except where stated

Capacitors

- C1 25pF silver mica 15V
- C2 0.1μF polyester
- C3 25μF elect. 16V
- C4 680pF silver mica 15V
- C5 0.1μF polyester
- C6 0.047μF polyester
- C7 0.22μF polyester
- C8 2μF elect. 5V
- C9 0.001μF polystyrene
- C10 0.1μF polystyrene
- C11 125μF elect. 16V
- C12 0.01μF ceramic 16V

- C13 1000μF elect. 25V
- C14 0.047μF polyester
- C15 1000μF elect. 16V

Semiconductors

- IC1 SL403D Integrated Circuit
- D1-D4 1N4001 rectifier diodes (4 off)

Loudspeaker

- LS1 7.5Ω or 8Ω, 8in by 5in moving-coil type capable of handling 3 Watts r.m.s.

Record Deck

- SP25 MkIII or similar Garrard deck (see text)

Pick-up

- RPH1 9TA/HC Sonotone ceramic cartridge

Miscellaneous

- SK1 Mono jack socket with switchable connections
 - T1 Mains transformer having 14V 0.5A secondary (see text)
- Veroboard 7in x 3 $\frac{3}{8}$ in x 0.1in matrix
 Knobs (3 off), screened lead (approx. 18in),
 3 core mains lead, 13A or 5A fused mains
 plug, 3 way plastic connecting block, con-
 necting wire, screws and wood for case,
 SPC4 MkII perspex cover

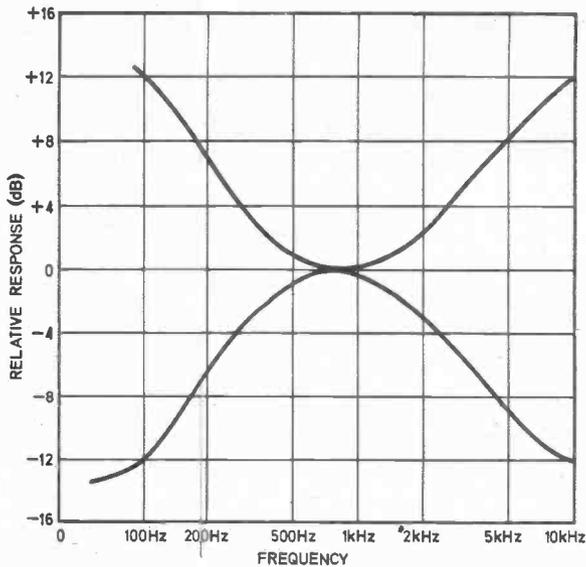


Fig. 2. Tone control characteristics of the Record Player.

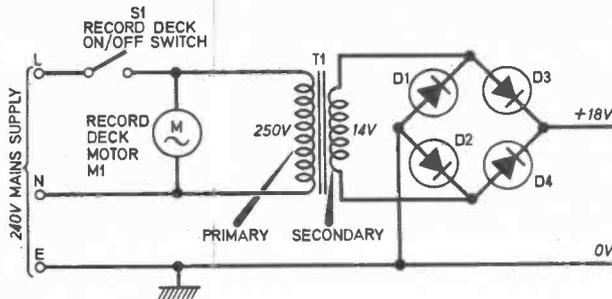


Fig. 3. Mains power supply of the Record Player.

The d.c. supply obtained from the circuit shown in Fig. 3 should be around 18 volts.

COMPONENT BOARD WIRING

A component board layout is shown in Fig. 4 using 0.1 inch pitch Veroboard. This design should be strictly adhered to to avoid instability.

The 0.1 inch pitch board is used to suit the lead spacing on the integrated circuit. This size is rather more difficult to use than the 0.15 inch pitch piece included in this issue, and anyone who has not used Veroboard before is recommended to build a simple project on the free sample before attempting this project. A full guide on using Veroboard is given in this issue. With 0.1 inch pitch board it is imperative to make good clean soldered joints and to check carefully that no two strips are bridged by solder.

The layout of the board is fairly open and it should be quite easy to follow Fig. 4. Because the three potentiometers are mounted directly to the board, using short lengths of 18 s.w.g. tinned copper wire, there are only a few flying connecting leads and this again helps to simplify

construction. The potentiometers also provide a mounting for one end of the board as they are pushed through the front of the cabinet. The rear of the board is mounted on a block of wood, fixed to the base of the cabinet, by two wood screws.

MAINS WIRING

The method of connection to the Garrard SP25 MKIII turntable used enables the whole unit to be switched on and off using the record deck on/off switch. As can be seen from Fig. 5 the existing wiring is slightly modified so that the mains supply to the transformer is controlled by the deck on/off switch S1. This gives the added advantage of switching off the complete unit after a period of automatic play.

PICK-UP UNIT WIRING

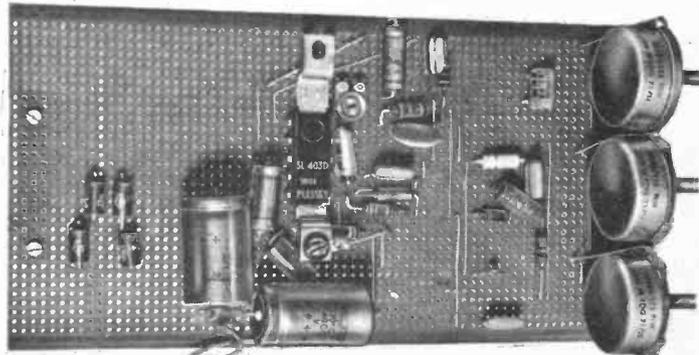
Pick-up wiring should follow manufacturer's instructions but the cartridge should be of the ceramic or crystal type and screened lead must be used as shown in Fig. 5.

The 9TAHC cartridge is a stereo cartridge and the record player can thus be used to play both mono and stereo records although the reproduction will be mono only. The two channel signals coming from the cartridge are combined by wiring the cartridge output leads together on the five way tagstrip under the deck (see Fig. 5).

On the SP25 MkIII deck the cartridge is held in a plastic pad which slides into the head shell on the arm. The 9TAHC cartridge recommended must be mounted on this pad with the extra balance weight provided as shown in our photograph. The four connecting leads are soldered to the pull out nylon plug in the base of the cartridge and this plug is then re-inserted in

Approximate cost of components

£ 20.00 plus case



the back of the cartridge. Never solder directly to the tags on a cartridge as this is likely to damage it. After connecting the leads slide the whole thing back into the head shell and wire up the connections under the deck as shown in Fig. 5.

For the 9TAHC cartridge the tracking weight should be set to 3 grams and the bias adjustment should be at position 3 (SP25 MkIII deck).

SETTING UP

Referring to Fig. 1 and Fig. 4, R8 must be used to adjust the quiescent amplifier output voltage—on pin 10 IC1—to half the supply rail voltage.

The quiescent output voltage is the voltage with the unit turned on, but with no record playing, and the controls set in their normal

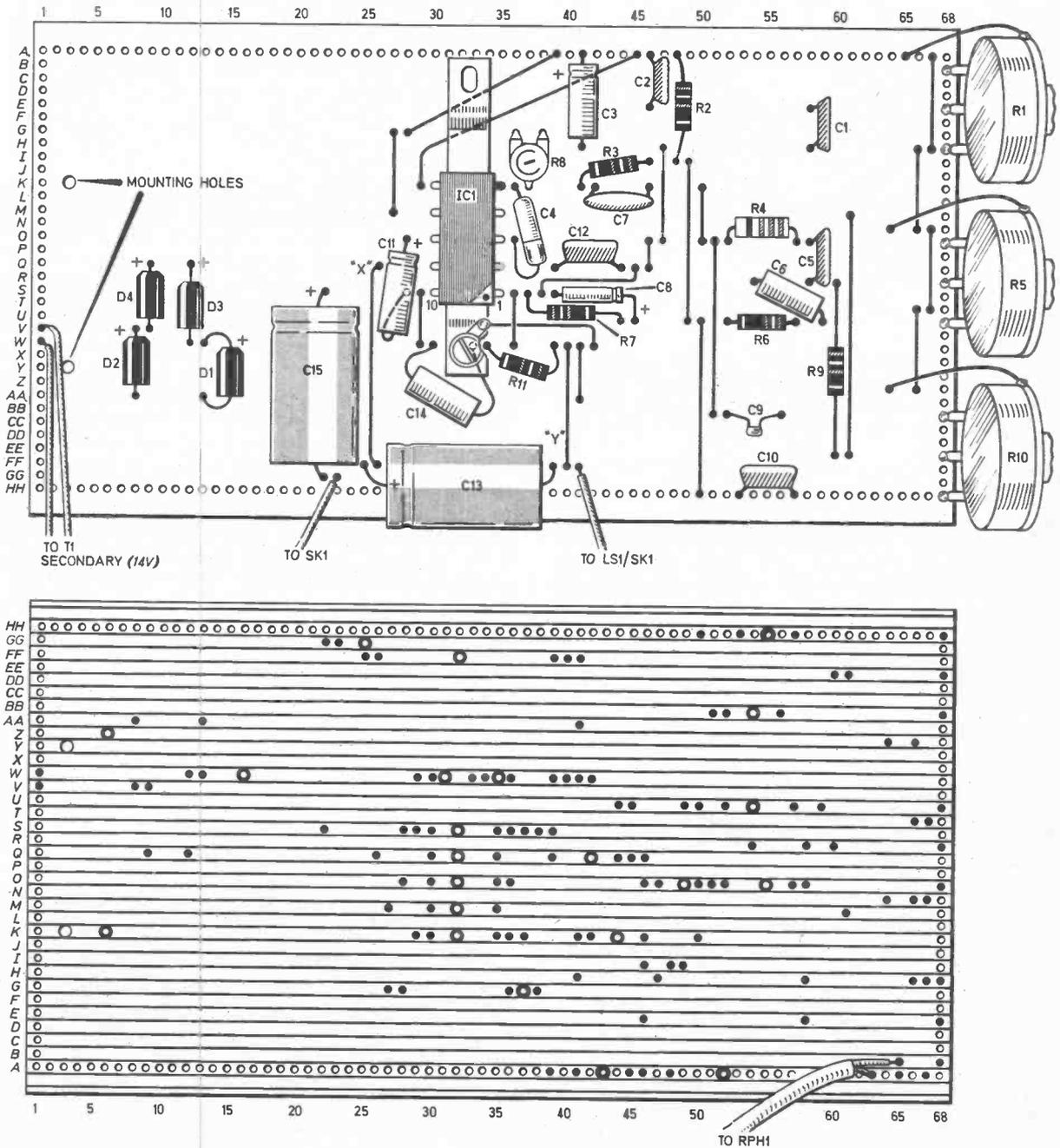


Fig. 4. Veroboard layout and wiring details. The board used is 0.1-inch matrix.

