Easy to build projects for everyone

Everyday ELECTRONICS

DEC. 79
45p

TWINKLING STAR
PEG-A-HOLE GAME
EVERLASTING CANDLE

Some simple presents for you to build

CHECKING YOUR CHRISTMAS LIGHTS

plus

Other bright ideas for seasonal decoration

Model TCSU1 — Micro-Soldering Station

Model CTC-24volts. Priced at **£9.75**(1.87)

Model XTC-24volts. Priced at **£9.75**(1.87)

Accurate pin point temperature control between 65° and 400°C. Heating element and sensor built in tip of the iron for fast response. Interchangeable slide-on bits from 4.7mm(3/16") down to 0.5mm. Zero voltage switching, no spikes. No magnetic field, no leakage. Supplied with miniature CTC(35-40watt) iron or XTC(50watt). TCSU1 soldering station with XTC or CTC iron **£36**(6.44) Nett to Industry.

Model TCSU2—
Specification as TCSU1 except temperature range 200°-400°C. Visual temperature indicators by square LED at 270, 300, 330 and 360°C. Priced at **£42.50**(7.50) Nett to Industry.

Model CX 17watts - 230volts

A miniature iron with the element enclosed first in a ceramic shaft, then in stainless steel. Virtually leak-free. Only 7½" long. Fitted with a 3/32" bit. **£4.20**(.98)
Range of 5 other bits available from ¼" down to 3/64".
Also available for 24volts.

Spare element Model CX230E

Model X25 25watts - 230volts

A general purpose iron also with a ceramic and steel shaft to give you toughness combined with near-perfect insulation. Fitted with 1/8" bit and priced at **£4.20**(.98)
Range of 4 other bits available.
Also available in 24volts.

Spare element Model X25/240E

Model SK3 Kit

Contains both the model CX230 soldering iron and the stand ST3. Priced at **£5.70**(1.49) It makes an excellent present for the radio amateur or hobbyist.

Model SK4 Kit

With the model X25/240 general purpose iron and the ST3 stand, this kit is a must for every toolkit in the home. Priced at **£5.70**(1.49)

Model SK1

This kit contains a 15watt miniature soldering iron, complete with 2 spare bits, a coil of solder, a heat sink and a booklet, 'How to Solder'. Priced at **£5.95**(1.53)

Model MLX 12volts

The soldering iron in this kit can be operated from any ordinary car battery. It is fitted with 15 feet flexible cable and battery clips. Packed in a strong plastic envelope it can be left in a car, a boat or a caravan ready for soldering in the field. Price **£4.55**(1.14)

ST3 Stand.

A strong chromium plated, steel spring screwed into a plastic base of high grade insulating material provides a safe and handy receptacle for all ANTEX models soldering irons. Priced at **£1.50**(.57)

V.A.T. + P&P as shown in brackets ( )

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EE12

MAGENTA ELECTRONICS LTD.

E.E. PROJECT KITS

Make us **YOUR No. 1 SUPPLIER OF KITS and COMPONENTS** for E.E. Projects. We supply carefully selected sets of parts to enable you to construct E.E. projects. Project kits include **ALL THE ELECTRONICS AND HARDWARE NEEDED**—we have even included appropriate screws, nuts and I.C. sockets. Each project kit comes complete with its own **FREE COMPONENT IDENTIFICATION SHEET.** We supply—you construct. **PRICES INCLUDE CASES UNLESS OTHERWISE STATED. BATTERIES NOT INCLUDED.** IF YOU DO NOT HAVE THE ISSUE OF E.E. WHICH CONTAINS THE PROJECT—YOU WILL NEED TO ORDER THE INSTRUCTIONS/REPRINT AS AN EXTRA—39p. each.

ONE ARMED BANDIT. Oct 79. £18·28. case extra £3·99.
HIGH IMPEDANCE VOLTMETER. Oct. 79. £16·22.
LIGHTS ON REMINDER. Oct. 79. £4·43.
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QUAD SIMULATOR. June 79. £6·07.
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3 BAND SHORT WAVE RADIO

Simple trf design covering 1·2-24MHz. **Covers most amateur bands and short wave broadcast bands.** Five controls-bandset, bandspread, reaction, wavechange and attenuator. Uses an internal 9v battery—very low current consumption. The 3 coils are all mounted on the pcb—selection is by a wavechange switch. Use with headphones or a crystal earpiece. **Kit contains all the components required including the pcb and case.** Instructions are included with this kit. Headphones are not included—we recommend our high impedance mono headphones.

KIT £18·97 **HEADPHONES EXTRA £3·28.**

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NO MINIMUM ORDER—ALL PRODUCTS ARE STOCK LINES. FIRST CLASS DELIVERY OF FIRST CLASS COMPONENTS. SEND FOR YOUR COPY AND SEE HOW EASY IT IS TO USE THE MAGENTA CATALOGUE! WRITE TODAY ENCLOSING 5 × 10p STAMPS.

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MAGENTA gives you FAST DELIVERY BY FIRST CLASS POST OF QUALITY COMPONENTS & KITS. All products are stock lines and are new & full specification. We give personal service & quality products to all our customers—**HAVE YOU TRIED US?**

ONE-ARMED BANDIT

Oct 79

Complete with 0·2" LED's and all components. **£18·28.** Case extra **£3·99**

CHASER LIGHTS

Sept 79

Complete kit — with Case, plugs and sockets etc. **£18·95**

G. P. POWER SUPPLY

Feb 79

0-20V 0-1A. Variable with calibrated VOLTMETER and AMMETER
All components and Hardware **£25·17.**
Case (horizontal & layout) **£4·98** extra.

DOING IT DIGITALLY

Complete kit of top quality components as specified by EVERYDAY ELECTRONICS. Kit comes complete with free component identification sheets.
TTL TEST BED £28·84.
FIRST 6 months COMPONENTS £4·98.
COMPONENTS FOR PARTS 7, 8, 9 & 10 £19·98 includes: photocells I.C.'s, Resistors, Capacitors, thermistors, microphone, speaker, presets etc.
PART 11 £2·73. PART 12 £3·19.
Reprints:—Part 1—75p others 39p each.

LOW COST METAL LOCATOR

E.E. June 79
WE HAVE MADE UP A *COMPLETE* HARDWARE KIT FOR THIS PROJECT, WITH HANDLE, COIL FORMER and SCREWS etc. Everything you need for the project, including electronics and case **£9·69.**
Or separately:
Electronics & Case £5·14.
Hardware Kit £4·75.

TEACH IN 80

NEW SERIES—ALL COMPONENTS IN STOCK NOW FOR FAST DELIVERY. All top quality components as specified by Everyday Electronics. Out kit comes complete with **FREE COMPONENT IDENTIFICATION SHEET.** Follow this educational series and learn about electronics—Start today! **SEND £22·95 for the TUTOR DECK and ADDITIONAL COMPONENTS parts 1-6.** All orders sent by **FIRST CLASS POST.** Out kit contains all these parts:—

TUTOR DECK: METER, BREADBOARD, TRANSFORMER, LEDS, POTENTIOMETERS, SWITCHES, SPEAKER, PLUGS, SOCKETS, BATTERY CLIPS, WIRE, CABLE, FUSES, FUSEHOLDERS, KNOBS. **ADDITIONAL COMPONENTS. PARTS 1-6,** RESISTORS, PHOTOCELL, DIODES, CAPACITORS.

CASE WOODWORK KIT £4·98 extra. Complete kit for tutor deck woodwork, contains all the softwood, hardboard, ramin, panel pins, adhesive, screws, feet, strap-handle, and fixings. Cut to size and ready to assemble.

IDEAL SOLDERING EQUIPMENT FOR THE TEACH IN AND ELECTRONICS

ANTEX X25 SOLDERING IRON 25W **£4·98**
SOLDERING IRON STAND **£2·03**
SPARE BITS. Small. Standard, Large. **65p** each.
SOLDER. Handy size **75p.**
DESOLDER BRAID **69p**
HOW TO SOLDER BOOKLET **12p**
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SIREN. 12V £5·95.
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6" ROUND SPEAKER. 8 ohm, 5W. **£2·18.**
CABINET SPEAKER. 8 ohm, 5W. 5" speaker. Cabinet 10" × 7" × 4". **£7·43**
RE-ENTRANT HORN SPEAKER. 8 ohm S.W. Horn dia. 5½". **£5·27.**
EARPIECES. Crystal 46p. Magnetic 18p.
STETHOSCOPE ATTACHMENT. Fits our earpieces 99p.
BUZZER. 6V 82p. 12V 85p.
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STEREO HEADPHONES. 8 ohm. Padded. **£4·24.**
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MICROPHONE DYNAMIC. 600 ohm. Cassette type. **£1·38.**
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SIGNAL INJECTOR. £5·48.
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SCREWDRIVER SET. Six piece. **£2·19.**
Q MAX PUNCH. ⅛" **£2·14.** ¼" **£2·30.** ⅜" **£2·41.** ½" **£2·50.**
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PANEL METERS. 60 × 45mm. Modern style. 50uA, 100uA, 1mA, 1A, 25V d.c. **£6·33.**
NIGHT LIGHT. Plug type. **£1·68.**
CONNECTING WIRE PACK. 5 × 5yd. coils. 35p.
VERO SPOT FACE CUTTER. £1·66.
VERO PIN INSERTION TOOL. 0·1" **£1·48.** 0·15" **£1·45**
RESISTOR COLOUR CODE CALCULATOR. 21p.

SEIKO MEMORY BANK

Calendar watch M354
Hours, mins., secs.
Month, day, date in 12 or 24 hour format all indicated continuously.
Monthly calendar display month, year and all dates for any selected month over 80 year period.
Memory bank function.
Any desired dates up to 11 can be stored in advanced.
2 year battery life.
Water resistant.
Metac Price

£79.50 **M11**

SEIKO Alarm Chronograph

With WEEKLY Alarm.
Hours, mins, secs, month, date, day, am/pm.
Weekly alarm – can be set for every day at designated time e.g. 6.30 am on Mon, Wed and Friday.
Alarm set time displayed above time of day.
Full stopwatch functions, laptime, split etc.

£89.95 **M10**

SEIKO Melody Alarm Chronograph

Chiming Alarm, plus chrono.
Hours, mins, secs, date, day, 24 hour alarm, 12 hour chronograph, 1/10th secs, Laptime, Back light, Stainless steel, mineral glass.

METAC PRICE

£92.95 **M19**

SEIKO Calculator Watch

Full specification calculator with memory, plus multi function watch.
Hours, mins, secs, day, date, backlight, Automatic calendar.
Long life battery.

£99.95 **M27**

CASIO CHRONO 95QS-3LB

Stainless steel case, water resistant to 66 feet.
Hours, mins, secs, am/pm, year, month, date, day.
Auto-calendar pre-programmed until the year 2029.
12/24 hour. Stopwatch function.
Range 7 hours. 1/100 sec. (Mode) Net time/lap-time/ 1st-2nd place times.
Dual time function.
Accuracy 15 secs per month.
Battery life approx 4 years.

£22.95 **M22**

CASIO LADIES 86CL-23B-1

Elegant slim line.
Stainless steel bracelet, fully adjustable.
Hour, mins, 10 sec symbol second by flash, am/pm.
Month, date, day.
Auto-calendar preprogrammed for 28th day in Feb.
Accuracy per month 15 secs.
Battery life approx 15 months.

£29.95 **M23**

CASIO F-200 Sports Chrono

Attractive Mens watch in black resin with mineral glass.
Hours, mins, secs, am/pm.
Month, date, alpha-numeric day.
Auto-calendar set 28th Feb.
Stopwatch working range 1 hour, units 1/100 sec. Mode, Net Time/lap/time/ 1st-2nd place times.
Accuracy approx 15 secs per month.
Battery 12 months.

£14.95 **M24**

CASIO ALARM CHRONO 81CS-36B

Hours, mins, secs, day, and also day, month and year perpetual automatic calendar.
100th sec chronograph to 7 hours.
Net time/lap/time/1st and 2nd place times. User optional 12/24 hr display. 24 Alarm. User optional, hourly chime.
Backlight, mineral glass, stainless steel.
Water resistant to 100ft.
Battery life approx 4 years.

£34.95 **M25**

BELTIME Chronograph

(9-Functions)
Hours, mins, secs, day, date, month, interchange feature, automatic calendar, backlight, Net time/lap/time.
Stainless steel bracelet.
Battery life 1 year.

£14.95 **M34**

BELTIME Multi Alarm

29 Functions
Hours, mins, secs, date, day.
Alarm, chronograph, Light.
Watch 8 functions, Alarm 4 functions, chronograph 17 functions.
Stainless steel bracelet.

£29.95 **M35**

CASIO F-8C 3 Year Battery life.

Hours, mins, secs, am/pm, date, day.
Auto calendar set 28th Feb.
Stopwatch function.
Accuracy 15 secs per month. Battery life approx 3 years.

£9.95 **M36**

CASIO CALENDAR 200 47CS-23B-1 Black. Stainless steel.

Hours, mins, 10 second symbol, second (by flash), am/pm. Month, day, date.
Auto-calendar set from 1901 to 2009.
Full month calendar display.
Dual time function.
Accuracy 10 secs per month. Battery life approx 15 months.

£59.95 **M37**

MELODY Multi Alarm Chronograph

Hours, mins, secs, Day, Date, Count-down alarm, Dual time zone, 1/100th sec stopwatch. Lap/split time, 1st and 2nd place times, Melody test function.

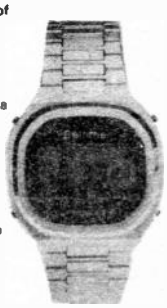
£26.95 **M30**

DUAL TIME-ALARM CHRONOGRAPH

Incorporating module of world famouse Japanese watch manufacture.
Hours, mins, secs, days of week, month, day and date, 24 hour alarm, 12 hour chronograph, 1/10th secs, lap time, Back light, stainless steel case and bracelet, Mineral glass, Battery hatch, long life battery.

£35.00 **M12**

PICOQUARTZ Microprocessor Alarm Chronograph



Multilanguage–day of the week can be set to English, French, German, Italian or Spanish.
Chime – every full hour combined with a response signal, beeping at every pressing of the functions.
Can be switched off.
12-24 hour format.
Backlight.
Chrono – 1, full scale chrono with lap, counting hours upto 24 hrs. Mins, secs. 1/100th secs.
Two Alarm systems.
Two time zones.

£37.95 **M32**

SEIKO CHRONOGRAPH

Hours, mins, secs and day of the week.
Month date and day of the week.
Stopwatch display – Hours, mins, secs up to 12 hours (mins, secs, 1/100 secs up to 20 minutes).
Lap timing.
Continuous time measurement of two competitors.
Stinless steel, mineral glass.

£56.00 **M33**

Metac ELECTRONICS & TIME CENTRES

North & Midlands
67 High Street, DAVENTRY
Northamptonshire
Telephone: 03272 76545

South of England
327 Edgware Road
LONDON W.2
Telephone: (01) 723 4753

QUARTZ LCD 5 Function

Hours, mins, secs., month, date, auto calender, back-light, quality metal bracelet.

£6.65

Guaranteed same day despatch.
Very slim, only 6mm thick.

M1

SOLAR QUARTZ LCD 5 Function

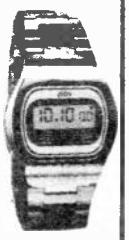
Genuine solar panel with battery back-up.
Hours, mins., secs., day, date. Fully adjustable bracelet. Back-light.
Only 7mm thick.

£8.65

Guaranteed same day despatch.

M2

QUARTZ LCD 11 Function SLIM CHRONO



6 digit, 11 functions.
Hours, mins., secs., day, date, day of week.
1/100th, 1/10th, secs., 10X secs., mins.,
Split and lap modes.
Back-light, auto calendar.
Only 8mm thick.
Stainless steel bracelet and back.
Adjustable bracelet.
Metac Price

£10.65 Thousands sold!
Guaranteed same day despatch.

M3

QUARTZ LCD ALARM 7 Function

Hours, mins., secs,. month, date, day.
6 digits, 3 flags plus continuous display of day and date or seconds. Back-light
Only 9mm thick.

£12.65

Guaranteed same day dispatch.

M4

MULTI ALARM 6 Digits 10 Functions

- Hours, mins., secs.
- Months, date, day.
- Basic alarm.
- Memory date alarm.
- Timer alarm with dual.
- Time and 10 country zone.
- Back-light.
- 8mm thick.

£18.65

M5

FRONT-BUTTON Alarm Chrono Dual Time

6 digits, 5 flags,
22 functions.
Constant display of hours and mins., plus optional seconds or date display.
AM/PM indication, month, date.
Continuous display of day.
Stop-watch to 12 hours 59·9 secs., in 1/10 second steps.
Split and lap timing modes.
Dual time zones.
Only 8mm thick.
Back-light. Fully adjustable open bracelet.
Guaranteed same day dispatch

£22.65

M6

SOLAR QUARTZ LCD Chronograph with Alarm Dual Time Zone Facility

6 digits, 5 flags.
22 functions.
Solar panel with battery back-up.
6 basic functions.
Stop-watch to 12 hours 59·9 secs., in 1/10 sec., steps.
Split and lap timing modes.
Dual time zones.
Alarm. 9mm thick. Back-light.
Fully adjustable bracelet.

£27.95

M7

ALARM CHRONO with 9 world time zones

- 6 digits, 5 flags.
- 6 basic functions.
- 8 further time zones.
- Count-down alarm.
- Stop-watch to 12 hours 59·9 secs. in 1/10 sec. steps.
- Split and timing modes.
- Alarm.
- 9 mm thick.
- Back-light.
- Fully adjustable bracelet.

£29.65

M8

SOLAR QUARTZ LCD Chronograph

Powered from solar panel with battery back-up.
6 digit, 11 functions.
Hours, mins., secs., day, date, day of week.
1/100th, 1/10th, secs., 10X secs., mins.
Split and lap modes.
Back-light, auto calendar. Only 8mm thick.
Stainless steel bracelet and back.
Adjustable bracelet.
Metac Price

£13.65

Guaranteed same day despatch.

M9

QUARTZ LCD Ladies Day Watch

Only 25 × 20mm and 6mm thick.
Hours, minutes, seconds, day, date, backlight and auto calendar.
Elegant metal bracelet in silver or gold fully adjustable to suit very slim wrists.
State colour preference.

£9.95

Guaranteed same day despatch.

M15

QUARTZ LCD Ladies Fashion Watch

Elegant bracelet in bronze/gold finish or silver colour.
Hours, mins, secs, day, date, backlight and auto calendar. Adjustable for the slimmest of wrists.
State colour preference.

£14.95

Guaranteed same day despatch

M17

QUARTZ LCD Ladies Cocktail Watch

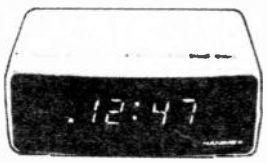
Highly functional watch which also suits those special occasions.
Beautifully designed with a very thin bracelet which retains strength as well as elegance.
Hours, mins, secs, day, date, backlight and autocalendar.
Bracelet fully adjustable to suit slim wrists.
State gold or silver finish.

£19.95

Guaranteed same day despatch

M18

HANIMEX Electronic LED Alarm Clock



Features and Specification
Hour minute display. Large LED display with p.m. and alarm on indicator. 24 Hours alarm with on off control. Display flashing for power loss indication. Repeatable 9 minute snooze. Display bright dim modes control. Size 5.15" × 3.93" × 2.36" (131mm × 11mm × 60mm)
Weight 1.43 lbs (0.65 kg)
AC power 220V.

£10.20 Thousands sold!

Mains operated.

Guaranteed same day despatch

M13

EXECUTIVE ALARM WATCH

6 Functions plus Alarm:
Conference signal,
5 minute snooze alarm.
Conference signal sounds 4 secs., before main alarm to give advance warning and an option to cancel.
Snooze sounds 5 mins., after main alarm and is always preceeded by the conference signal.

£14.95

M60

MACY QUARTZ ANALOGUE

Automatic Calendar
Day and Date
infinite bracelet.
This mans watch has elegance as well as the robust appearance provided by a watch with traditional features. Accuracy is provided by a quartz crystal powered by a long life miniature battery.

£24.95

M21

Metac price breakthrough for an Alarm Chronograph with Dual Time only

£18.95

OUTSTANDING FEATURES

- **DUAL TIME.** Local time always visible and you can set and recall any other time zone (such as GMT). Also has a light for night viewing.
- **CALENDAR FUNCTIONS** include the date and day in each time zone.
- **CHRONOGRAPH/STOPWATCH** displays up to 12 hours, 59 minutes, and 59.9 seconds.
- On command, stopwatch display freezes to show intermediate (split/lap) time while stopwatch continues to run. Can also switch to and from timekeeping and stopwatch modes without affecting either's operation.
- **ALARM** can be set to anytime within a 24 hour period. At the designated time, a pleasant, but effective buzzer sounds to remind or awaken you!

Guaranteed same day dispatch. M16

HOW TO ORDER

Payment can be made by sending cheque, postal order, Barclay, Access or American Express card numbers. Write your name, address and order details clearly, enclose 40 pence per single item for post and packing or the amount stated in the advert. All products carry 1 year written guarantee and full money-back 10 day reassurance. Battery fitting and electronic calibration service is available to customers at any Metac shop. All prices include VAT currently at 15%.

Metac Wholesale:
Trade enquiries – send for a complete list of prices for all the goods advertised plus many more not shown also minimum order details.
Telephone orders: Credit card customers can telephone orders direct to Oaventry (03272) 76545 or Edgware Rd. 01-723 4753 24 hours a day.

Service Enquiries 03272-77659
CALLERS WELCOME Shops open 9-30am-6.00

Metac ELECTRONICS & TIME CENTRES

North & Midlands
67 High Street, DAVENTRY
Northamptonshire
Telephone: 03272 76545

South of England
327 Edgware Road
LONDON W.2
Telephone: (01) 723 4753

Techknowledgey for sale.

The Mark III FM Tuner

DIY Hi-Fi will never seem the same again. Ambit's Mark III tuner system is electrically & visually superior to all others. Some options available, but the illustrated version with reference series modules:
£149.00 + £18.62 VAT

With Hyperfi Series modules
£185.00 + £23.12

ALL TUNER KITS £3 carriage

Features of the system:

* Precision construction & design of all parts
* Time/frequency display
* State of the art performance with facilities for updates, using modular plug in systems.
* Deviation level calibrator for recording
* All usual tuner features

Digital Dorchester All Band Broadcast Tuner: LW/MW/SW/SW/SW/FM stereo

A multiband superhet tuner, constructed using a single IC for RF/IF processing - but with all features you would expect of designs of far greater complexity. The FM section uses a three section (air gang) tuned FET tunerhead, with ceramic IF filters and interstation mute; AM employs a double balanced mixer input stage, with mechanical IF filters - plus a BFO and MOSFET product detector for CW/SSB reception. Styled in a matching unit to the Mark III FM only tuner, employing the same degree of care in mechanical design to enable easy construction. MW/LW reception via a ferrite rod antenna.

Electronics only (PCB and all components thereon)	£33.00 + £4.95 VAT
Complete with digital frequency readout/clock-timer hardware	£99.00 + £14.85 VAT
Complete with MA1023 clock/timer module with dial scale	£66.00 + £9.90 VAT

Hardware packages are available separately if you wish to house your own designs in a professional case structure. Please deduct the cost of electronics from complete prices.

LW/MW/FM LCD Digital Frequency Display - July PW feature

Update your old radio, or build this into a new design. Or use it as a servicing aid - this low power unit with LCD display reads direct frequency in kHz/MHz, or with usual AM/FM IF offsets for received frequency. Low power LCD means no RFI - 15-20mA at 9v even with the divide by 100 prescalar. FM resolution is 100kHz, AM 1kHz. Sensitivities better than 10mV
Complete kit £19.50 + £2.93 VAT, built and tested module £27.00 + £4.05VAT

Ambit stocks and distributes a wide range of frequency counter LSI for all types of DFM- part two of the catalogue contains details of the MSM5523/4/5/6 range, and the versatile MSL2318 divide by ten or hundred prescalar IC. The DFM1 combined counter for AM,FM SW and direct/clock/stopwatch/timers - details available, but SAE please !

PW SANDBANKS PI METAL LOCATOR

Maintaining our professional approach to home constructor kits, we offer the pulse induction 'Sandbanks'. Now with injection molded casing for greatly improved enviromental sealing. £37.00+£5.55vat

VHF MONITOR RX WITH PLESSEY IC

4/9 channel version of the PW design but using standard (fundx9) crystals, and TOYO 8 pole crystal filter with matching transformers. Coil sets from our standard range to cover bands from 40 to 200MHz. Complete module kit £31.25 +£3.90vat .