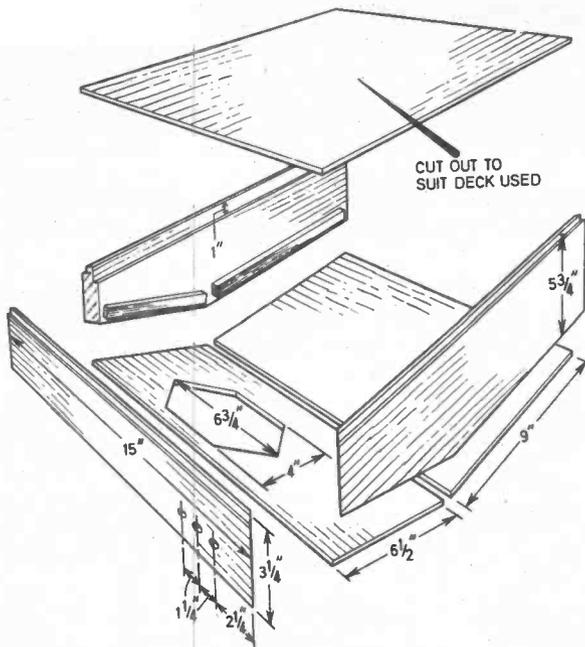
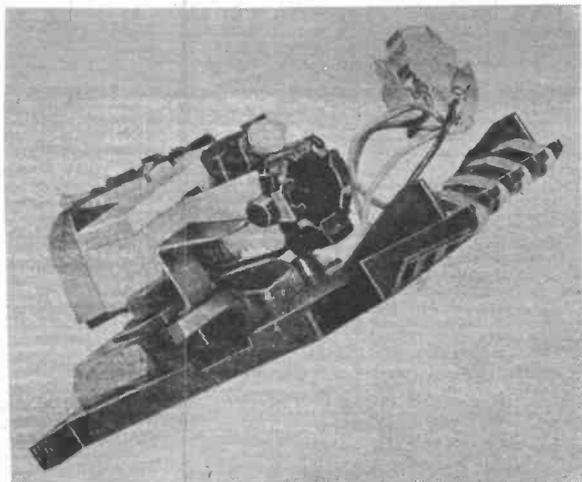


Fig. 6. Basic cabinet details of the prototype. This cabinet may be made to any design required. The back panel has not been shown but is rectangular with holes for SK1 and the mains lead.

positions. To set this, first measure the supply line at points X and Y in Fig. 4 (X is positive), this should be around 18 volts d.c., then move the positive voltmeter lead from point X to pin 10 on IC1 and set R8 to give a reading of exactly half that obtained across X and Y. If you do not have a voltmeter and do not wish to purchase one yet, you may be able to get a shop to set this for you or you can build your own

The cartridge mounted in its shell. Extra balance weight and connecting plug can be clearly seen.



voltmeter—a simple one will be described very soon in *Teach-In*.

SPEAKER UNIT

Great attention was paid by the author to the proportions of the wooden plinth and the position of the speaker was decided upon to balance performance with acceptable plinth height. The listening tests carried out in fact show negligible high frequency attenuation due to the speaker position provided the unit is stood on a hard flat surface. For purists however, a socket is provided as shown in Fig. 5 for an external 8 ohm speaker. When such a speaker is connected it automatically cuts off the internal speaker.

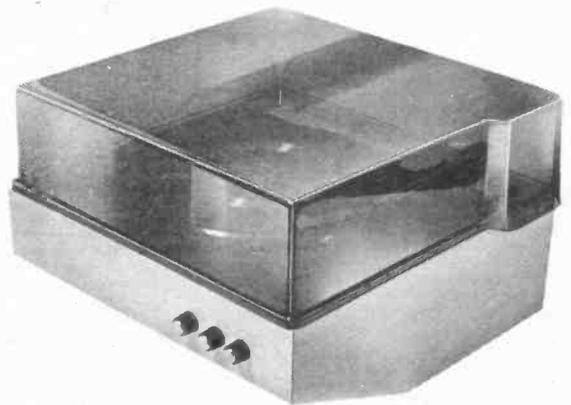
WOODEN PLINTH

The unit is designed to use a standard Garrard SPC 4 MkII perspex moulded cover and the shaping of the upper edges of the plinth to accommodate this was carried out using a Black & Decker circular saw attachment. The cabinet style and shape can of course, be made to individual requirements and Fig. 6 only provides basic information on the prototype.

The mounting for the record deck should be cut to the manufacturer's template, and will obviously vary depending on the type of deck decided upon. You do not have to use the SP25 MkIII deck or the 9TAHC cartridge as recommended. This cartridge can also be fitted to any of the following alternative decks: Garrard 2025 TC; Model 3000; Model 40B; Model 3500.

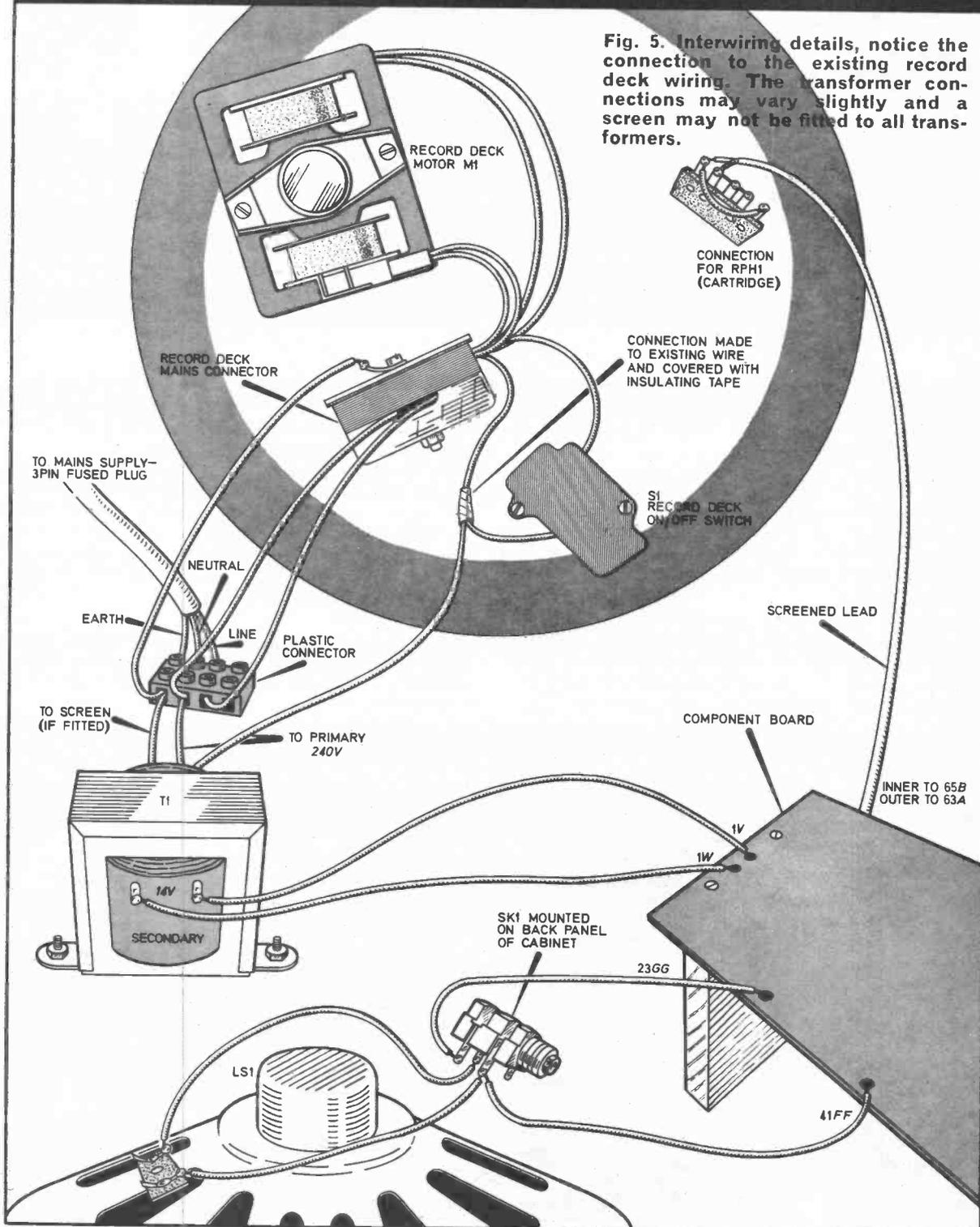
Under music and speed conditions as prevailing in this application, it is not necessary to use a heat-sink with the SL403D. If, however, continuous sine wave power is applied at full output power for testing then a heat sink must be fitted.

The SL403D integrated circuit is an upstaged version of the SL403A. The SL403D includes internal protection against permanent a.c. and d.c. short circuits of its input and output terminals to ground. Make sure that the type you buy has the suffix D. ▣



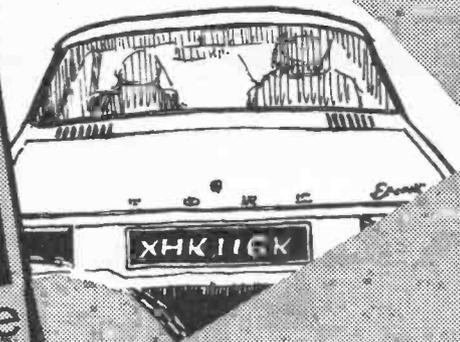
RECORD PLAYER_WIRING DETAILS

Fig. 5. Interwiring details, notice the connection to the existing record deck wiring. The transformer connections may vary slightly and a screen may not be fitted to all transformers.



Windscreen Wiper Control

By SB. Squire



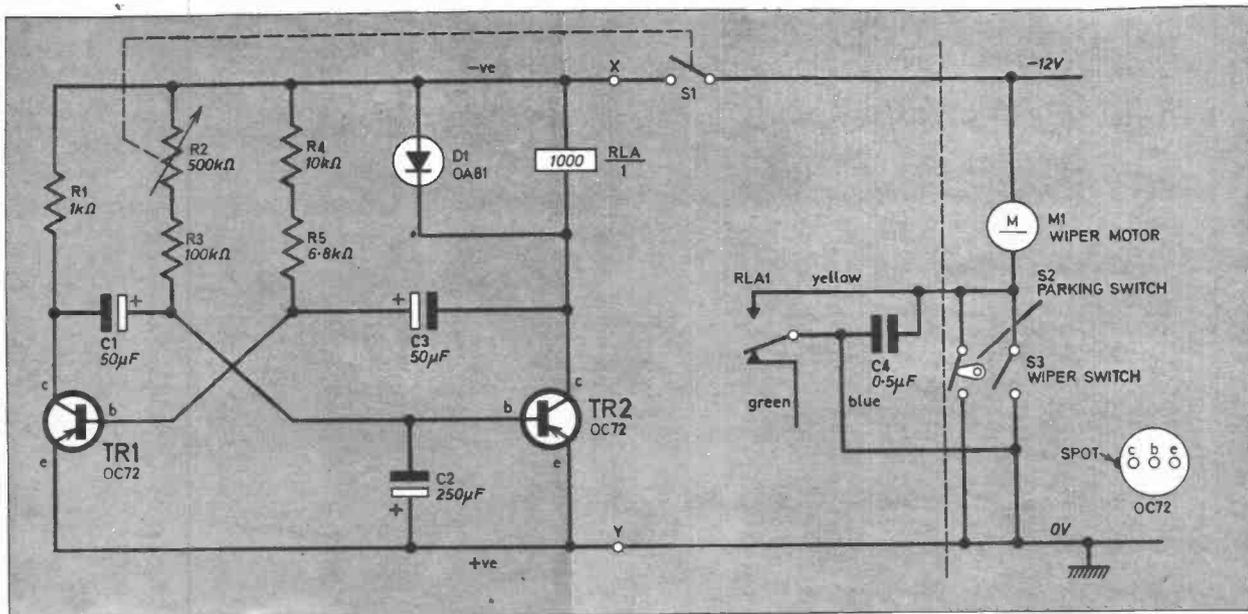
Dirty wet road! Drizzle! Fog! Smears screen and scraping wipers. EVERYDAY ELECTRONICS comes to the motorists aid with this intermittent, add on, wiper control.