MICROMARKET

OSTS overflow:

6800P	650p	8212	230p	2102	170p
6820P	600p	8216	195p	2112	340p
6850P	275p	8224	350p	2513	754p
6810	400p	8228	478p	4027	578p
6852	365p	8251	625p	2114	1000p
8080	630p	8255	540p	+15% VAT	

RADIO and AUDIO MODULES : Consistently the most advanced

FOR FM

EF5801-3-4 series: 6 stage varicap tuning, all with oscillator output

5801	Dual gate MOSFET RF stages, bipolar mixer	£17.45 + 2.61VAT
5803	Dual gate RF/mixer stages, amplified LO out	£19.75 + 2.96VAT
5804	'Hyperfi' series, with internal PIN diode agc, and ultra wide range tuning system	£24.95 + 3.74VAT
EF5402	4 stage varicap tuner with TDA1062 and LO output. Uses FET/IC input. PIN agc	£10.75 + 1.61VAT

FOR 30-200MHz

The EF series are available on special order to cover bands (usually approx 20% of the centre frequency) in the range described. Details in our price list.

FOR FM IFs at 10.7MHz

7030	single 6 pole linear phase filter IF with HA1137£10.95 + 1.64VAT
7130	two 6 pole linear phase filter IF with CA3189E £16.25 + 2.44VAT
7230	Hyperfi IF, switched bandwidth, AGC IF preamp, linear phase ceramic filters with diode switched narrow filter £24.95+3.74VAT

DECODERS for MPX (STEREO)

Various types, guaranteed the world's biggest and best ranges

LARSHOLT FM TUNERSETS

7252	MOSFET front end combined with CA3089 IF £26.50 +3.97VAT
7252	JFET front end, combined with IF and decoder £26.50 +3.97VAT

FM/AM tuning synthesiser, see details elsewhere in th is advertisement

COMPONENTS FOR RADIO/COMMUNICATIONS/AUDIO/TV etc.

As usual, Ambit brings you the latest and best, a small selection of which is shown in this advertisement. The Ambit catalogues contain information on most of the devices mentioned here - and an order for the new part three will ensure you stay up with latest developments. Data photocopying service described in pricelist info.

RADIO ICs for FM	vat	
CA3089E	1.94	29
CA3189E	2.45	37
HA1137W	2.20	33
HA11225	2.20	33
SN76660N	0.75	11
RADIO ICs for AM/FM		
TDA1090	3.35	50
TDA1083	1.95	29
TDA1220	1.40	21
IF AMPLIFIERS		
K84406	0.50	07
MC1350	1.20	18
see comms ics also		
COMMUNICATIONS		
KB4412	2.55	38
KB4413	2.75	41
SO6000	3.75	56

SL1600 series		
SL1610	1.60	24
SL1611	1.60	24
SL1612	1.60	24
SL1613	1.89	28
SL1620	2.17	33
SL1621	2.17	33
SL1623	2.44	37
SL 624	3.28	49
SL1625	2.17	33
SL1626	2.44	37
SL1630	1.62	24
SL1640	1.89	28
SL1641	1.89	28
SL6640	2.75	41
SL6690	3.20	48
MC3357	3.12	47
MC1496	1.25	19
NE544	1.70	25

Audio preamps	vat	
LM381N	1.81	27
LM382N	1.65	25
KB4436	2.53	38
KB4438	2.22	33
TDA1028	3.50	53
TDA1029	3.50	53
TDA1074	3.75	56
Audio power		
T8A820M	0.75	11
T8A810AS	1.09	16
LM380N	1.00	15
ULN2283	1.00	15
TDA2002	1.95	29
HA1370	2.99	45
TDA2020	2.99	45

FETs, MOSFETs, bipolars. and various others: see PL

2SJ133/2SJ48 £10.00 + £1.50 pr. Various high voltage drivers etc. from correctly matched Hitachi series transistors. (All 120v types)

OSTS: Remember all OSTS stocks are obtained from BS9000 approved sources - your assurance that all devices are very best first quality commercial types. Some LPSN TTL is presently in great demand, so please check by phone before ordering .

TTL: Standard AND LP Schottky

All prices listed in pence *

	'N'	'LSN'		'N'	'LSN'		'N'	'LSN'		'LSN'
7400	13	20	7472	28		74142	265		74257	108
7401	13	20	7473	32	38	74143	312		74260	153
7402	14	20	7474	27	38	74144	312		74273	124
7403	14	20	7475	38	40	74145	65	87	74283	120
7404	14	24	7476	37	38	74147	175		74293	95
7405	18	26	7478		38	74148	109	191	74365	49
7406	38		7480	48		74150	99		74366	49
7409	17	24	7481	86		74151	64	84	74367	43
7410	15	24	7482	69		74153	64	54	74368	49
7411	20	24	7485	104	99	74154	96		74373	77
7412	17		7486		40	74155	54	110	74374	77
7413	30		7489	205		74156	80	110	74377	124
7414	51		7490	33	90	74157	67	55	74379	130
7415		24	7491	76	110	74158		60	74393	140
7416	30		7492	38	78	74159	210			
7417	30		7493	32	99	74160	82	130		
7420	16	24	7494	78		74161		78		
7421	29	24	7495a	65	99	74162		130		
7423	27		7496	58	120	74163	92	78		
7425	27		7497	185		74164	104	130		
7426		27	741XX series			74165	105			
7427	27	29	74107		32 38	74167	20			
7428	35	32	74109		63 38	74169		200		
7430	17	24	74110		54 54	74170	230	200		
7432	25	24	74111		68	74172	625			
7437	40	24	74112		38	74174	87	120		
7438	33	24	74113		38	74175	87	110		
7440	17	24	74114		38	74176	75			
7441	74		74116	198		74177	78			
7442	70	99	74118	83		74181	165	350		
7443	115		74120	115		74183		210		
7444	112		74121	25		74184	135			
7445	94		74122	46		74185	134			
7446	94		74123	46		74188	275			
7447	82	89	74124		137	74190		92		
7448	56	99	74125	38	44	74192	105	180		
7449		99	74126	57	44	74193	105	180		
7451	17	24	74128	74		74194	105			
7453	17		74132	73	78	74196	99	110		
7454	17	24	74136		40	74197		110		
7455	35	24	74138		60	74198	150			
7460	17		74139		60	74199	160			
7463		124	74141	56		74247		90		
7470	28					74253		105		

VOLTAGE REGS:

7800 series 1Amp pos	95p
7900 series 1Amp neg	100p
78M series ½Amp pos	90p
78LCP 100mA	35p
78MGT2C variable	175p
79MGT2C variable	175p
/23CN variable IC	65p
NE550	73p
L200 variable V and I	195p

MAINS EMI FILTERS

(BS etc approved types)

1 Amp in IEC chassis connector	4.83
6 Amp in IEC	5.83
5 Amp wirein	3.87

(Toroid cores in Cat no. 2)

MISC. Counter/timer, scalar devices.....

NE555 30p NE556 78p NE558 180p
LM3909 72p

95H90DC divide by 10/11 to 320MHz	780p
11C90DC divide by 10/11 to 650MHz	1400p
8629 divide by 100 to 175MHz min	420p
MSL2318 divide by 10/100 to 175MHz min	420p
ICM7216BIPI : 8 decade 10MHz DFM counter and full function timer, with direct drive for an LED display (mpx). Uses 10MHz xtal	1982p
ICM7217AIPI ; 4 decade programmable counter with direct LED drive	950p
ICM7207 clock pulse generator	495p
ICM7208 : 7 decade counter display	1495p
ICM7106CP : LCD DVM (3½ digit)	955p
ICM7106CPK : evaluation kit for 7106	24.80
ICM7107CP : LED DVM (3½ digit)	955p
ICM7107CPK : LED DVM kit for 7107	20.65
DKI MSM5523/4 : LED/Fluorescent display driver IC for time/timer/stopwatch/ AM/FM received frequency display and direct counter (use MSL2318 prescalar) Inc Crystal	1400p
MSM5525 : AM/FM frequency only couner, for fluorescent displays (6LT06) inc xtal	1100p
MSM5526 : as MSM5525 but for LCD	1100p
4 digit LCD for ICM7106 or MSM5526	1100p
10 LED (2½x5mm) bar graph driver PCB for LOG or LIN (specify). Kit ex leds	300p

IMPORTANT: ALL PRICES SHOWN EXCLUDE VAT - WHICH MUST BE ADDED AT 15% OVERALL. PLEASE NOTE THE REDUCED CMOS/LPSN TTL RANGES DUE TO CURRENT SUPPLY SHORTAGE

CD4000

4000	17		4522	149	
4001	17		4528	102	
4002	17		4529	141	
4006	109		4532	125	
4007	18		4538	150	
4008	80		4539	110	
4009	58		4543	174	
4010	58		4549	399	
4011	17		4554	153	
4012	17		4558	117	
4013	55		4560	218	
4014	95		4562	530	
4016	52		4566	159	
4017	80		4568	281	
4018	80		4569	303	
4019	60		4572	25	
4020	93		4584	63	
4021	82		4585	100	
4022	90				
4023	17				
4024	76				
4025	17				
4026	180				
4027	55				
4028	72				
4029	100				
4030	58				
4035	120				
4040	83				
4042	85				
4043	85				
4044	80				
4046	130				
4048	60				
4049	55				
4050	55				
4051	65				
4052	65				
4053	65				
4055	135				
4059	563				
4060	115				
4063	109				
4066	53				
4068	25				
4069	20				
4070	20				
4071	20				
4072	20				
4073	20				
4075	20				
4076	90				

LINEARS

CA3130E	84
CA3130T	90
CA3140E	
CA3140T	72
LM301AH	67
LM301AN	30
LM339N	66
LM348N	186
LM3900N	60
709HC	64
709PC	36
710HC	65
710PC	59
723CN	65
741CH	66
741CN	27
747CN	70
748CN	36
NE531N	105

7 SEG DISPLAYS

HP5082 series.....

Red	7650	233p
	7653	233p
Yell	7660	233p
	7663	233p
Grn	7670	233p
	7673	233p
Fairchild	FND 500/507	150p

MORE FROM THE GENERAL AMBIT CATALOGUE RANGES:

Varicap tuning diodes for AM/FM/TV :
1·9 v AM tuning (Cr 15:1) from TOKO–

KV1211	double matched	175p	26p vat
KV1210	triple matched	245p	37p vat
KV1215	triple snap-apart	245p	37p vat
MVAM115	single 15v	105p	16p vat
MVAM125	single 25v	105p	16p vat
MVAM2	double 25v	148p	22p vat
BB204/104	double FM	40p	6p vat
8A102	single AFC etc	30p	4p vat
BA121/ITT210	single apart	30p	4p vat
BB105B	single UHF	40p	6p vat

PIN DIODES, 8 ANDSWITCH types

8A479	PIN attenuator	35p	5p vat
TDA1061	Pi-form atten.	95p	14p vat
BA182	Bandswitch	21p	3p vat

All RF semiconductors stocked in depth. Please ask for quantity pricing details.

MPU controllable digital freq. synthesiser PCB. Preliminary.

Serial data controlled, with the standard swallow count system for maximum speed of operation. Multiple time constant filters, suitable for AM/FM and other communications/generator applications. Not for beginners. Full preliminary data package £1 + SAE. No phone enquiries answered on this system for the time being. Watch this space.....
Projected cost of the controller PCB less than £30: comprises the two modulus counter, prog.div., phase detector, multiple TC loop filter/integrators.

TOP GRADE LEDs by AEG: PRICES ARE EXC. VAT (add 15%)

SIZE	Red	Green	Yello	Orang	Quantity discounts for LEDs:
5mm	14p	16p	15p	20p	10 per type - less 10%
3mm	13p	15p	18p	19p	100 per type - less 30%
2½x5	17p	20p	20p	24p	100 mix in 10s - less 25%

FUTA8A FLUORESCENT VACUUM DISPLAYS for CLOCKs etc

5LT02	clock display (static drive) with AM/PM flags	£9 + 1.35
5LT03	DFM display for MSM5525 LSI counter	£9.45 + 1.42 vat
6LT06	5 digit DFM display (GI AY58100) mpxed	£9.75 +1.46 vat

TOKO COILS, FILTERs, CHOKES, etc for AM/FM/TV comms –

TYPE	Size: 5mm	7mm	10mm	(please add VAT @15%)
AM IF	55p	33p	30p	Various for ICs, transistor etc.
FM IF	55p	33p	33p	Various for ICs, transistor etc.
SW coils			33p	Two impedance series
OSC coils	55p	33p	33p	For LW/MW/SW
TV vif/sif			35p	

Various coils in the range 20k Hz to 300MHz - see TOKO catalogue

CERAMIC and MECHANICAL FILTERS (inc MURATA TYPES)

CFT4558/ CFT455C 60p; CFX014 -180p; CFU455C - 85p
CFT470C · 60p; CFU470C ·65p
MURATA CFU455H and CFU455F cermic block filters 1.95ea
MURATA CFM455 series ladder filters. D,E,F,G,H bandwidths available now (20,16,12,8,6 kHz) £8.35 ea (metal encapsulated)
SFD4558, SFD4708, SFD4728 85p ea
CFM2 series mechanical elements types A,8,C,D (4·10kHz bandwidth) - 65p ea. (As used in RCME feature)

MULTIPLEX/PILOT TONE FILTERS, FM IF FILTERS (see cat and :)

CFSE10.7/SFE10.7 - stereo FM IF ceramic filters (sim FM4 etc) 50p
CFS810.7/SFE10.7MJ - mono bandwidth ceramic FM IF filters 50p
SFE10.7ML - ultra linear phase stereo ceramic IF filters 70p
CDA10.7 - 10.7MHz ceramic discriminator (for CA3089 etc) 70p

Current news: A PCB for the Mullard DC tone and volume control system is now available £3 + 0.45 VAT. HMOS PA modules for 60-100W - kit £14 +£2.10VAT, heatsink £4.10+0.61. FM radio control system crystals £3.75 pair inc VAT (Sept on) . MK50366N: static drive clock/timer IC £3.78 + 0.57 VAT. 12½kHz channel spacing 8 pole 10.7MHz XTAL filter by TOYO type H4402 £15.50 + £2.32VAT. A further updated pricelist is now available, and we would like to remind you that enquiries can only be answered if accompanied either by an official business letterhead, or an SAE. STOP PRESS: TOKO's new split-apart triple AM tuning diodes are in stock £2.45 + 37p VAT, (KV1215). S BL1 diode DBM 1·500MHz - £4.25+0.64p.

Terms: CWO please. Account facilities for commercial customers OA. Postage 25p per order. Minimum credit invoice for account customers £10.00. Please follow instructions on VAT, which is usually shown as a separate amount. Overseas customers welcome - please allow for postage etc according to desired shipping method. Access facilities for credit purchases.

Catalogues: Ambit. Part 1 45p. Part 2 50p 90p pair. TOKO Euro shortform 20p. Micrometals toroid cores 40p. All inc PP etc. Full data service described in pricelist supplements.

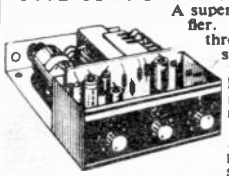
Hours/phone: We are open from 9am -7pm for phone calls. Callers from 10am to 7pm. Administrative enquiries 9am to 4.30pm please (not Saturdays). Saturday service 10am to 6pm.

ambit international ®

AMBIT catalogues are guaranteed to contain the most up-to-date and best informed comment on modern developments and advances in the field of radio and audio. There is no competetive publication that even approaches the broad range of parts/information on modern techniques.

2 Gresham Road, Brentwood, Essex. TELEPHONE 0277 216029

SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz 30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume. Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7¼" deep. AC 200/250V. PRICE £18·40, P. & P. £1·20

HARVERSONIC MODEL P.A. TWO ZERO

An advanced solid state general purpose mono amplifier suitable for Public Addresssystem, Disco Guitar, Gram, etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp). Input 1, 15mV into 47k. Input 2, 15mV into 47k (suitable for use with mic. or guitar etc.). Input 3, 200mV into 1 meg. suitable for gram, tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 30 watts music power. Very attractively finished purpose built cabinet made from black vinyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200/240 volts. Size approx. 12¼in wide × 5in high × 7¼in deep.
Special introductory price £29·00+ £2·50 carriage and packing.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER

Size 11¾" × 14¼" × 1⅞" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details.
Only £8·80 each + p. & p. (one 90p, two £1·10).
Now available in 8" round version. 10 watts RMS 60Hz 20KHz £6·30. P. & P. (one 65p, two 75p).

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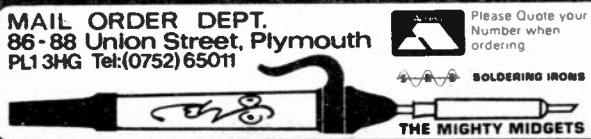

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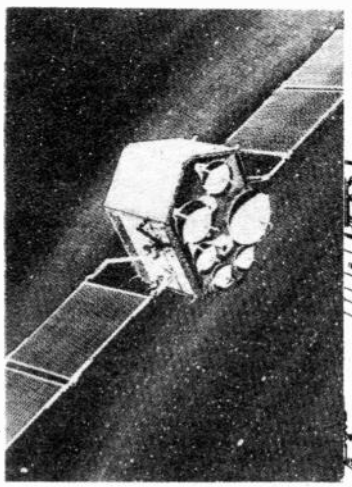

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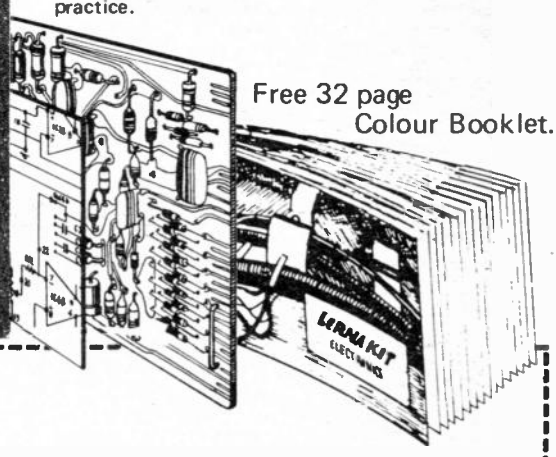

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1504	ARL4850 (FLV117)	·5mm (·2)	RED	£0·12
1505	MIL 5251 (TIL222)	·5mm (·2)	GREEN	£0·22
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1520	OCP71 Photo transistor			£0·40

LED CLIPS
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RED Two-Digit Reflector	o/no 1524	£2·08
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Type	No.	Type	No.	Type	No.
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250mA	612 6p	1·5A	616 7p	4A	620 10p
550mA	613 6p	2A	617 6p	5A	621 6p
800mA	614 8p	2·5A	618 7p		

ANTI-SURGE 20mm

Type	No.	Type	No.	Type	No.
100mA	622	1A	625	2·5A	628
250mA	623	2A	626	3·15A	629
500mA	624	1·6A	627	5A	630

All 8p each

QUICK-BLOW 1¼in.

Type	No.	Type	No.	Type	No.
250mA	631	500mA	632	800mA	634

All 8p each

Type	No.	Type	No.	Type	No.
1A	635	2·5A	638	4A	641
2A	637	3A	639	5A	642

All 6p each

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¾in 2BA	843	£0·52	¾in 6BA	849	£0·24
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3140	1·0MFD 35V	£0·13	3144	22MFD 16V	£0·25
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130	2 pin DIN plug to 2 pin DIN inline socket Length 5m	£0·78
131	5 pin DIN plug to 3 pin DIN plug 1 & 4 and 3 & 5 Length 1·5m	£0·95
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£1·13
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161	4in	2¾in	1¼in	£0·85
162	5½in	4in	1¼in	£0·97
163	4in	2¾in	2in	£0·87
164	3in	2in	1in	£0·60
165	7in	5in	2½in	£1·43
166	8in	6in	3in	£1·82
167	6in	4in	2in	£0·18

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Projects... Theory... and Popular Features...

These last few weeks before Christmas are hectic ones for the typical household and this has been borne in mind in planning this month's issue.

One of the many extra chores that have to be organised is the setting up of decorative lights, but this is not always a simple and trouble-free operation.

Anyone who has had experience in handling strings of miniature electric light bulbs knows only too well the trouble that can be caused by just a single defective bulb. This is always a possibility, especially in the case of lights that have been in one's possession for a number of years and are brought out of storage annually to provide another brief but scintillating performance.

Anything that helps the harassed householder to pin-point the fault quickly will be welcome at this time. Such helpful practical guidance is offered this month in our special feature *Xmas Lights Without Tears*. The same article also gives ideas for improving the overall reliability of decorative lights.

Dealing with a closely related theme is *Xmas Bright Ideas* which provides a few novel circuit ideas for electronically controlling decorative lights. These can be put to imaginative use by our readers to enhance the overall effects of such illuminations.

Coming now to fully detailed projects, time is short we realise but constructors should be able to complete at least one of our three simple novelties before Christmas.

That perennial problem of seeking out unusual and interesting small gifts for children could be solved with our *Everlasting Candle* or the *Peg-A-Hole* game; while the *Twinkling Star* will add further lustre to any Christmas Tree, or fit into other decorative arrangements.

All three are easy to build, need but a few circuit components and make use of commonplace materials and items found around the home.

From among the other projects this month we make special mention of the *Lightcall*, principally because this simple device could be of great service to the hard-of-hearing. Its construction and installation would be a worth-while task (during the Christmas vacation?) for any enthusiast who knows of a neighbour or relative who would appreciate a visual back-up for the doorbell or chimes.

Our January issue will be published on Friday, December 14. See page 817 for details.

Readers' Enquiries

We cannot undertake to answer readers' letters requesting modifications, designs or information on commercial equipment or subjects not published by us. All letters requiring a personal reply should be accompanied by a stamped self-addressed envelope.

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Component Supplies

Readers should note that we do not supply electronic components for building the projects featured in EVERYDAY ELECTRONICS, but these requirements can be met by our advertisers.

Everyday
ELECTRONICS

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Back Issues
Certain back issues* of EVERYDAY ELECTRONICS are available worldwide price 70p inclusive of postage and packing per copy. Enquiries with remittance should be sent to Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. In the event of non-availability remittances will be returned.
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A special feature showing you how to rapidly trace a faulty bulb in a string of lamps and simple ways of extending bulb life.

XMAS LIGHTS WITHOUT TEARS

By T. R. de Vaux-Balbirnie

IN the author's house, Christmas starts by standing on a chair and reaching into the loft to recover a rather old cardboard carton. Labelled "Christmas Box" in felt tip pen, it contains all the usual decorations including a 40 lamp set of lights for the Christmas tree.

When the lights are plugged in they never work first time even though they were in good condition the previous year. Perhaps the fairies "pop" a bulb or two on their annual visit to the Christmas Box in the summer. More likely, a lamp on its last legs fails under the vibration of packing the lights away.

It seems that there are two problems associated with these lights and the author has attempted to solve, or at least to alleviate, both. The first problem is the inherent short life of the bulbs and the second is finding which bulb has "blown" in the event of failure.

BULBS ARE SERIES CONNECTED

Christmas tree light sets have all the bulbs connected in series, i.e. in a chain, see Fig. 1. This has the disadvantage that failure of one bulb causes them all to go out.

Due to the large number of lamps in the set and the short life of the bulbs this is a grave problem. It is true that certain types of bulbs are designed to short circuit themselves internally when the filament blows so preserving continuity in the circuit. It is then an easy matter to spot which lamp has failed as it is the only one not glowing. Unfortunately, from experience, they are not very reliable and the self-shorting mechanism does not always work.

Another problem is that the "shorted" lamp causes all the other lamps in the chain to be overloaded so that other bulbs near the end of their lives will fail more quickly. A chain reaction could occur resulting in failure of all the bulbs unless a special "fuse bulb" is included in the circuit. This will blow if the current rises excessively.

Lamps connected in series are never a good idea but it would be difficult and expensive to make mains voltage bulbs of the small size required. As it is, the bulbs share the mains voltage equally so that in a 40 lamp set, for instance, the voltage rating for each lamp will be 6 volts (240/40). In a set of 20 lamps it will be 12 volts and so on. Such bulbs may be manufactured relatively cheaply (although a packet of 6 cost 39p in 1978 and gave little service.)

EXTENDING BULB LIFE

In an effort to extend the life of the bulbs, several ways of dimming them slightly have been explored. Such dim-

Fig. 1. Lamps in Christmas Lights are connected as shown above—in series.