THIS wiper control has been designed to operate with self-parking windscreen wiper motors either 2 wire or 3 wire (permanent magnet type) on 12 volt positive or negative earth systems.

Summer and winter the British motorist has to put up with driving through mist, fog and light rain, though the motorist is probably used to this, the device to be described will give the driver a more pleasant and safe journey.

One of the hazards of driving through mist, fog and light rain is that the windscreen does not get wet enough between normal sweeps of the wiper blades to prevent smearing or to stop that annoying sound of scraping, as the wiper blades brush over a near-dry surface. To prevent the driver having to keep switching the wipers on and off, this device will provide a variable delay between wiper sweeps. The duration of the delay is adjusted by the driver to suit prevailing weather conditions.

Fig. 1. Complete circuit diagram of the car wiper control. Wiring on the right of the dotted line is that for a 12V positive earth car with a 2 wire field coil motor.



CIRCUIT DESCRIPTION

The basic circuit with wiring for a 2 wire motor is shown in Fig. 1. The circuit uses two small power transistors in an astable (free-running) multivibrator which operates relay RLA via which the wiper motor obtains its power. The sweep delay time is adjustable by means of the potentiometer R2, the ganged switch S1 being used for switching the unit on and off. Overall circuitry is such that normal function of the car's windscreen wiper is unimpaired—though a small wiring modification is required for permanent magnet wiper motors which will later be described.

The values for C3, R4 and R5 have been chosen to ensure that over the timing range the relay does not remain energised long enough to enable the wiper blades to make more than one sweep at a time. This is not necessarily critical, but one sweep per relay operation was aimed at. Capacitor C2 decouples the base of TR2 against variations on the supply voltage, caused by the dynamo or alternator, that could produce a

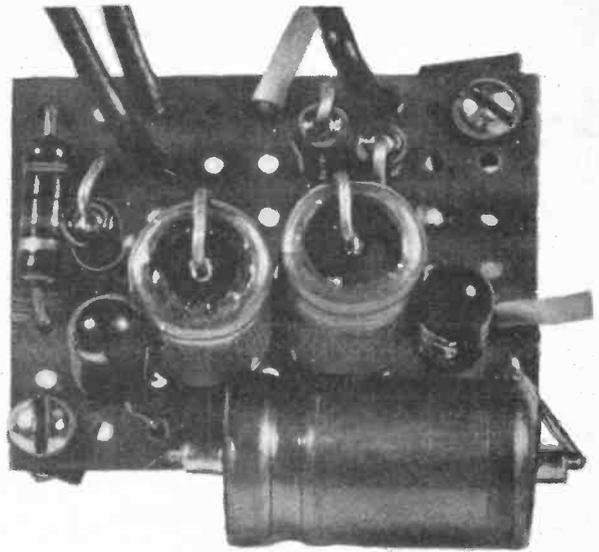
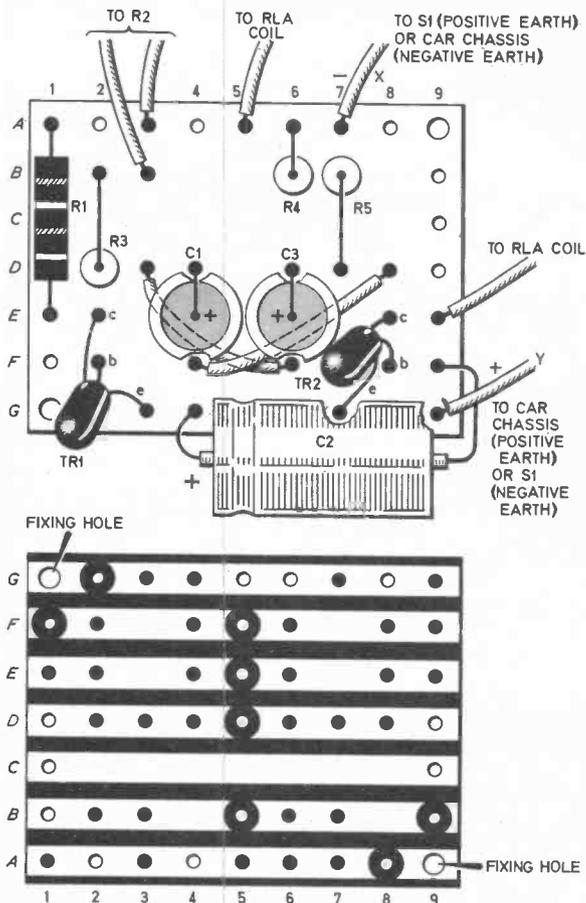


Fig. 2. Veroboard layout and wiring diagram. This diagram applies to all car wiring configurations, connecting wires X and Y are reversed—as indicated—for negative earth cars.



switching transient. The high back e.m.f. produced in the relay coil when TR2 is cut off (thus de-energising the relay) is prevented from damaging transistor TR2 by diode D1 providing a shunt path for the back e.m.f. Capacitor C4 suppresses any transients at the relay contacts caused by sparking and should be a high voltage type mounted close to the contacts.

CONSTRUCTION

The components are assembled on to part of the piece of Veroboard enclosed in this issue (Fig. 2) which is then mounted along with the relay on a simple metal chassis (Fig. 3). The board is held by two 6BA screws.

Some constructors may not wish to mount everything under the dashboard in the form shown, but a virtue of this unit is that its operation is not affected by long leads so the main unit may be mounted remotely from R2. Flying leads from the unit to the car may be terminated in bullet snap connectors, this enables the unit to be quickly connected and disconnected if necessary.

The supply to the unit should be obtained from the car ignition switch via the fuses in order to give some protection. Earth return is made via a short lead through the car chassis.

The relay used is a G.P.O. 3,000 type with

Approximate cost of components



1.75 plus case

WINDSCREEN WIPER CONTROL CONSTRUCTIONAL DETAILS

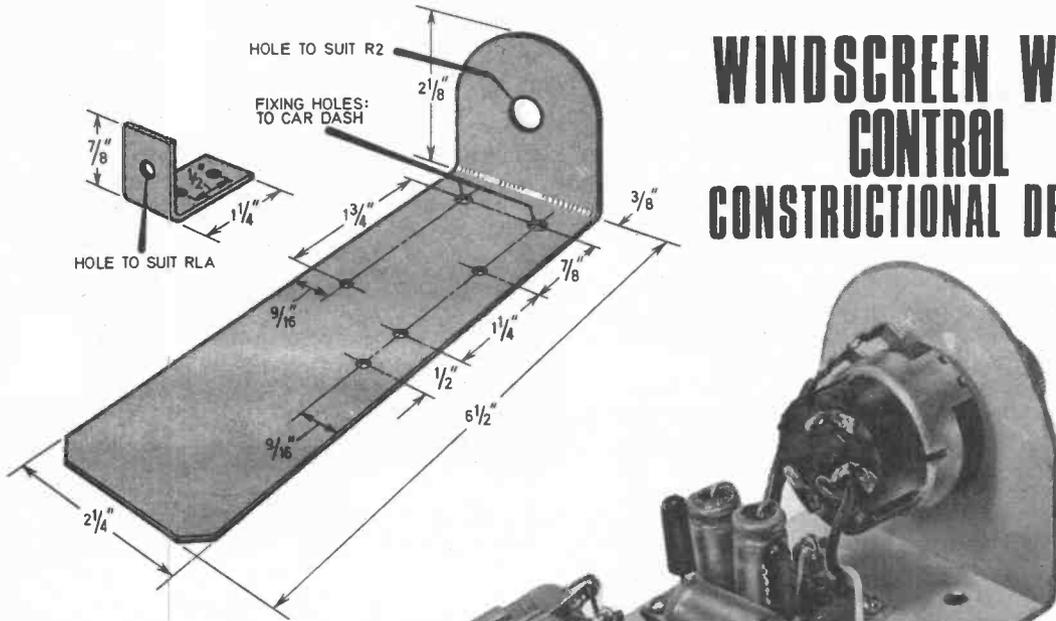


Fig. 3. Chassis details for the car wiper control.

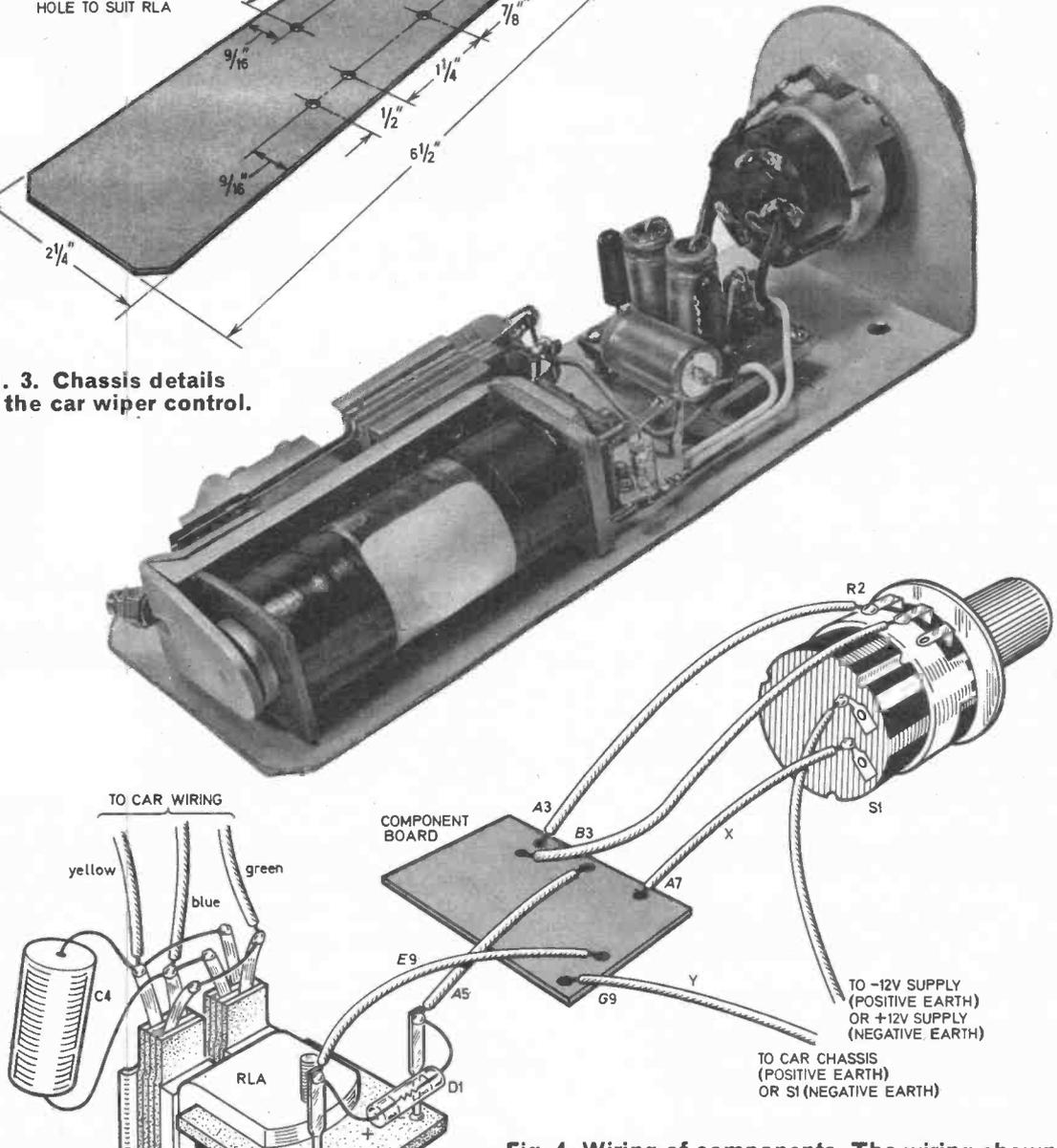
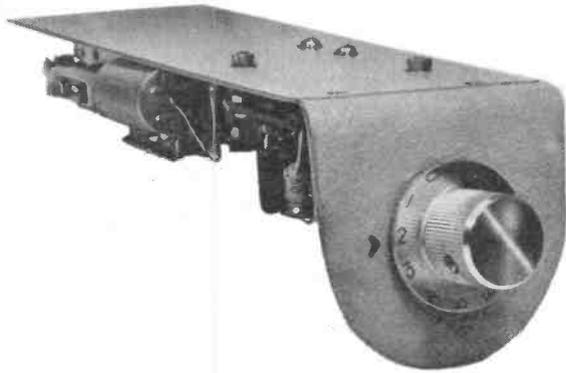


Fig. 4. Wiring of components. The wiring shown is for a positive earth supply. Note that two sets of ordinary changeover contacts have been used, wired in parallel.



heavy-duty changeover contacts and a coil resistance of 1,000 ohms. Obviously any other relay possessing the same specifications and workable on 12 volts will suffice. In the case of the contacts, because they are well suppressed and only make momentarily, two sets of ordinary changeover contacts wired in parallel will work quite satisfactorily if heavy-duty contacts are not available. It is pointed out that any relay having a coil resistance different to that stated, if used, will seriously affect the timing range.

LAYOUT AND WIRING

A layout and wiring diagram of the Veroboard is given in Fig. 2, this diagram applies to all car configurations discussed later in this article. Anyone who has not used Veroboard before can find a complete photographic run down on how to go about wiring up the board in the special article in this issue, this article refers specifically to the *Snap Sequence Indicator*, but the method of use is the same and the wiring is carried out with reference to Fig. 2 in this windscreen wiper control article. Notice the two links on top of the board—these should be fitted before the components.

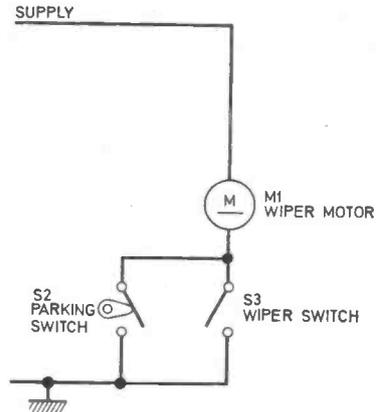


Fig. 5. Wiring diagram of a two wire field coil wiper motor with self parking facility.

FITTING

Diagrams will be given to show how the unit may be wired to almost any car having a 12V system and self-parking wipers. Fig. 5 is the diagram for older cars using field coil motors with a self-parking switch. The wiring of a positive earth system using self-parking, field coil motor is that shown in Fig. 1 and Fig. 4, only the yellow and blue wires on RLA1 are used, the green need not be fitted, remember Fig. 2 applies to all systems. For a negative earth self-parking field coil motor system simply reverse wires X and Y. The polarity of the supply to the electronic circuit must always be kept the same way around.

You will be able to tell if your car is wired for positive or negative earth by looking at the battery and finding which side is connected to the chassis.

Next month we will describe how to identify your car wiring system and methods of fixing the control to other cars.

Components....

Resistors:

- R1 1k Ω
- R2 500k Ω lin. potentiometer with s.p.s.t. switch (S1)
- R3 100k Ω
- R4 10k Ω
- R5 6.8k Ω
- All $\pm 10\%$, $\frac{1}{4}$ W carbon except where stated.

Capacitors:

- C1 50 μ F elect. 25V
- C2 250 μ F elect. 25V
- C3 50 μ F elect. 25V
- C4 0.5 μ F 400V

Semiconductors

- TR1 OC72 Germanium pnp
- TR2 OC72 Germanium pnp
- D1 OA81

Miscellaneous

RLA1 GPO 3000 type relay, 1000 Ω resistance with one set of heavy duty changeover contacts or two sets of ordinary changeover contacts (see text) control knob numbered 0 to 10.

Veroboard 9 holes x 7 strips, 0.15in. matrix (part of give away), metal for chassis, connecting wire and 6BA fixings.

COMPONENT BUYING & SUPPLYING



... I sat down and did some thinking.

WHEN the Editor of EVERYDAY ELECTRONICS asked me to write some articles on supplying components I sat down and did some thinking. I have now fully recovered ... but it did occur to me that this business is a team venture, involving the contributor responsible for the Constructional Article, the Component Supplier, and the Customer.

To get a balanced picture, all facets must be shown. I would like particularly to show how the customer can help us, how we can give better service to the customer—and how the author can assist us both. I will start with the most important member: you the customer.

Your Needs

Theoretically your needs are relatively simple; you require the right components for your project, delivered quickly, and at the right price. We shall see that in practice the fulfilment of this ideal is not so easy. You may be lucky enough to have a good Component Shop close at hand, but I'm sure that many of you are thrown on to the resources of the various Mail Order firms who specialise in electronic components. Most of them are efficient and painstaking, but a little co-operation from you can work wonders. I would suggest that if they have a Catalogue *this should be your first purchase*. I will now discuss the basic problems and suggest what to do and what to avoid.

There are three basic problems, the customer must transmit the order to us, the supplier, also sufficient money to cover the transaction, and lastly the supplier must get the goods to the customer.

We will consider for the moment the first two. If I deal with this rather thoroughly it is because the Postal Strike opened our eyes to the fact that there are other ways of transmitting orders and money besides the G.P.O. However, let us start at square one and please bear with me if I state the obvious, remember it may be news to some!



... this should be your first purchase.

Making Out The Order

You have just decided you would like to build a piece of equipment described in EVERYDAY ELECTRONICS and you turn to the list of parts required. Some of them you may already have so you list out the others. In the article the designer will number the components so as to be able to refer to them in the text: thus the capacitors will be numbered C1, C2, C3, etc. and the resistors R1, R2, R3, etc. Please remember C1 or C2 or R1 or R2 will convey nothing to your supplier! But customers continue to ask for a C1 or an R1 without telling us from what article they are quoting!!

So take a sheet of lined paper and at the top write your name and address in "Block Capitals" yes please BLOCK CAPITALS. Of course you know you live in "Little Squiggletown" but written in your best copperplate longhand, to the

No. 1 Customers

First of a series of three articles

by Alan Sproxton, Home Radio (Components) Ltd.

dealer it looks halfway between the Plessey Trademark and an invitation in Arabic to visit the Cairo Museum! We have a file in our office full of orders with no name or address at all!! So if you do not get your goods within a reasonable time just check with your supplier!

Now write down your requirements giving adequate descriptions and prices. Total it up and add something on for postage. Many firms supply their own Order Forms and it obviously helps them (and you) to use them.

Transmitting The Order

Now the order and money must be transmitted to your supplier. If you have an account with your supplier you can just pick up the phone and perhaps even the same day the parts are on their way to you. You must give your dealer adequate references before he will consent to your opening an account, but I think you will find it less difficult than you suppose. For those of you who have a steady and regular demand for electronic parts there are big advantages in having an account.

During the Postal strike customers who had accounts with us

... halfway between the Plessey Trademark and an invitation in Arabic to visit the Cairo Museum!



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G.240 Miniature soldering iron 18 watt 240 volts extensively used by H.M. Forces. Suitable for high speed soldering and fitted with iron coated 3/32" bit. Also available for 220 volts. Spare bits 1/8", 3/16" and 1/4" are obtainable. Price **£1.83** (Supplied in standard pack)



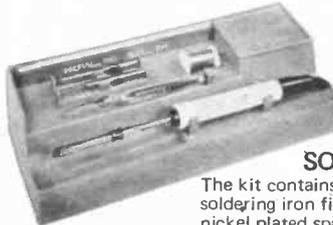
CCN.240 New model 15 watt 240 volts miniature soldering iron with ceramic shaft to ensure perfect insulation (4,000 v A.C.). Will solder live transistors in perfect safety, fitted with 3/32" iron coated bit. Spare bits 1/8", 3/16" and 1/4" available. Can also be supplied for 220 volts. Price **£1.80**

CCN.240/7 The same soldering iron fitted with our new 7-star high efficiency bit for very high speed soldering. The bits are iron coated, nickel and chromium plated. Price **£1.95**



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ES.240 25 watt 240 volts soldering iron fitted with 1/8" iron coated bit and packed in a transparent display box. Spare bits 3/32", 3/16" and 1/4" available. Can also be supplied for 220 and 110 volts. Price **£1.83**



SK. 1 SOLDERING KIT

The kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, heat sink, cleaning pad, stand and booklet "How to Solder". Also available for 220 volts.

Price **£2.75**



SK. 2 SOLDERING KIT

This kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, Heat Sink, 1 amp fuse and booklet "How to Solder"

Price **£2.40**.



MES. 12

A battery operated 12 volts 25 watt soldering iron complete with 15' lead, two crocodile clips for connection to car battery and a booklet "How to Solder" packed in a strong plastic wallet.