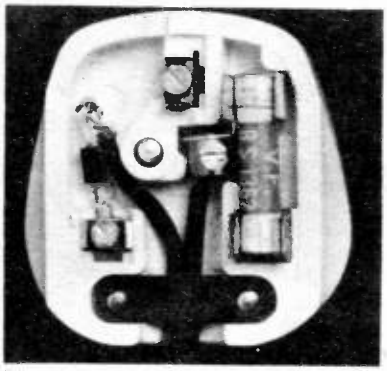


Fig. 2. Simple and convenient means of connecting a diode in series with the Christmas Lights. See text for details.

ming of filament lamps has a dramatic effect in increasing the life. It is thought that these lights are too bright anyway—the pinpricks of brilliant light can be very distracting. There seems to be a definite case for introducing a slight dimming.

A cheap and extremely simple way of achieving this is to connect a suitable diode in series with the chain of lights. This rectifies the mains supply so that current only flows on one of the half cycles. A small diode may be chosen which will fit inside the mains plug as shown in Fig. 2.

The diode may be connected (either way round) in the neutral lead using a hooked connection for the lead out of the plug. This connection must be soldered. The cable clamp on the plug must be tight so that a trial tug on the wire cannot dislodge the wire from the diode. As virtually no heat is generated in the diode it will be quite safe in position.

DIODE RATING

The diode must be capable of withstanding the current required for the lights and also must have a voltage rating at least equal to the peak voltage of the mains supply. For a 240 volt mains it will be necessary to choose a diode with at least 340 volts working. The type 1N4004 is ideal.

Experiments yielded no noticeable flickering as might be expected from such an arrangement (the current is turned off for half the wave cycle and the filaments in the bulbs have a chance to cool down a little before the next current pulse arrives).

As a general rule, the resistance of a metallic conductor rises with increased temperature. When a lamp is under-run it will operate at a lower temperature than normal so its resistance will be lower. This means that a higher average current will flow in the lamp than theory predicts. This ultimately means that the dimming effect is not as great as might be imagined but it is still significant.

Obviously a transformer could be used to reduce the voltage applied to the lights. This idea was ruled out on the grounds of cost and size.

BULB ACTS AS RESISTOR

Another way to achieve dimming is to connect a suitable resistor in series with the lights. The disadvantage of a resistor is that it dissipates heat and could be dangerous for this reason. The advantage over the diode idea is that the effect may be controlled by suitable selection of the value of the resistor. This idea was almost ruled out on safety grounds until experiments with *mains lamps* as *resistors* were investigated. Here the heat is far less likely to be a problem and there is no difficulty with the housing or connections.

In operation the mains lamp will probably glow a little. The light may be used to illuminate a Christmas scene or just hidden out of the way. A standard bayonet lampholder is used in series with the chain. In the author's case, the correct effect was obtained with a 60 watt lamp but there is room for experiment here. As mains voltage exists along the chain it is essential to make proper connections to the lampholder.

Beware of calculations based on the resistance of the lamp—once more, the temperature effect of resistance makes such figures misleading. For instance, the calculated value of the resistance of a 60 watt lamp is about 1 kilohm. However, a multimeter indicates a resistance of only 80 ohms! Under working conditions, the resistance of the lamp will be somewhere between these extremes.

USING A CAPACITOR

An excellent, if unconventional, way to dim the lights was found. This was to connect a *capacitor* in series with the chain. A capacitor allows an a.c. current to flow but not d.c. In a way, a capacitor behaves as a resistor as far as a.c. is concerned but there is one important difference. A capacitor produces no heat and wastes no energy.

A good effect was obtained with a 1μF capacitor but a brighter operation was obtained with 2·2μF (or two 1μF capacitors wired in parallel) When buying a capacitor it must be a good quality component with a working voltage of at least 340 volts. **On no account must it be an electrolytic capacitor. These are polarised and must not be used in a.c. work of this kind.**

Another idea is to connect a few more bulbs of the same type in series with the chain. An old, discarded set of lights would be ideal for the purpose. Care must be taken over the quality of the joints. Trial and error will soon reveal the best number of additional lamps.

It would be possible to replace all the 6 volt bulbs in a 40 lamp set with the 12 volt variety designed for 20 lamp sets. It is likely that the final effect would be too dim, however. Unless lamps have the same current rating, **it is important not to mix lamps of different voltages.**

TRACING FAULTY BULB

So much for extending the lives of bulbs. Now for the other problem—that of finding which bulb has blown when failure occurs. The most obvious way is to replace the lamps one by one with a lamp known to be good. Alternatively, each lamp may be tested with a battery. This is a tedious job especially when the blown bulb is

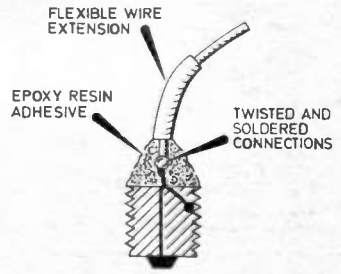


Fig. 3. Construction details for making a test lamp.

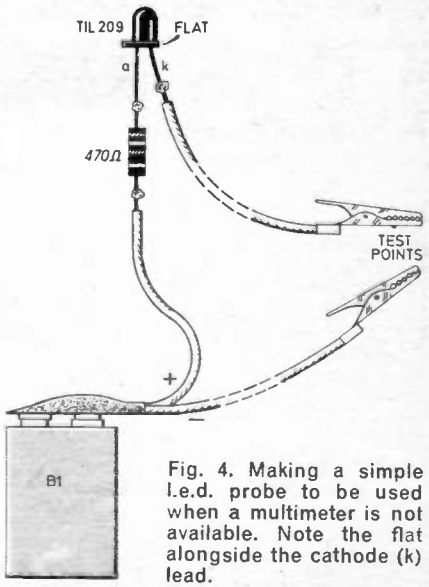


Fig. 4. Making a simple l.e.d. probe to be used when a multimeter is not available. Note the flat alongside the cathode (k) lead.

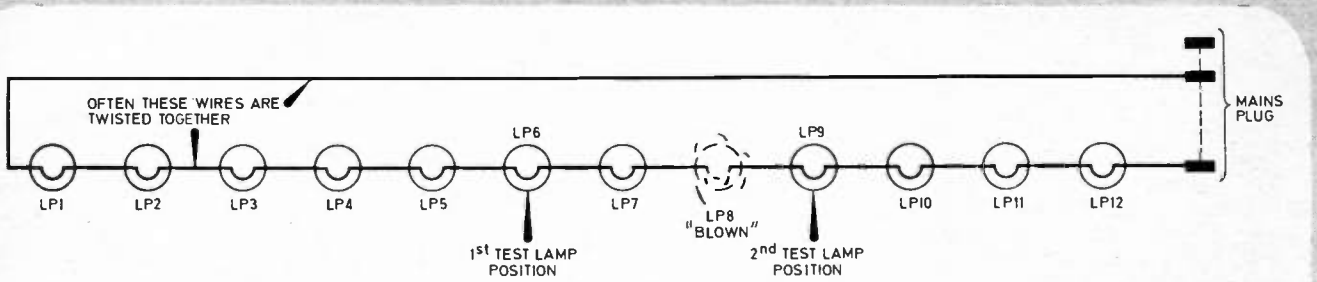


Fig. 5. Procedure for tracing a faulty bulb in a string of twelve series connected bulbs.

the last one in the chain to be tested! Another problem is that when the bulbs are on the tree it is easy to miss one. Although the following method sounds complicated at first it greatly reduces the time required to locate the faulty lamp.

TEST LAMPS

Three "test lamps" are made in the following way. Old "blown" (non-functioning) bulbs have the glass broken and carefully removed. The wires leading to the filament are then gently twisted together and a short length of wire soldered to them as seen in Fig. 3. The whole joint is protected with a little quick setting epoxy resin adhesive.

As well as these test lamps, a multimeter will be required. If none is available, a suitable alternative is an l.e.d. connected in series with a 470 ohm resistor and a 9 volt battery (as shown in Fig. 4). When using l.e.d.s it should be remembered that they will only work one way round with the battery. **For all the following the plug is disconnected from the mains.**

EXAMPLE

For simplicity of description, imagine a set of only 12 lamps with number 8 blown, Fig. 5. A lamp near the centre of the chain (say LP6) is replaced with a test lamp. Checks are then made with the multimeter set to *ohms* or with the l.e.d. between the wire end on the test lamp and the Live and Neutral pins on the mains plug in turn.

In this example, a low ohms reading (or l.e.d. on) will be indicated between the test lamp and the Neutral but a high ohms value (or l.e.d. off) between this and the Live pin. This shows that the fault lies in the latter half of the chain. In this way the fault has been narrowed to one half of the chain. Naturally, if a low reading is indicated in both of these tests, then the faulty lamp is the one which has been replaced with the test lamp i.e. LP6. A high reading in both tests will indicate a faulty bulb in each half.

Having established which is the faulty half, another test lamp is connected about half way along that section (say LP9). Checks are then made as above between the test lamp just inserted and that already in LP6 and the live pin of the plug in turn. In the example, a high reading will be indicated between LP6 and LP9. This locates the faulty quarter of the chain.

FURTHER CHECKS

A similar check will narrow the location of the bulb still further but when it has been found to within two or three bulbs it is simpler to check by substitution than to pursue the above method any further.

With a 40 lamp set, one operation will find which "20" the fault lies in. The next operation will find which "10" and the third operation will locate which "5". Another test may be used to find which "2" or "3", then substitution used.

One day someone may invent very reliable l.e.d. Christmas tree light sets —there are some very good colours these days. Until that time the foregoing may help to avoid unnecessary aggro during the festive season.

XMAS BRIGHT IDEAS

By E. M. Lyndsell

SANTA'S EYES

AMONG the many decorations used at Christmas time is a cardboard face of Santa Claus. By use of the circuit in Fig. 1 Santa's eyes can be made to wink (or flash) at you.

The circuit uses a 555 timer i.c. wired as an astable multivibrator. The flashing rate is set by the values of R1, R2, VR1 and C1. The output at pin 3 alternately switches at this rate between 0V and +9V. Thus for pin 3 at 0V, D1 is lit with D2 off; for pin 3 at +9V, D2 is lit and D1 off.

If the l.e.d.s are fitted in the eye positions on the "Santa card", he will appear to be winking at you. A red knob on VR1 placed at Santa's nose will add to the effect and allow the flashing rate to be altered to suit. Lots of fun for the children.

Alternatively, a single l.e.d. could be used on a cardboard replica of "Rudolph" at his nose position.

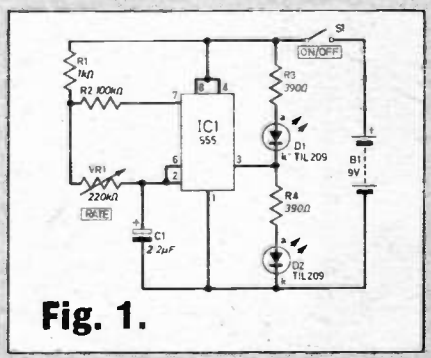


Fig. 1.

FLASHING TREE LIGHTS

The Christmas tree lights can be caused to repeatedly flash on and off by the application of the circuit in Fig. 2. Once again, a single 555 timer i.c. is used in the astable mode with its output feeding a relay coil.

The relay contacts are wired to act as a switch in series with the string of lamps. The contacts need to be of the normally closed (n.c.) variety to allow the lamps to be on (no flashing) when the unit is switched off. *The contact rating must be 240V a.c. at a current to suit the total bulb load.*

Resistor R1 is made small in relation to R2 to obtain an almost 1:1 mark/space ratio; R2 and C1 control the operation rate which has been arranged to flash at 0·5Hz.

When the output at pin 3 is low (0V), the relay coil is not activated and the contacts are closed and the lamps are lit. When pin 3 goes high (+9V) the coil is energised and the contacts open and the lights are switched off. Thus under running conditions, the lamps are alternately switched on and off at 0·5Hz producing a low-rate flashing effect.