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2G305	421p	2N3415	221p	40320	471p	BCY32	25p	B8X77	271p	NKT404	621p
2G308	20p	2N3416	221p	40321	321p	BCY33	25p	B8X78	271p	NKT405	75p
2G309	30p	2N3417	871p	40323	321p	BCY34	30p	B8Y10	271p	NKT406	621p
2G371	15p	2N3570	1.25	40324	471p	BCY38	40p	B8Y11	271p	NKT407	871p
2G374	20p	2N3572	971p	40326	371p	BCY39	60p	B8Y24	15p	NKT408	621p
2G381	221p	2N3605	271p	40329	30p	BCY40	50p	B8Y24	15p	NKT409	271p
2N444	221p	2N3606	271p	40347	271p	BCY42	15p	B8Y26	171p	NKT403F82	271p
2N607	20p	2N3607	221p	40349	271p	BCY43	15p	B8Y27	171p	NKT613F38	321p
2N697	17p	2N3702	11p	40348	521p	BCY64	321p	B8Y27	171p	NKT613F38	321p
2N698	25p	2N3703	10p	40360	421p	BCY68	221p	B8Y28	171p	NKT613F38	321p
2N706	121p	2N3704	11p	40361	471p	BCY69	221p	B8Y29	171p	NKT613F38	321p
2N705A	121p	2N3705	10p	40362	571p	BCY90	971p	B8Y32	25p	NKT715	20p
2N708	15p	2N3706	09p	40364	471p	BCY91	971p	B8Y36	25p	NKT781	30p
2N709	621p	2N3707	11p	40406	571p	BCY71	25p	B8Y37	25p	NKT10410	30p
2N718	25p	2N3708	07p	40407	40p	BCY72	171p	B8Y38	25p	NKT10439	371p
2N725	30p	2N3709	09p	40408	521p	BCZ10	271p	B8Y39	221p	NKT10519	321p
2N727	30p	2N3710	09p	40410	621p	BCZ11	421p	B8Y40	321p	NKT20329	371p
2N914	171p	2N3711	12p	40467A	571p	BD116	1.12	B8Y51	321p	NKT20339	371p
2N916	171p	2N3715	1.25	40468A	571p	BD121	85p	B8Y52	321p	NKT80111	871p
2N929	221p	2N3791	22.06	AC 107	30p	BD124	60p	B8Y54	40p	NKT80112	871p
2N930	271p	2N3819	35p	AC126	20p	BD131	75p	B8Y66	90p	NKT80211	871p
2N1090	221p	2N3823	971p	AC127	25p	BD132	85p	B8Y78	471p	NKT80212	871p
2N1091	221p	2N3855	271p	AC128	20p	BDY10	1.25	B8Y82	521p	NKT80213	871p
2N1131	20p	2N3856	271p	AC134	25p	BDY11	1.25	B8Y90	571p	NKT80214	871p
2N1132	25p	2N3857	271p	AC176	25p	BDY17	1.25	B8Y95A	121p	NKT80215	871p
2N1302	171p	2N3855A	30p	AC187	621p	BDY18	1.25	B8W41	421p	NKT80216	871p
2N1303	171p	2N3856A	30p	AC188	371p	BDY20	1.12	B8W70	271p	NKT80217	871p
2N1304	221p	2N3856A	35p	AC177	871p	CY117	75p	C424	271p	NKT80218	871p
2N1305	221p	2N3858	25p	ACY18	25p	BDY68	971p	C425	25p	NKT80219	871p
2N1306A	20p	2N3858A	30p	ACY19	25p	BDY69	1.25	C426	40p	NKT80221	871p
2N1307	25p	2N3859	271p	ACY20	25p	BDY61	1.25	C425	55p	NKT80223	871p
2N1308	30p	2N3859A	321p	ACY21	25p	BDY62	1.25	C426	40p	NKT80224	871p
2N1309	30p	2N3860	30p	ACY22	20p	BF115	25p	C428	871p	NKT80225	871p
2N1607	171p	2N3866	1.50	ACY28	20p	BF117	471p	C744	30p	NKT80226	871p
2N1613	25p	2N3877	40p	ACY40	25p	BF178	1.25	D18P1	271p	NKT80227	871p
2N1621	30p	2N3901	40p	ACY41	25p	BF167	1.25	D18P2	40p	NKT80228	871p
2N1632	30p	2N3906	371p	ACY44	40p	BF173	1.25	D18P3	371p	NKT80229	871p
2N1638	271p	2N3900A	40p	AD140	521p	BF177	30p	D16P4	40p	NKT80230	871p
2N1639	271p	2N3901	87p	AD149	571p	BF178	30p	GET102	30p	NKT80231	871p
2N1671 B	1.00	2N3903	85p	AD160	621p	BF179	30p	GET113	20p	NKT80232	871p
2N1711	25p	2N3904	35p	AD161	371p	BF180	30p	GET114	20p	NKT80233	871p
2N1899	821p	2N3903	871p	AD162	371p	BF181	321p	GET118	20p	NKT80234	871p
2N1893	871p	2N3906	871p	AD163	421p	BF184	25p	GET119	20p	NKT80235	871p
2N2147	821p	2N4058	171p	AF114	25p	BF185	421p	GET120	521p	NKT80236	871p
2N2148	871p	2N4059	10p	AF115	25p	BF194	171p	GET125	521p	NKT80237	871p
2N2160	571p	2N4080	121p	AF116	25p	BF195	15p	GET126	521p	NKT80238	871p
2N2193	40p	2N4081	121p	AF117	25p	BF196	15p	GET127	521p	NKT80239	871p
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2N2218	23p	2N4286	171p	AF125	14p	BF224	14p	GET187	221p	NKT80243	871p
2N2219	20p	2N4287	171p	AF126	20p	BF225	15p	GET188	221p	NKT80244	871p
2N2220	25p	2N4288	171p	AF127	171p	BF227	25p	MJ400	01.074	NKT80245	871p
2N2221	25p	2N4289	171p	AF129	371p	BF238	23p	MJ420	1.12	NKT80246	871p
2N2222	30p	2N4290	171p	AF178	421p	BF244	23p	MJ421	1.12	NKT80247	871p
2N2270	471p	2N4291	171p	AF179	771p	BFW61	471p	MJ430	01.023	NKT80248	871p
2N2297	30p	2N4292	121p	AF180	621p	BFX12	221p	MJ440	35p	NKT80249	871p
2N2368	171p	2N4293	121p	AF181	621p	BFX13	221p	MJ449	971p	NKT80250	871p
2N2369	171p	2N4294	551p	AF239	451p	BFX29	30p	MJ481	1.12	NKT80251	871p
2N2369A	171p	2N5028	571p	AF279	471p	BFX30	30p	MJ490	01.00	NKT80252	871p
2N2410	421p	2N5029	471p	AF280	621p	BFX42	371p	MJ491	01.37	NKT80253	871p
2N2483	271p	2N5030	421p	AF211	321p	BFX44	371p	MJ800	02.17	NKT80254	871p
2N2484	321p	2N5172	13p	AFY26	25p	BFY58	671p	MC638	621p	NKT80255	871p
2N2538	221p	2N5173	13p	AFY27	371p	BFX84	25p	ME520	60p	NKT80256	871p
2N2640	221p	2N5175	521p	AFY28	371p	BFX85	321p	MJ521	75p	NKT80257	871p
2N2613	35p	2N5176	45p	AFY29	271p	BFX86	25p	MPF102	421p	NKT80258	871p
2N2614	30p	2N5232A	30p	AFY36	25p	BFX87	271p	MPF103	371p	NKT80259	871p
2N2644	621p	2N5245	45p	AFY60	25p	BFX88	25p	MPF104	371p	NKT80260	871p
2N2696	321p	2N5246	421p	AFY61	821p	BFX89	621p	MPF105	371p	NKT80261	871p
2N2711	25p	2N5247	871p	AFY64	821p	BFX93A	70p	MP3638	321p	NKT80262	871p
2N2712	25p	2N5265	42.25	AY185	321p	BFY10	321p	NKT0013	471p	NKT80263	871p
2N2713	271p	2N5268	42.75	AU103	1.12	BFY11	421p	NKT124	421p	NKT80264	871p
2N2714	30p	2N5267	42.82	ASZ21	421p	BFY17	221p	NKT125	271p	NKT80265	871p
2N2865	621p	2N5308	371p	BC107	10p	BFY18	321p	NKT126	271p	NKT80266	871p
2N2904	30p	2N5306	40p	BC108	15p	BFY27	321p	NKT128	271p	NKT80267	871p
2N2904A	321p	2N5307	371p	BC109	10p	BFY28	30p	NKT135	271p	NKT80268	871p
2N2905	371p	2N5308	371p	BC113	15p	BFY21	421p	NKT137	321p	NKT80269	871p
2N2905A	40p	2N5309	621p	BC115	15p	BFY24	45p	NKT210	30p	NKT80270	871p
2N2906	25p	2N5310	421p	BC116A	15p	BFY25	25p	NKT211	30p	NKT80271	871p
2N2906A	271p	2N5354	271p	BC118	10p	BFY26	20p	NKT212	30p	NKT80272	871p
2N2907	30p	2N5355	271p	BC121	20p	BFY29	50p	NKT213	30p	NKT80273	871p
2N2925	15p	2N5358	321p	BC122	20p	BFY30	50p	NKT214	221p	NKT80274	871p
2N2924	15p	2N5365	371p	BC125	20p	BFY41	60p	NKT215	221p	NKT80275	871p
2N2925	15p	2N5366	371p	BC126	20p	BFY43	621p	NKT216	371p	NKT80276	871p
2N2926	15p	2N5367	371p	BC140	371p	BFY30	23p	NKT217	421p	NKT80277	871p
Green	14p	2N5657	571p	BC147	10p	BFY51	20p	NKT219	621p	NKT80278	871p
Yellow	13p	2N5658	75p	BC148	371p	BFY52	23p	NKT223	271p	NKT80279	871p
Orange	12p	2N5620	42.00	BC149	12p	BFY53	171p	NKT224	25p	NKT80280	871p
2N3011	30p	2N3102	50p	BC162	171p	BFY58A	571p	NKT225	221p	NKT80281	871p
2N3014	321p	2N3103	25p	BC157	30p	BFY76	421p	NKT229	30p	NKT80282	871p
2N3053	18p	2N3104	25p	BC158	11p	BFY76	421p	NKT237	35p	NKT80283	871p
2N3054	48p	2N3105	321p	BC159	11p	BFY77	35p	NKT238	35p	NKT80284	871p
2N3055	25p	2N3106	321p	BC160	621p	BFY90	271p	NKT240	271p	NKT80285	871p
2N3133	30p	2N3503	271p	BC167	11p	BFW58	271p	NKT241	271p	NKT80286	871p
2N3134	30p	2N3504	271p	BC168	10p	BFW59	25p	NKT242	20p	NKT80287	871p
2N3135	25p	2N3128	70p	BC168C	11p	BFW60	25p	NKT243	621p	NKT80288	871p
2N3136	25p	2N3140	771p	BC169B	11p	BFX25	1.12	NKT244	171p	NKT80289	871p
2N3390	25p	2N3141	721p	BC169C	11p	BFX29	1.12	NKT245	25p	NKT80290	871p
2N3391	25p	2N3142	721p	BC170	121p	BFY10	1.1				



... if you are in a hurry for goods, don't ask for them to be sent C.O.D. It takes about three times as long as ordinary post!!

were able to order as usual. Of course the more usual way, and one whose popularity will not diminish, is the Postal Service. I would however, like to draw your attention to another method which is independent of the Post and has the additional advantage of saving you money. I refer you to the Bank Giro System. *Not* the Post Office Giro which is of course dependent on the Postal Service.

You can walk into *any branch of any Bank* and ask for a Giro Credit Transfer form. You may write your order on the back of the form and the amount to pay on the front. You will need to know the account number and bank code of your supplier, but having completed the form, hand it in to the Bank with your money.

Now here is the bit which appeals to us Scotsmen: if you hand it in to your own Bank it will cost you *nothing*, if it is another bank it will cost you 2p!! But remember you have saved yourself the cost of a Postal Order or Cheque plus a stamp and an envelope!

We were so taken with the idea that we printed our own Bank Giro Forms with an order form on the back. In case other dealers would like to emulate us, the size of the form must not be less than 6½ x 3in or more than 8 x 4in. Another advantage is that security is 100 per cent!! One slight disadvantage is that it probably takes about a day longer than the post!

Sending The Money

You are now only left with the problem of how to send your money. We have already mentioned the Bank Giro—during the strike several customers tele-

phoned their orders to us and sent the money by Bank Giro.

Then there is the Post Office Giro which is being used, with either a Giro Cheque or a Credit Transfer. Still by far the most popular way of payment is the Postal Order, and although the security it gives is not 100 per cent very few seem to go astray. Lastly, by cheque; and this method is gaining in popularity every day.

Delivering The Goods

Now we will turn to the problems of getting the goods to you. This can be done by:

- (1) Parcel Post (up to 22lb or 3ft 6in size)
- (2) British Road Services
- (3) British Rail Express Parcels Service
- (4) Private Carrier

Number one is the most popular but for the larger, heavier items one has to use one of the other services. British Rail is quite good and provided you collect your parcel from the station probably takes the same time as the Post. It does cost a few shillings more, but we found it a very useful alternative during the Postal Strike! Private Carriers are expensive but good. They do a door-to-door service and are usually very zealous of their reputation for delivering the goods with nothing missing and undamaged. We use them occasionally for expensive consignments.

Finally, if you are in a hurry for goods, don't ask for them to be sent C.O.D. It takes about three times as long as ordinary post!!

Queries

The only type of query you can reasonably expect your dealer to accept, is whether he has a certain

item in stock and how much it costs. Technical queries should be sent to the magazine concerned and here again should be limited to articles appearing in that particular magazine.

We frequently are asked "Please supply me with a price list for a complete set of parts for the XYZ Signal Generator appearing in the current issue of "Sparks Weekly". We always try to be helpful as I am sure do other suppliers, but most of us work with a small staff and pricing a long list can tie up one member for quite a while. Sometimes we are asked to produce a list for an article that appeared three or four years ago, and I freely admit we cannot always oblige.

Above all when making your request *do* include a stamped addressed envelope!

In my next article I will talk about the supplier and explain some of his problems and how he is attempting to cope with them.



... pricing a long list can tie up one member for quite a while.

Beginners' Brief

MAy we introduce . . . let's skip the formalities and get straight to the heart of things. There are in fact two very important "things" or components that the newcomer to electronics must quickly become acquainted with. They are both members of the **semiconductor** family, but don't let the name worry you unduly.

The **transistor** is that rather wonderful device around which modern electronics is chiefly built. Please understand we are talking of that tiny, three-legged device about the size of a pea—often nowadays more closely resembling the split variety, actually. Non-technical folk refer to the portable radio receiver as a "transistor"—but we know better of course.

The transistor is the **solid state** or **semiconductor** (take your pick, it doesn't really matter which term is used) counterpart of the **triode valve**. It provides similar functions, all of which boil down essentially to the ability to **amplify**; in other words, a very small electric current in one circuit can be made to influence or control a very much larger current flowing in another circuit.

This basic amplifying action permits us to perform a number of other useful operations, such

as the generation of signals of various **frequencies**, and of all manner of **waveforms**. All of these operations are determined by the use of circuits composed generally of a number of **resistors** and **capacitors** arranged around a transistor.

The transistor is therefore quite obviously the "heart" of the electronic circuit; it is known as an **active** device in due recognition of its ability to actively affect and control current flowing in the circuit. In contrast, the other associated components, such as resistors, capacitors and inductors, are known as **passive** components because their action or influence upon the current flowing in the circuit is of a more limited nature.

Like its "valve" equivalent, the transistor has been developed from a more humble electronic device—the **diode**. As the name suggests, this latter device has only two external terminals or leads. The solid state diode, the ancestor of the transistor, has been around a very long time—in its early form it was known as a crystal detector and in those far off days was frequently associated with a "cat's whisker."

The function of the diode is more simple and more limited than that of the transistor. Nevertheless it plays a very important part in modern electronics—in fact it is employed far more extensively in computers than in

radio receivers.

The feature of the diode is the capability of passing current in **one direction** only. Change the polarity of the supply (reverse positive and negative) and the diode literally "closes up". It is a very efficient high speed **electronic switch**.

The semiconductor family does not comprise the diode and transistor alone. From these two fundamental types have been developed a large host of different yet allied devices. These are usually more complicated in their operation, but they increase greatly the possible applications of electronic circuits. They include devices known as **thyristors**, **triacs**, **field effect (f.e.t.) transistors**, and **phototransistors**, and there are many others.

But the newcomer to electronics need initially be concerned only with the two founder members the transistor and the diode. With these two common devices many simple yet interesting and very useful circuits can be built.

Well the introduction is over. There will be plenty of opportunity for getting better acquainted, in due course. Semiconductors have their own peculiarities and need proper understanding, if the best is to be coaxed from them. But have no fear, plenty of detailed technical advice will be forthcoming in various **EVERYDAY ELECTRONICS** articles.

ABBREVIATIONS

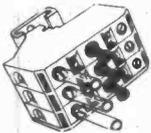
The following is a list of abbreviations used in the text of articles and in components lists. Only the direct meaning of the abbreviations is given, no attempt has been made to describe the meaning of the words in full. For further information and full descriptions readers should follow the *Teach-In* series.

A	ampere (amp)
a.c.	alternating current
BA	British Association (nut and bolt sizes)
dB	decibel
d.c.	direct current
elect.	electrolytic
e.m.f.	electromotive force
Hz	Hertz (cycles per second)
in.	inch
l.d.r.	light dependent resistor

lin.	linear
log.	logarithmic
mm	millimetre
n.p.n.	} transistor structure (two types)
p.n.p.	
Ω	ohms
oz.	ounces
p.v.c.	polyvinyl chloride
r.m.s.	root mean square
s.p.s.t.	single pole single throw
s.w.g.	standard wire gauge
V	volt
W	watt
k	kilo (×1,000)
M	Mega (×1,000,000)
m	milli (÷1,000)
μ	micro (÷1,000,000)
p	pico (÷1,000,000,000,000)

Flex Connector

A quick way to connect equipment to the mains safely and firmly—L, N, and E. coded to new colour scheme; disconnection by plugs prevents accidental switching on: has socket which allows insertion of meter without disconnection cable inlets firmly hold one hair wire on up to four 7-029 cables. 85p each.



MULTI-SPEED MOTOR

Six speeds are available 600, 850 and 1,100 r.p.m. and 8,000; 12,000 & 15,000 r.p.m. shaft is 1/4 in. diameter 230/240V. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx. 2 in. dia. x 5 in. long, mains 230/240V. Price 85p plus 25p postage and insurance.



70 THINGS YOU CAN MAKE

Send SAE today for list of 70 constructor projects—instruments, alarms, counters, locks, radios etc. etc.

20 AMP Electrical PROGRAMMER

Learn in your sleep: Have Radio playing and kettle boiling as you awake—switch on light, alarm, off intruders—have warm house to come home to. All these and many other things you can do if you invest in an Electrical Programmer. Made by the famous Smiths Instrument Company. This is essentially a 230/240 volt mains operated Clock and a 20 amp Switch, the switch-off time of which can be delayed up to 12 hours (continuously variable not stepped). Similarly the switch-on time can be delayed. This is a beautiful unit, size 5 1/2 x 3 1/2 x 2 1/2 in. deep. Metal encased, glass fronted with chrome surround. Offered at £2 40 plus 25p postage and insurance.



RESETTABLE FUSE

How long does it take you to renew a fuse? Time yourself when next one blows. Then reckoning your time at £1 per hour see how quickly our resettable fuse (auto circuit breaker) will pay for itself. Price only £1 each or £11 per dozen, specify 5, 10 or 15 amp—simply fit in place of switch.

BLANKET SWITCH

Double pole with neon light into side so luminous in dark. Ideal for dark room light or for use with waterproof element, new plastic case 80p each. 3 heat model 40p.



2kW FAN HEATER
Three position switching to suit changes in the weather. Switch up for full heater (2kW), switch down for half heat (1kW), switch central blows cold for summer cooling—adjustable thermostat acts as auto control and safety cut-out. Complete kit £3 75. Post and ins. 38p.

COMPUTER TAPE

2,400ft of the Best Magnetic Tape money can buy—users claim good results with Video and sound. 1in wide £1 45 plus 33p post and insurance, with cassette. 1/2in wide £1 25 plus 30p post and insurance with cassette. 3/4in wide £1 10 plus 25p post and insurance with cassette. Spare reel and cassette—1in £1, 1in 85p, 1/2in 75p each plus 20p post and insurance.



SPARTAN Portable RADIO

Long and medium wave, 7 transistor, size 6in. x 4in. x 1 1/2in. with larger than usual speaker giving very good tone. Built-in ferrite aerial and telescopic aerial for distant stations. A real bargain complete with leather case, carrying sling, earplug and case £3 75 plus 25p post and ins.



PROTECT VALUABLE DEVICES FROM THERMAL RUNAWAY OR OVER-HEATING

Thyristors, rectifiers transistors, etc., which use heat-sinks can easily be protected. Simply make the contact thermostat part of the heat sink.

Motors and equipment generally, can also be adequately protected by having thermostats in strategic spots on the casing. Our contact thermostat has a calibrated dial for setting between 90 deg. to 190 deg. F. or with the dial removed range setting is between 80 to 800 deg. F. Price 50p.



CAPACITOR DISCHARGE CAR IGNITION

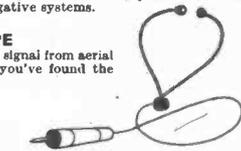
ELECTRONIC IGNITION

This system which has proved to be amazingly efficient and reliable was first described in the *Wireless World* about a year ago. We can supply kit of parts for improved and even more efficient version price £4 95 + 30p post. When ordering please state whether for positive or negative systems.



RADIO STETHOSCOPE

Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. £2—twin stetho. set instead of earpiece 75p extra post and ins. 20p.



P.E. GEMINI

Dual purpose twin 30 watt stereo amplifier for exceptional performance. Complete kit of parts less case £45 or reprint of data and parts list 55p.



THIS MONTH'S SNIP 15 WATT 12in. HI-FI SPEAKER

Is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi and public address. Handling 15 watts R.M.S.—Cone moulded fibre—Freq. response 30-10,000 c.p.s.—specify 3 or 15 ohms. Chassis diam. 12in.—12 1/2in. over mounting lugs. Overall 5 1/2in. height. A £10 speaker offered this month for £3 75 plus 30p post and ins.



OUT OF SEASON BARGAIN TANGENTIAL HEATER UNIT

This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2kW. element and 1kW. element allowing switching 1, 2 and 3kW. and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only need control switch. £3 50, 3kW. Model as above except 2 kilowatts £2 50. Don't miss this. Control Switch 35p. P. & P. 40p.



DESCRIBED IN THIS ISSUE

Kits of parts available as follows:—

HOME SENTINEL INTRUDER ALARM

Complete kit, with case £2 75.

SNAP INDICATOR

All components but not case or battery 75p.

WINDSCREEN WIPER CONTROL

All components including metal for chassis £1 50.