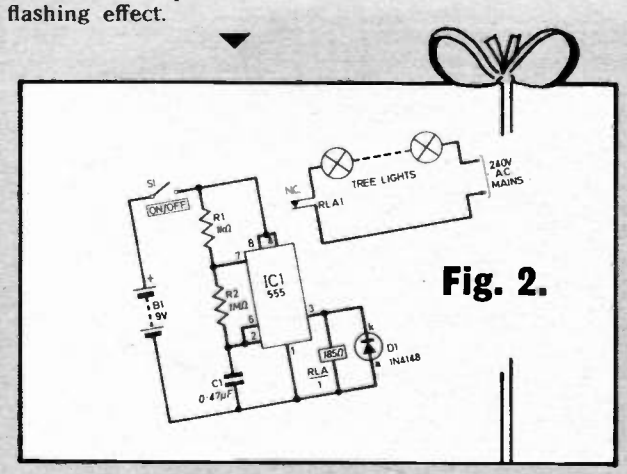


Fig. 2.

XMAS SOUND-TO-LIGHT

For the teenage fraternity the circuit of Fig. 4 is included. This converts the sound picked up by a microphone into a flashing light pattern—the lights being a string on a Xmas tree.

Almost any microphone can be used and is placed close to a source of music such as that from a loudspeaker of a record player for example. The signals are first amplified (or attenuated) by a variable gain amplifier, IC1 and then isolated and boosted by the action of T1. The resultant signal on the secondary of the "step-up" transformer is connected to the gate terminal of a mains thyristor loaded with the string of lights.

The lamps flash in time with the amplitude peaks of the music heard in the loudspeaker. The threshold of triggering is variable by means of VR1. The i.c. amplifier is battery powered—two PP3 batteries are suitable.

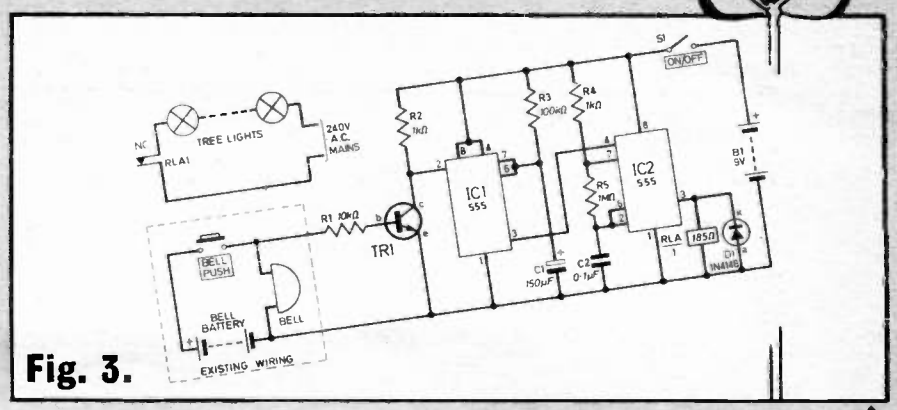


Fig. 3.

BELL-LIGHTS

With the party in full swing it is sometimes difficult to hear the doorbell when it rings. The circuit of Fig. 3 will announce the arrival of a caller by flashing the lights on the Christmas tree (or elsewhere) for a period of about 15 seconds when the bell-push is operated. After this time the lights return to their constant illumination condition.

Here two 555 timers are employed, one wired as an astable with the other as a monostable.

The reset terminal, pin 4 of IC2 (astable configuration) is linked to the output of IC1 which is at 0V in the untriggered condition. This inhibits the operation of IC2.

Integrated circuit IC1 is switched on for a time governed by the values of R3 and C1 when a low voltage (less than 3V) is received on pin 2, the trigger input. This happens when the bell push is operated via TR1 functioning as an inverter. IC1, pin 3, goes high allowing IC2 to oscillate and cause the relay contacts to open and close as described for Fig. 2. *Contacts must be capable of handling mains voltages.*

The astable here runs at a faster rate than the previous astable to produce a more startling effect.

The lights will flash for each successive operation of the bell-push after the expiration of the monostable "on" time for each push. □

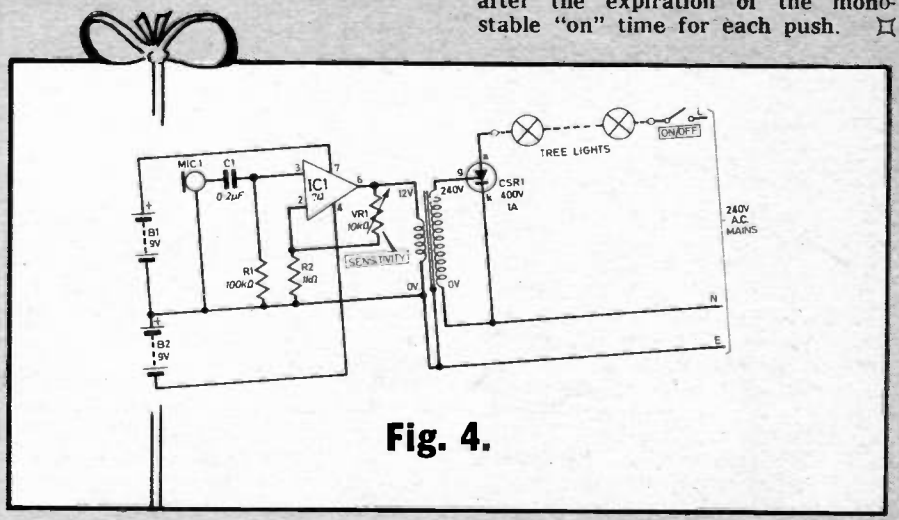


Fig. 4.

PEG-A-HOLE GAME

By F. G. Rayer

THIS game is suitable for one or more players, and can be of any grade of difficulty, from the very easy to almost impossible. In play, shaped metal plates with holes drilled at their centres are placed one by one on a metal peg using a "stick" fitted with a crocodile clip. As the size of the hole becomes smaller and smaller, so does the successful placing of the piece on the peg become more and more difficult. An additional "hazard" is the releasing of the plate from the crocodile clip. This device can therefore be used to measure co-ordination and a steady hand.

RULES OF PLAY

A single player can find how small a hole he can successfully peg, or can place the metal pieces while timing himself. Two players can take it in turns to place the pieces, until one (the loser) fails, or they can compete individually while timing the successful placing of a certain number of plates.

The game can be made more interesting for two players (or teams) by using say 10 pieces and numbering them 1 to 10, these being the points scored for successfully placing the piece on the peg. The point value is to be inversely proportional to the hole size i.e. the smallest hole—10 pts, the largest hole—1 pt.

The players take turns and are allowed to choose any piece to try and peg. If successful they score its point value. If they fail, that players score so far is reduced by the point value of that piece but that piece remains on the peg. The winner is the player with the highest score after all ten pieces have been played.

CIRCUIT OPERATION

The complete circuit diagram of the Peg-a-Hole game is seen in Fig. 1.

The circuit uses a thyristor, CSR1. This device exhibits an open circuit between anode and cathode until a positive voltage is received at its gate terminal. The lamp LP1 is normally off. The "peg" is wired to the gate terminal.

The crocodile clip which is used for gripping the actual playing pieces is connected via R1 to the positive supply rail. Thus when a gripped metal plate touches the peg, with S1 closed, a positive voltage appears on the gate terminal and causes CSR1 to turn on, (anode effectively shorted to cathode) resulting in LP1 being lit. The lamp remains on even if the contact to the peg is broken, and can only be turned off by means of S1.

A 6·3V 150mA bulb is fitted, but a 3·5V 300mA bulb could be used instead. A three-cell 4·5 volt battery is adequate, but 6V could be used, with a bulb to suit.

ASSEMBLY ON BASE

The game is constructed on a board about 200×150mm and 12 to 18mm or so thick as seen in Fig. 2.

The metal peg used in the prototype was a 76mm long nail, driven through from the bottom. Recess the wood for the head, or drive it flat with the surface. Solder on a wire and bring it up through a hole near to where the tagstrip is to be positioned. This is the gate (g) connection to the thyristor.

Screw the batten mounting lampholder and the tagstrip to the board and solder the components to the strip and wire the latter to the holder. A strip of aluminium, about 115mm long and 20mm wide should be shaped to secure the battery to the board, and fitted by means of two screws.

Switch S1 consists of a strip of metal, bearing on a round-headed screw. It is simply lifted with one's finger to break circuit. And may be rotated to one side to leave the game permanently off. A conventional switch, or push-for-off switch could be used instead.

Convenient and economical battery connectors for the 1289 battery can be made from paper clips soldered to lengths of p.v.c. covered wire.

A sheet of cardboard glued to the underside will protect the wiring and the playing area. Four rubber feet fitted to the underside will afford the same protection and enhance the appearance.

PLAYING PIECES

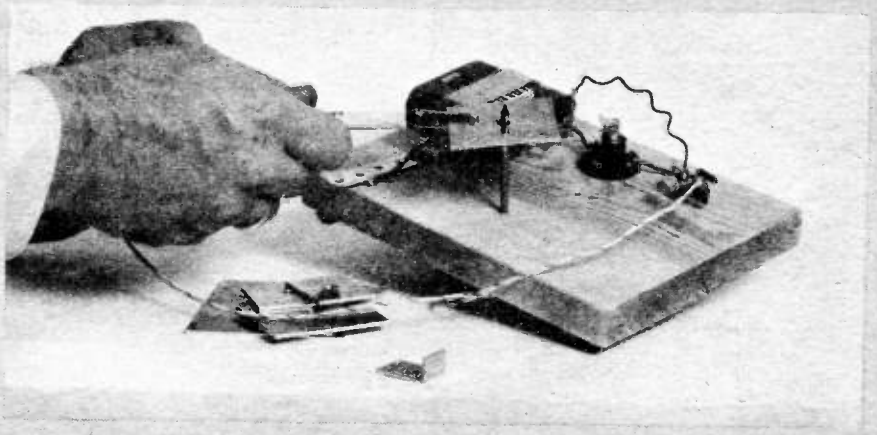
The "gripper" for the playing pieces is made by feeding about 50cm of flexible p.v.c. covered wire, fitted with a crocodile clip at one end, through an old Biro pen case. The clip should be a tight push fit into the end, otherwise it will need to be glued. The free end is then soldered to the tag strip.

The metal playing pieces used by the author were rectangular in shape and cut from stout scrap aluminium sheet (16 s.w.g.). Any shape could be used e.g. triangular, circular, hexagonal, etc., or a combination of different shapes for the sake of appearance, with a range of different sized holes drilled at each plate centre.

PLAY

Several different ideas for playing have been discussed earlier, and no doubt constructors will devise their own rules for the game.

Beside its obvious amusement value, this unit has a more serious application in testing a persons co-ordination and could be used in this connection with children, the hole sizes probably being enlarged. ☐



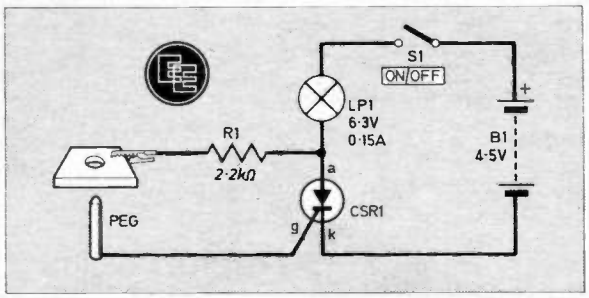
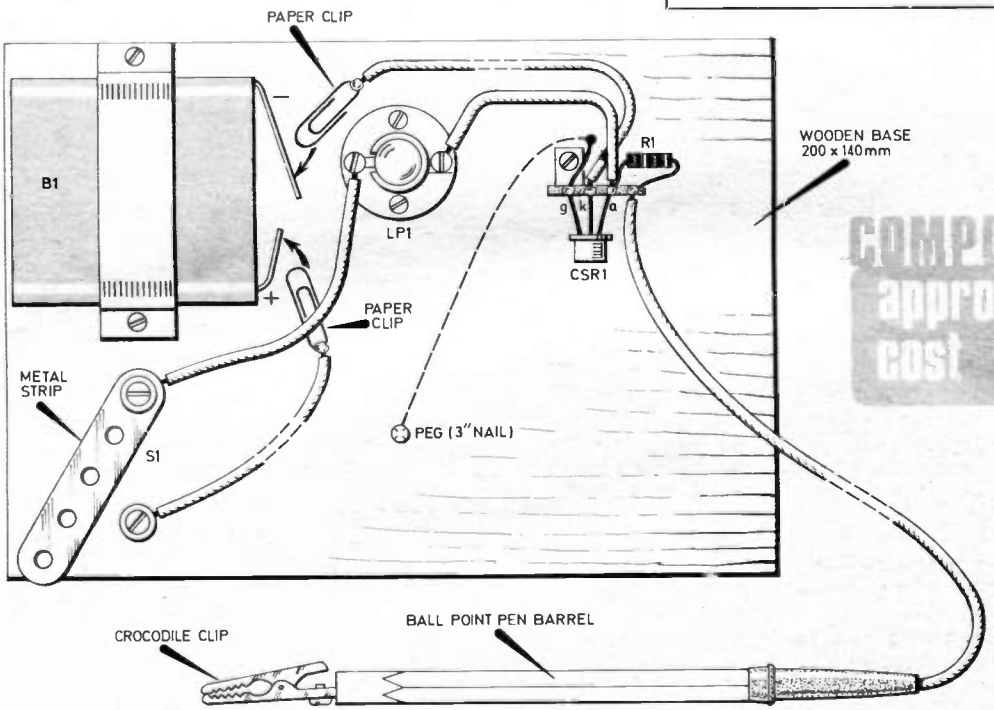


Fig. 1. Circuit diagram of the Peg-a-Hole game.