RECORD PLAYER

All components, but not case, loudspeaker, record deck or pick-up

INTEGRATED CIRCUIT BARGAIN

A parcel of integrated circuits made by the famous Plessey Company. A once-in-a-lifetime offer of Micro-electronic devices well below cost of manufacture. The parcel contains 5 ICs all new and perfect, first-grade devices, definitely not sub-standard or seconds. 4 of the ICs are single silicon chip GP amplifiers. The 5th is a monolithic NFN matched pair. Regular price of parcel well over £5. Full credit details of the ICs are included and in addition you will receive a list of many different ICs available at bargain prices 25p upwards with circuits and technical data of each. Complete parcel only £1 post paid. **DON'T MISS THIS TERRIFIC BARGAIN.**

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Standard size 1 1/2 wafers—silver-plated 5-amp contact, standard 1/2 spindle 3/4 long—with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10 way	12 way
1 pole	40p	40p							
2 poles	40p	40p							
3 poles	40p	40p	40p	40p	70p	70p	70p	95p	95p
4 poles	40p	40p	40p	70p	70p	70p	70p	11 20	11 20
5 poles	40p	40p	70p	70p	95p	95p	95p	11 45	11 45
6 poles	40p	70p	70p	70p	95p	95p	95p	11 70	11 70
7 poles	70p	70p	70p	85p	11 20	11 20	11 20	11 95	11 95
8 poles	70p	70p	70p	95p	11 20	11 20	11 20	12 20	12 20
9 poles	70p	70p	95p	95p	11 45	11 45	11 45	12 45	12 45
10 poles	70p	70p	95p	11 20	11 45	11 45	11 45	12 70	12 70
11 poles	70p	95p	95p	11 20	11 70	11 70	11 70	12 95	12 95
12 poles	70p	95p	95p	11 20	11 70	11 70	11 70	13 20	13 20

Where postage is not stated then orders over £5 are post free. Below £5 add 20p. Semi-conductors add 5p post. Over £1 post free. S.A.E. with enquiries please.

TREASURE TRACER

Complete Kit (except wooden batten) to make the metal detector as the circuit in *Practical Wireless* August issue. £3 95 plus 20p post and insurance.

DRILL CONTROLLER NEW IKW MODEL

Electronically changes speed from approximately 10 revs. to maximum. Full power to all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £1 50 plus 15p post and insurance. Made up model also available. £2 25 plus 15p post and p.

CONTROL DRILL SPEEDS

EE CONSTRUCTOR PROJECTS

as described in this issue and in companion magazines. We can probably supply components. Send S.A.E. for list naming the project.

HIGH ACCURACY THERMOSTAT

Uses differential comparator I.C. with thermistor as probe. Designer claims temperature control to within 1/7th of a degree. Complete kit with power pack £5 50.

AUTO-ELECTRIC CAR AERIAL

with dashboard control switch—fully extendable to 40in. or fully retractable. Suitable for 12v. positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. £6 plus 25p post and ins.



TOGGLE SWITCH

3 amp 250v. with fixing ring 75p each, 75p doz.

CAR ELECTRIC PLUG

Fits in place of cigarette lighter. Useful method for making a quick connection into the car electrical system. 38p each or 10 for £3 42.

ROCKER SWITCH

13 amp self-fixing into an oblong hole. Size approximately 1" x 1 1/2" 6p each, 10 for 54p.



MAINS RELAY BARGAIN

Special this month are some single, double and treble pole changeover relays. Contacts rated at 15 amps. Operating coil wound for 240V A.C. Good British Make. Ex-unused equipment. Size approx. 1 1/2" x 1". Open construction. Single pole 25p each 10 for £2 25. Treble pole 38p each 10 for £3 15.

BALANCED ARMATURE UNIT

500 ohm, operates speaker or microphone, so useful in intercom or similar circuits, 38p each, £3 50 doz.



THERMOSTAT

Continuously variable 30°-90° C. Has sensor bulb connected by 33in. of flexible tubing. On operation a 15 amp 250 volt switch is opened and in addition a plunger moves through approx 1/2in. This could be used to open valve on ventilator etc. £1 50 plus 23p p. & ins.



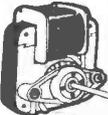
5A 3-PIN SWITCHED SOCKETS

An excellent opportunity to make that bench dish you have needed or to stock up for future jobs. This month we offer 6 British made (Hicraft) bakelite flush mounting shuttered switch sockets for only 50p plus 15p post and insurance. (20 boxes post free).



MAINS MOTOR

Precision made—as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at 50p. Postage 15p for first one then 5p for each one ordered.



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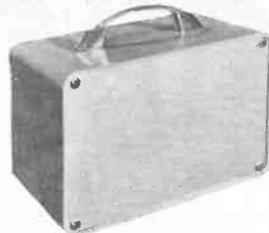
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Build this small, inexpensive unit in a few hours. Essential for "heavy" music and guitar solo effects.



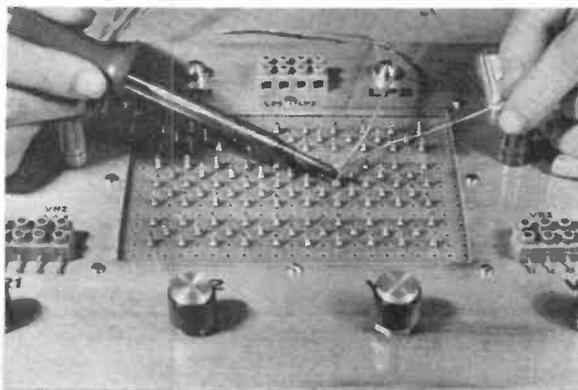
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DEMO DECK

Although originally designed with the beginner in mind, this circuit building deck has proved very useful for experiments and prototypes of every kind.

We recommend the Demo Deck as a useful experimental system to all our readers. Carefully constructed it will last for years and can house many of your tools and components.



This simple inexpensive meter is a must for the colour photographer. Gives quick indication of the colour filters necessary for correction in any light. Can be used with natural or studio lighting.

BEGINNERS!

DO NOT MISS PART 2 OF

TEACH-IN

Which deals with the electric current, resistance and resistors.

TO AVOID DISAPPOINTMENT—Order Now! DEC. ISSUE ON SALE NOV. 19

Ruminations

By Sensor

Moonshine

The launching of men into space hardly makes headlines these days—we have all become too blasé! But thanks to modern electronics, we can share the experiences of the space travellers from the safety and comfort of our own homes. The excellent television pictures, live from the moon, showing the Apollo 15 astronauts Scott and Irwin collecting rock samples and engaged in various other tasks, made compelling viewing for millions.

It was, perhaps, unfortunate that the low lunar gravity gave the movements of the astronauts a strange inhuman quality which reminded me of those television puppets, "Bill and Ben, the Flowerpot Men". The effect was heightened by the space suits and the poor sound quality—which, one presumes, was due to technical limitations imposed by the

space suits (I swear someone said, "Bo, Bo, shugalug"). However, no criticism of the project is intended; a great deal of scientific work was done and, in consequence, our knowledge of the universe will be increased.

When Uri Gagarin became the first man to orbit the earth (when was it, 1962?) the news broke here at breakfast time. In the development laboratory of a large computer manufacturer the engineers gathered together to discuss this fantastic achievement. Men normally dedicated to their work left 'scopes and soldering irons untouched and began to calculate rocket thrusts and speculate on trajectories. The chief development engineer, anxious to bring his team down to earth, was heard to murmur that here was, surely, the most subtle form of industrial sabotage!

Words and Music

The urge to "have a go" at someone else's job, something different from our bread and butter activity, seems to exist within most of us to a greater or lesser extent. Our hobbies and pastimes satisfy this urge to be

someone else and, perhaps, help us to keep our sanity.

One form of "game playing" that was popular with computer engineers in their lighter moments, particularly around Christmas time, was the transcribing of music for the computer. A programme had been written containing instructions which caused the computer to perform a number of 'shifts' so as to generate the required audio frequencies. A paper tape had to be prepared from the written music of the piece that the computer was required to perform and, if the whole tedious and time consuming process had been correctly carried out, some semblance of the tune could be obtained from the loudspeaker of the computer, after feeding in the tapes.

The performance was very much inferior to those given by sea lions at the circus; the timing was better but the spontaneity and élan were sadly lacking. Sea lions customarily applaud themselves by clapping their flippers together; no doubt this could be simulated by the tape punch accompanied by 'Hoinks' on the loudspeaker.

MEMORY STORE

Retrieval By

Harry Kitchen

THE name of the man who first aroused my interest in radio is, alas, no longer in my memory store. It was an RAF wireless "OP" stationed near my father's mine situated in a remote part of India during the last war. It all started innocently enough, with a pile of American radio magazines given me by my friend; the fires of enthusiasm were lit and are still burning brightly.

What mattered was the fact that circuit diagrams were a profound mystery. (Stand up the rotter who said they still are). The mine blacksmith produced a monstrous soldering iron, a native radio shop produced a pile of components that were ancient when Victoria was Empress, the cooks' charcoal fire was commandeered, and it was every man for himself.

The soldering iron glowed red, (well it had to be hot hadn't it?) resistors smouldered, wax sizzled from paper capacitors, (what a pyromaniac's delight when one

"went up") solder flew everywhere but on the joint, the cook muttered devilishly. Coils were wound on anything that stood still long enough; 175 turns on the former, *the rest still on the reel*. Scratching ones head produced no sound in the phones, only a mysterious silence where glorious music should have been. My friend had been posted, (wonder how he managed it?) and advice was very conspicuous by its absence. I still wonder how much my friend knew besides morse.

Time passed, and my store of knowledge grew. Being in the wilderness undoubtedly saved my life. An absence of mains meant oil lighting and batteries for wireless power; batteries can shock, (and did they shock) but mercifully lacked the capacity to kill.

All good things come to an end, and soon enough it was time to start thinking of further education. An apprenticeship; that was the thing, and letters flew between our little part of the world and several illustrious British radio manufacturers. One offered what I wanted, and so it was that

an ex colonial returned "home."

The apprenticeship completed, I was rapidly acquainted with the most fundamental tenet appertaining to ex apprentices; that reasonable jobs were only for the very clever, good jobs only for those with friends or relatives in high positions. Since I had lacked the foresight to appoint a friend or relative to a suitably high position, and since I wasn't terribly keen on the job I was put on, there was no alternative but to seek greener pastures.

Here I did myself a great favour. Having leaped off the dung heap at a relatively tender age, subsequent leaps onto better (?) jobs came much more easily. The unknown is almost always less fearsome than was thought. Fifty years in one job can mean contentment; it can also mean lack of confidence, or lack of ambition. A rolling stone gathers no moss; equally, a static person gathers no experience.

Electronics as an occupation, or as a hobby, is rarely equalled, never surpassed. It has been both to me for 18 years and I like it. Most decidedly, I like it.

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P. P. & Ins. 50p

(Overseas P. & P. £1)



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Exclusive to readers of "EVERYDAY ELECTRONICS" "EVERYDAY SEVEN"



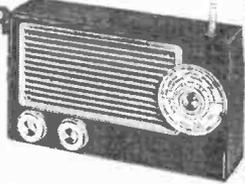
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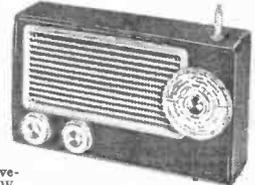
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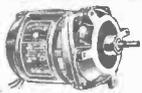
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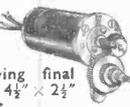
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100μA	23-10	50V. D.C.	22-60
100-0-100μA ..	23-10	300V. D.C.	22-60
200μA	22-87	15V. A.C.	22-60
500μA	22-75	300V. A.C.	22-60
500-0-500μA ..	22-60	8 Meter 1mA ..	22-87
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50-0-50μA ..	22-60	20V. D.C.	22-60
100μA	22-60	50V. D.C.	22-60
100-0-100μA ..	22-37	300V. D.C.	22-60
500μA	22-25	15V. A.C.	22-60
1mA	22-60	300V. A.C.	22-60
5mA	22-60	8 Meter 1mA ..	22-10
10mA	22-60	VU Meter	23-10
50mA	22-60	1 amp. A.C.	22-60
100mA	22-60	5 amp. A.C.	22-60
500mA	22-60	10 amp. A.C.	22-60
1 amp.	22-60	20 amp. A.C.	22-60
5 amp.	22-60	30 amp. A.C.	22-60

Type MR.65P. 3 1/4 in. x 3 1/4 in. fronts.

50μA	3-37	10V. D.C.	22-10
50-0-50μA ..	22-75	20V. D.C.	22-10
100μA	22-75	50V. D.C.	22-10
100-0-100μA ..	22-60	300V. D.C.	22-10
200μA	22-60	300V. D.C.	22-10
500μA	22-37	15V. A.C.	22-10
500-0-500μA ..	22-10	50V. A.C.	22-10
1mA	22-10	150V. A.C.	22-10
5mA	22-10	300V. A.C.	22-10
10mA	22-10	8 Meter 1mA ..	22-10
50mA	22-10	VU Meter	23-37
100mA	22-10	50mA A.C.	22-10
500mA	22-10	100mA A.C.	22-10
1 amp.	22-10	5 amp. A.C.	22-10
5 amp.	22-10	10 amp. A.C.	22-10
		20 amp. A.C.	22-10
		30 amp. A.C.	22-10

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50μA	24-50	20V. d.c.	23-97
100μA	24-25	50V. d.c.	23-97
1mA	23-97	300V. d.c.	23-97
50-0-50μA ..	24-25		
1-0-1mA	23-97	Dual range	
5A d.c.	23-97	500mA/5A d.c.	24-25
10V d.c.	23-97	5V/50V d.c.	24-25

Type MR.35P. 1 21/32 in. square fronts.



50μA	23-00	200mA	21-37
50-0-50μA ..	21-87	300mA	21-37
100μA	21-87	500mA	21-37
100-0-100μA ..	21-75	750mA	21-37
200μA	21-75	1 amp.	21-37
500μA	21-50	2 amp.	21-37
500-0-500μA ..	21-37	5 amp.	21-37
1mA	21-37	10 amp.	21-37
1-0-1mA	21-37	5V. D.C.	21-37
2mA	21-37	10V. D.C.	21-37
5mA	21-37	15V. D.C.	21-37
10mA	21-37	20V. D.C.	21-37
50mA	21-37	100V. D.C.	21-37
100mA	21-37	150V. D.C.	21-37
500mA	21-37	300V. D.C.	21-37
150mA	21-37	600V. D.C.	21-37
		750V. D.C.	21-37
		15V. A.C.	21-37
		60V. A.C.	21-37
		150V. A.C.	21-37
		300V. A.C.	21-37
		500V. A.C.	21-37
		8 Meter 1mA ..	21-10
		VU Meter	22-10

Type MR.45P. 2 in. square fronts.

50μA	22-25	5 amp.	21-50
50-0-50μA ..	22-10	10V. D.C.	21-50
100μA	22-10	20V. D.C.	21-50
100-0-100μA ..	21-87	50V. D.C.	21-50
200μA	21-87	300V. D.C.	21-50
500μA	21-60	15V. A.C.	21-50
500-0-500μA ..	21-50	300V. A.C.	21-50
1mA	21-50	8 Meter 1mA ..	21-87
5mA	21-50	VU Meter	22-25
10mA	21-50	1 amp. A.C.	21-50
50mA	21-50	5 amp. A.C.	21-50
100mA	21-50	10 amp. A.C.	21-50
500mA	21-50	20 amp. A.C.	21-50
1 amp.	21-50	30 amp. A.C.	21-50

"SEW" BAKELITE PANEL METERS

Type MR.65. 3 1/4 in. square fronts.



500μA	21-75	500mA	21-75
1 amp.	21-75	5 amp.	21-75
5 amp.	21-75	15 amp.	21-75
30 amp.	21-75	50 amp.	21-75
60 amp.	21-75	30 amp. A.C.	21-75
5V. D.C.	21-75	50 amp. A.C.	21-75
10V. D.C.	21-75	VU Meter	23-10
20V. D.C.	21-75		
50V. D.C.	21-75		
150V. D.C.	21-75		
300V. D.C.	21-75		
30V. A.C.	21-75		
50V. A.C.	21-75		
300V. A.C.	21-75		
500mA A.C.	21-75		
1 amp. A.C.	21-75		
5 amp. A.C.	21-75		
10 amp. A.C.	21-75		
20 amp. A.C.	21-75		
30 amp. A.C.	21-75		
50 amp. A.C.	21-75		
100mA	21-75		



Type PE.70. 3 17/32 in. x 1 15/32 in. x 2 1/2 in. deep.

50μA	23-00	500μA	23-60
50-0-50μA ..	22-87	1mA	23-37
100μA	22-87	5 amp.	23-37
100-0-100μA ..	22-75	10 amp. A.C.	23-37
200μA	22-75	VU Meter	23-25

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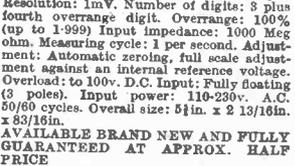
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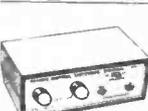
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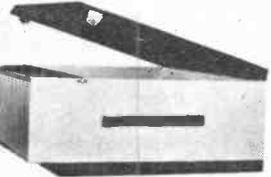
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Everyday Electronics, November 1971

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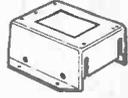
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1N5407	45p	2N3705	13p	40512	185p	AS727	36p	BC268	15p	E2512	164p	OC44	42p
1844	9p	2N3706	13p	40602	10p	AS728	27p	BC269	17p	EA403	10p	OC45	38p
18940	5p	2N3707	13p	40669	140p	AS729	36p	BC300	49p	EB363	10p	OC70	21p
2N696	17p	2N3708	13p	AC107	46p	AU111	97p	BC301	37p	EC401	18p	OC71	38p
2N697	18p	2N3709	11p	AC126	20p	B30C250	24p	BC303	60p	EC402	17p	OC72	38p
2N706	12p	2N3710	13p	AC127	20p	B30C550/300	34p	BCY30	60p	ER900	54p	OC75	40p
2N930	29p	2N3711	13p	AC128	20p	B1912	66p	BCY31	75p	MCI140	25p	OC81	25p
2N1131	29p	2N3731	12p	AC141H	34p	B5041	72p	BCY70	18p	MJ481	120p	OC81D	26p
2N1132	29p	2N3794	15p	AC141HK	87p	BA102	25p	BCY71	33p	MJ491	135p	OC83	25p
2N1302	29p	2N3819	25p	AC142H	25p	BA130	22p	BCY72	15p	MJ371	108p	OC84	25p
2N1303	18p	2N3820	25p	AC142HK	22p	BA145	27p	BD121	105p	MJ5521	82p	P346A	29p
2N1304	26p	2N3904	35p	AC153K	22p	BA155	15p	BD123	105p	MJ22955	165p	82CN1	10p
2N1305	26p	2N3906	35p	AC176	16p	BA156	13p	BD124	100p	MJ23055	82p	8CI141D	187p
2N1306	33p	2N4036	55p	AC176K	17p	BA133	13p	BD130	50p	MFF102	37p	8CI146D	247p
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2N1308	36p	2N4059	10p	AC188K	23p	BB103/G	18p	BD132	10p	MP8634	30p	8D4	12p
2N1309	36p	2N4060	11p	*AC187K/188K	BC107	BC107	12p	BD135	38p	NKT211	25p	V763	28p
2N1596	102p	2N4061	11p		40p	BC108	11p	BD136	44p	NKT212	25p	W106B1	45p
2N1599	122p	2N4062	12p	ACY17	31p	BC109	12p	BD141	227p	NKT213	25p	W106D1	83p
2N1613	23p	2N4124	18p	ACY18	18p	BC122	21p	BDY20	92p	NKT214	23p	W02	40p
2N1711	28p	2N4126	27p	ACY19	23p	BC125	15p	BF115	23p	NKT217	60p	WFO2	95p
2N1893	54p	2N4284	15p	ACY20	20p	BC136	22p	BF167	18p	NKT261	21p	ZTX300	14p
2N2147	95p	2N4286	15p	ACY21	21p	BC140	30p	BF173	19p	NKT271	18p	ZTX301	18p
2N2218	34p	2N4289	15p	ACY22	21p	BC147	10p	BF177	25p	NKT274	25p	ZTX302	22p
2N2218A	44p	2N4291	15p	ACY39	63p	BC148	9p	BF178	31p	NKT275	23p	ZTX303	22p
2N2219	38p	2N4292	16p	ACY40	17p	BC149	9p	BF184	14p	NKT403	85p	ZTX304	27p
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2N2484	42p	2N4991	62p	AD149	58p	BC159	12p	BFX18	90p	NKT674F	24p	ZTX502	25p
2N2646	47p	2N5062	81p	AD150	50p	BC167	11p	BFX29	31p	NKT677F	22p	ZTX503	22p
2N2904	35p	2N5098	35p	AD161	33p	BC168	10p	BFX94	25p	NKT715	30p	ZTX504	55p
2N2904A	42p	2N5163	25p	AD162	36p	BC169	11p	BFX85	32p	NKT773	25p	ZTX530	27p
2N2905	44p	2N5172	18p	*AD161/162	60p	BC177	14p	BFX87	28p	OA47	8p	ZTX531	33p
2N2905A	47p	2N5192	125p	AF114	24p	BC178	13p	BFX88	28p	OA90	6p		
2N3924	20p	2N5195	147p	AF115	24p	BC179	14p	BFX50	23p	OA91	5p		
2N2925	22p	2N5457	49p	AF116	23p	BC182L	11p	BFY51	20p	OA95	6p		
2N2926	11p	2N5459	49p	AF117	23p	BC183L	10p	BFY52	25p	OA200	9p		
2N3053	27p	40250	71p	AF118	82p	BC184L	11p	BFY90	104p	OA202	10p		
2N3054	80p	40251	89p	AF124	24p	BC186	42p	B8X20	16p	OC19	50p	* Matched pair	

MULLARD UNILEX AUDIO MODULES

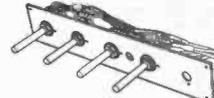
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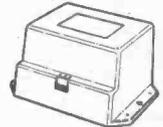
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0.47 µF 35 volts	0.47 µF 50 volts	150 µF	20 volts
0.68 µF 20 volts	0.68 µF 35 volts	150 µF	6 volts
1.0 µF 15 volts	0.68 µF 50 volts		
2.2 µF 3 volts	1.0 µF 35 volts	Standard	
2.7 µF 15 volts	1.0 µF 75 volts	6.8 µF	50 volts
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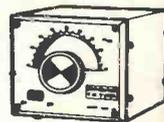
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