COMPONENTS

R1	2·2kΩ ¼W carbon ±5%
CSR1	CSR1/05 or other type to accommodate LP1 current
LP1	6·3V 150mA m.e.s. bulb
B1	4·5V type 1289
S1	single-pole on/off (home-made type used in prototype)

Batten mounting m.e.s. bulb holder; standard crocodile clip; 4-way tag strip with support; aluminium plate; woodscrews (7 off); pen case; flexible wire; wood for base; rubber feet; 76mm long wire nail; paper clips (2 off)



COMPONENTS approximate cost £1.50

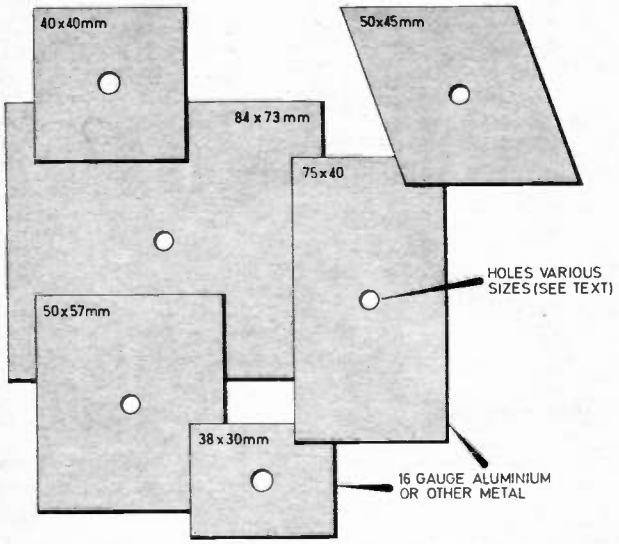
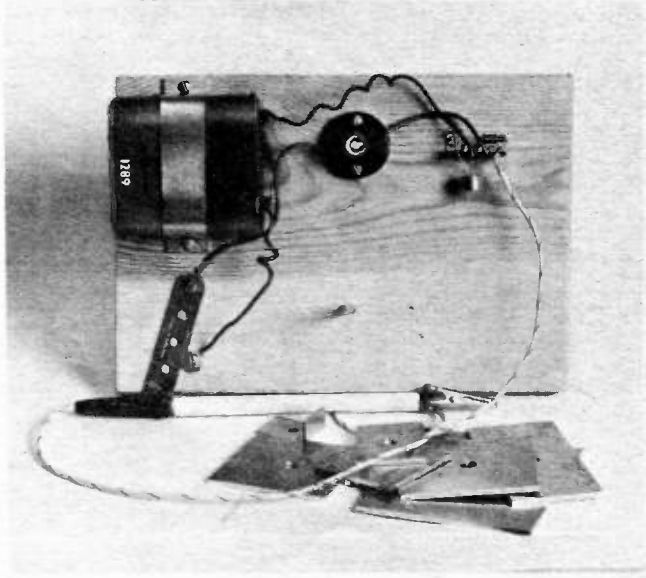


Fig. 2. Completed game showing interwiring and suggested dimensions for the metal pieces.



The complete game showing stick and metal pieces.

EVERLASTING CANDLE

By A. Sproxton

THE purpose of this useful gadget is to provide a convenient portable form of light for the odd nocturnal visit to the bathroom. It also has the added advantages that it will never fail because of a used-up battery, and it is easy to find in the dark because of the tiny glow from the incorporated light emitting diode.

CIRCUIT DESCRIPTION

The circuit diagram is shown in Fig. 1. It consists of a 1·25V m.e.s. bulb and rechargeable battery wired in parallel with the transformer secondary and an l.e.d.

With the candle in position on the charger board, S2 opens turning off the lamp, and S1 closes completing the circuit from the secondary of the transformer. The light emitting diode D1 acts as a rectifier and the battery is supplied with a charging current.

When the candle is removed, S2 closes turning on the light, and S1 opens switching off the battery charging circuit. The resistor R1 is used to reduce the charging voltage to a suitable value. Besides acting as a rectifier, D1 also serves to show when charging is taking place.

CHARGER BOARD

It is best to start construction with the board for the charger. This consists of a piece of plywood 150mm x 100mm x 15mm. To determine the positions of S1 and magnet B, take the ceiling rose and remove the terminal block. This can easily be done using a hot soldering iron and some ingenuity.

Place the rose on the board about 10mm from one end, draw round it and mark the position of the terminal block and lower knock out panel. Recesses can now be cut in the board so that reed switch S1 and magnet B can be mounted flush with the surface as shown in Fig. 2a. Note that magnet B is offset. This is because the contacts in S2 are at one end of the glass envelope and not in the centre.

Two holes should now be drilled through the board to take the leads from S1, which can now be mounted and secured in position by bending its wires carefully with pliers. Glue magnet B in place.

CANDLE

Construction of the candle itself can start next. The switch S2 consists of part of a single-pole changeover reed switch. The unwanted "normally open" contact wire should be cut off carefully about 5mm from the glass. This switch can now be glued with Araldite onto the base of the ceiling rose in the recess where the terminal block used to be, see Fig. 3, making sure that the contacts of the switch are on the right hand side. Magnet A can then be glued down over the lower knock-out panel.

ROSE GUIDES AND CONTACTS

At this stage the ceiling rose base should be placed on the charger board to make sure that S1 and S2 are aligned properly and are working. The top of the charger board can then be covered with Formica or similar laminate.

The rose guides can be mounted next. These are positioned by placing the ceiling rose base in the correct operating position on the charger board, drawing round it and spacing out the rose guides about 5mm outside this circle.

Next the charger contacts are fixed in position. These are made of large brass drawing pins with 24 s.w.g. tinned copper wire attached to them and are located in the following way. Place the rose base on the charger board and mark the position of the mounting screw holes. A small hole is then drilled through the board at these points to take the contact wires and then the contacts themselves are secured (glued) in position.

Finally the transformer and associated components can be mounted and wired up as shown in Fig. 2b and c. The underside of the board should be finished with a protective covering e.g. hardboard, and a small ventilated plastic box fitted over the transformer for safety reasons.

The contacts on the underside of the ceiling rose can be fitted next. These consist of short 2BA bolts with solder tags mounted on the inside, see Fig. 3. These should be countersunk so they lie flush with the rest of the underside. Replace the cover on the rose and place it in its correct operating position on the charger board. Mark the desired location of the l.e.d. and carrying handle, drill suitable size holes and fit these components.

Assembly of the candle unit can now be completed. Take one of the end caps, cut it down to about 15mm in length and drill a hole in the centre just big enough to fit over the hole in the top of the ceiling rose. Glue this on to the ceiling rose cover. The other end cap should be similarly treated so that it can take lamp LP1.

COMPLETING ASSEMBLY

Wires are then soldered onto the battery and lamp according to Fig. 3 and the two solder tags fitted to the ceiling rose cover. Complete the wiring and slot the unit together. Care should be taken to wire the l.e.d. in the way shown or the battery will not charge and may be damaged.

As a finishing touch some form of location marks can be put on the board and candle to ensure that it is always set down in the right position.

COMPONENTS

R1	220Ω ½W carbon ± 10%	
T1	mains primary/6V 100mA secondary transformer	
D1	TIL209 l.e.d. red or green	
B1	1·5V type U11 rechargeable battery	
LP1	1·25V 0·25A m.e.s. lamp	
S1	s.p.s.t. normally open reed switch including magnet	
S2	s.p.d.t. reed switch including magnet	

m.e.s. bulb holder; mains cable; connecting wire; ceiling rose; piece of plastic tubing with end caps to fit; cable clip for handle; piece of plywood 150mm × 100mm; covering for charger board; 2BA countersunk bolts, nuts and solder tags (2 off each); 4BA nuts, bolts and solder tags (2 off each); brass drawing pins (2 off); rubber feet (4 off); nuts and bolts for handle.

See Shop Talk page 798

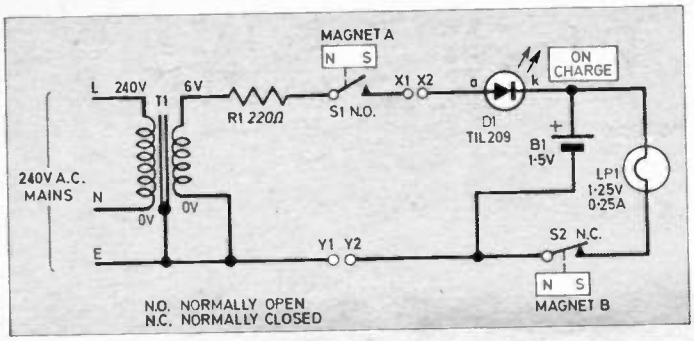
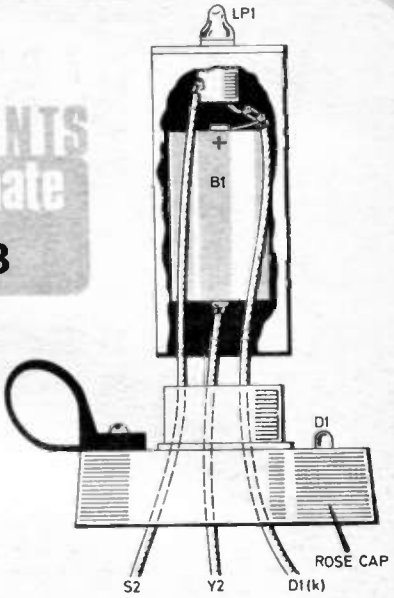
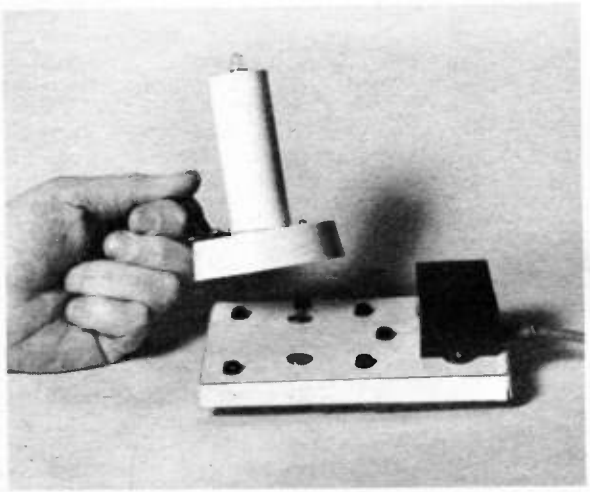


Fig. 1. Complete circuit diagram of the Everlasting Candle.

COMPONENTS approximate cost £8





The "candle" being removed from the charger base. For safety reasons a plastic cover **must** be placed over the mains transformer.

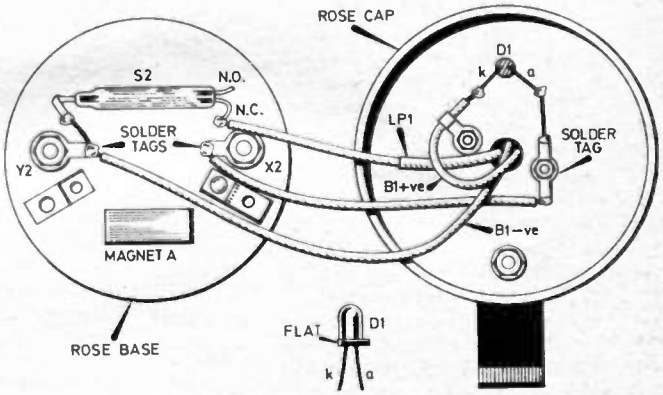


Fig. 3. Component layout of the candle unit.

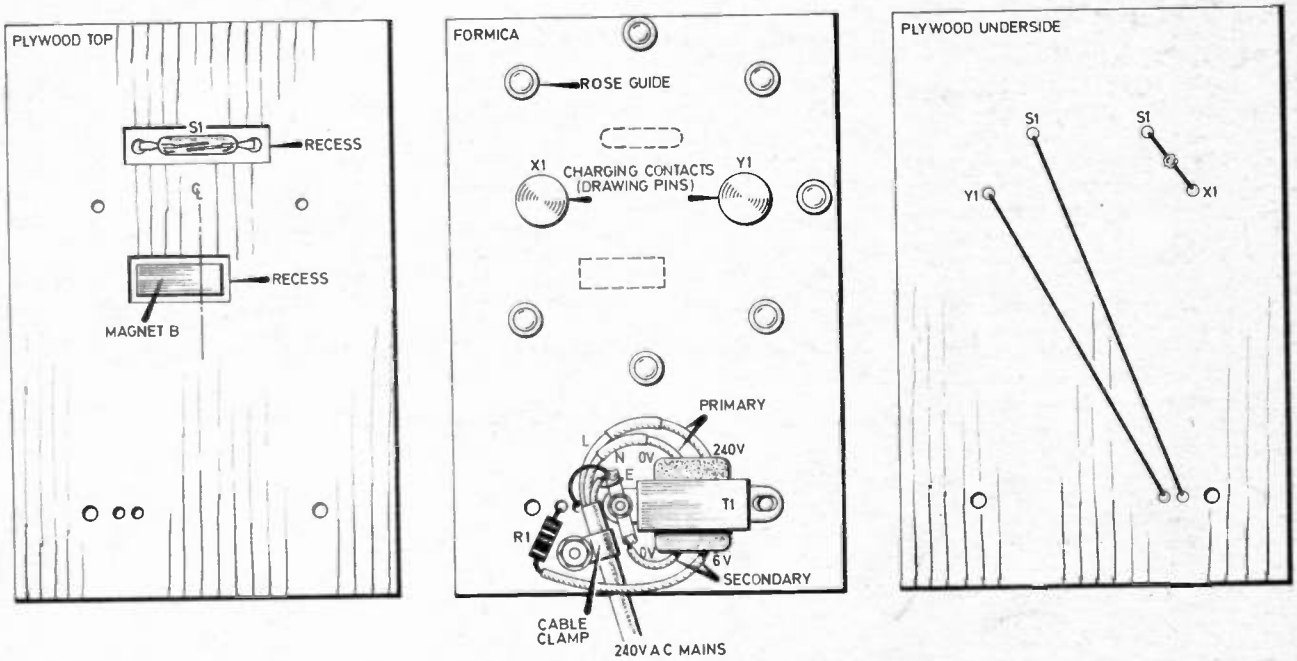


Fig. 2. Component layout of charger board showing (a) top side before covering with Formica, (b) top side after covering, (c) the underside.

TWINKLING STAR

By E. M. Lyndsell

CHRISTMAS will be with us again soon and homes will be adorned with decorations of many sorts. The Twinkling Star described here is intended to be such a decoration and was originally designed to hang on the Christmas tree but could also be used to decorate a wall or window.

Construction is quite straightforward and uses easily obtainable components allowing it to be built in good time for the festive season.

The unit consumes an average of 400mA and for this reason a mains derived power supply is incorporated. For those with a 9 volt battery eliminator capable of supplying this current, D1, T1, C1 and S1 can be omitted from the shopping list.

CIRCUIT DESCRIPTION

The complete circuit diagram of the unit is shown in Fig. 1. Use is made of the versatile 555 timer i.c. Two devices are used here, IC1, 2 both wired as astable multivibrators. Output from the 555 is at pin 3, and the number of times per second (frequency) that it switches between the 0V and positive supply rails is determined by the values of C2 and C3 and their series resistors.

The frequency of IC1 is equal to $1/[(R1+2R2)\times C2]=2{\cdot}3$Hz, and for IC2 the frequency is 1·5Hz.

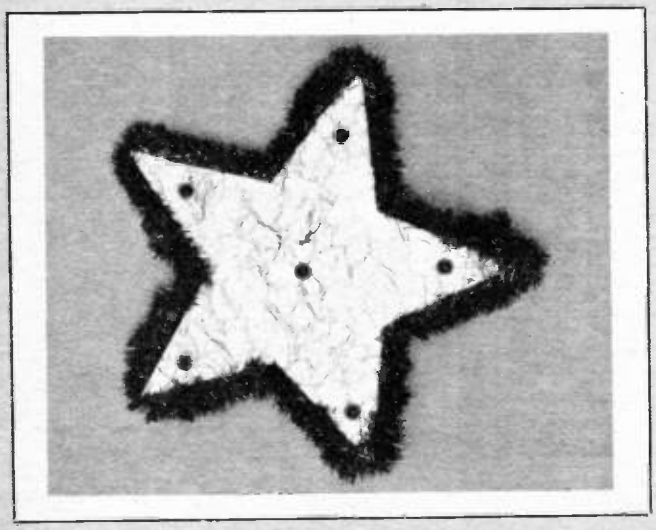
The exact values of frequency are not too important, but their ratio is, as this determines the flashing rate and brightness of LP3. A frequency ratio of 2:3 was found most suitable. This can be experimented with by changing the values of R4 and/or R2.

When power is applied to the circuit lamp pair LP1 and LP2 will flash alternatively at 2·3Hz as will pair LP4 and LP5 at 1·5Hz. Lamp LP3 will only be on (bright) when IC1 pin 3 is high *and* IC2 pin 3 is low and vice versa. The centre lamp LP6 is on all the time as it is connected directly across the supply lines.

The total effect is to simulate a twinkling star.

The wattage of LP6 is less than all the other lamps in an attempt to produce an even illumination from all lamps. The other lamps will appear less bright than their rating due to being constantly turned on and off.

The lamps are over-run to increase brightness i.e. 6V lamps operat- from a 9V power supply. This has the effect of reducing the bulb life but is of little consequence in this application.



POWER SUPPLY SECTION

Mains voltage is placed across the primary of T1 via S1 resulting in 6V a.c. appearing across T1 secondary. This is half-wave rectified by D1 to produce pulsed d.c. to reservoir capacitor C1 which results in a fairly smooth d.c. level of about 9 volts at C1 positive terminal.

STAR

The construction is in two distinct parts, the encased circuit board/transformer and the star lamp wiring. Four wires interconnect the two.

The prototype five-pointed star was made from hardboard and covered with aluminium cooking foil and edged with tinsel. The star was drawn inside a 30cm diameter circle. This dimension is not critical and can be altered to suit application.

With the hardboard cut to shape drill the six lampholder mounting holes. The size will vary according to holders obtained. Secure the plastic four-way terminal block in place using countersunk bolts. Crinkled foil (or other covering) can now be lightly glued or folded over the edges to hold in place followed by the fixing of the lampholders which can then be interconnected according to Fig. 2.

CIRCUIT BOARD

The remainder of the components with the exception of the transformer were mounted on a small piece of 0·1 inch matrix stripboard size 19 strips x 22 holes with breaks made on the underside as seen in Fig. 3.

Assemble the components as shown in Fig. 3 including the flying leads and then fix this and the transformer to the base of the case. The four wires from the board reach the externally mounted screw terminal block via a small hole drilled in the case. The mains cable enters the case, near the transformer, via a cable strain relief bush or other means of securing cable.

Insert the bulbs in their holders and interconnect the two sections and plug into the mains. A twinkling star should be seen, which should add sparkle to your festive decorations. ☐

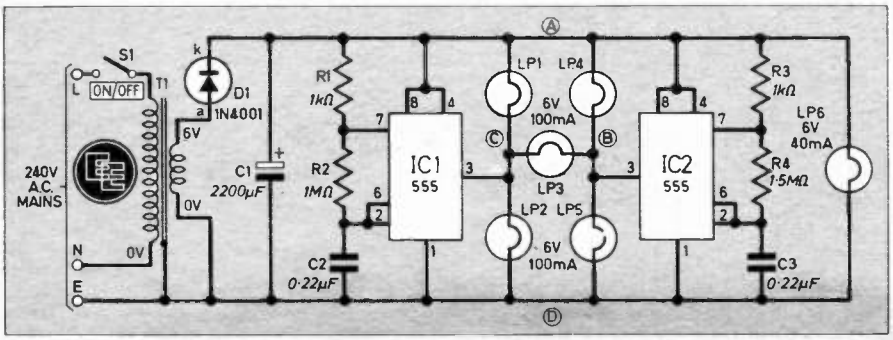


Fig. 1. The complete circuit diagram of the Twinkling Star including an integral power supply unit. Alternately, a battery eliminator can be employed, see text.

COMPONENTS

Resistors
R1 1kΩ
R2 1MΩ
R3 1kΩ
R4 1·5MΩ
All ¼W carbon ± 5%

Capacitors
C1 1000μF 10V elect.
C2, 3 0·22μF plastic (2 off)

Semiconductors
D1 1N4001 or other 1A silicon diode
IC1, 2 555 timer i.c. (2 off)

Miscellaneous
LP1-LP5 6V 100mA m.e.s. bulbs (5 off)
LP6 6V 40mA m.e.s. bulb
T1 mains primary/6V 500mA secondary
S1 mains on/off toggle
Stripboard: 0·1 inch matrix 19 strips × 22 holes; m.e.s. lampholders (6 off); 4-way plastic screw terminal block (2 off); p.v.c. covered wire; materials for star; case; 6BA fixings; solder tag; mains cable.

COMPONENTS approximate cost **£4.20** excluding case

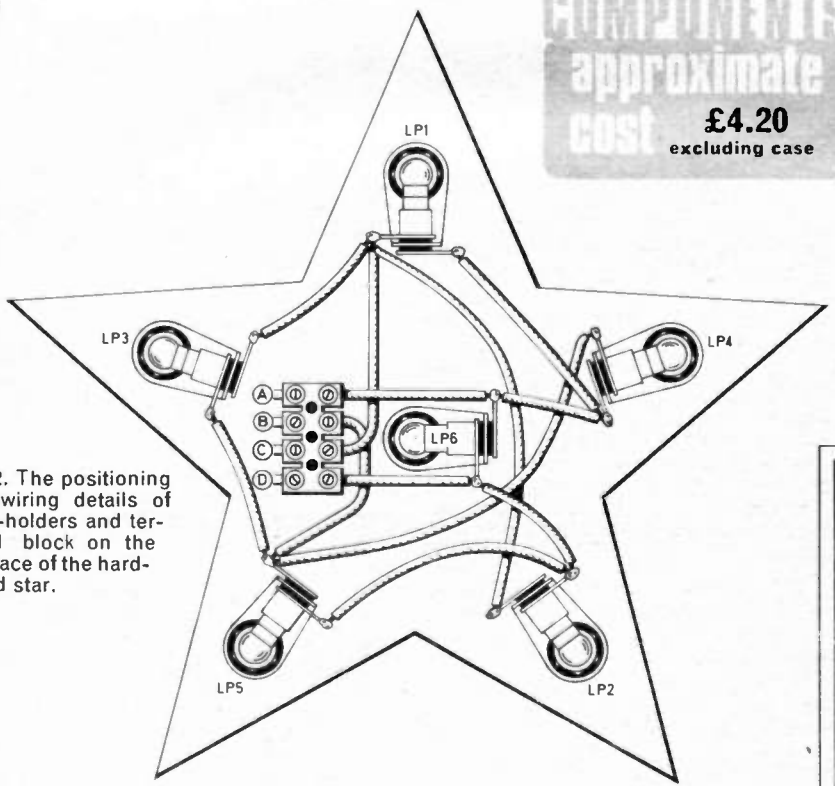
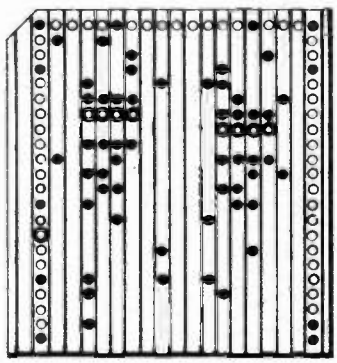


Fig. 2. The positioning and wiring details of lamp-holders and terminal block on the rear face of the hardboard star.



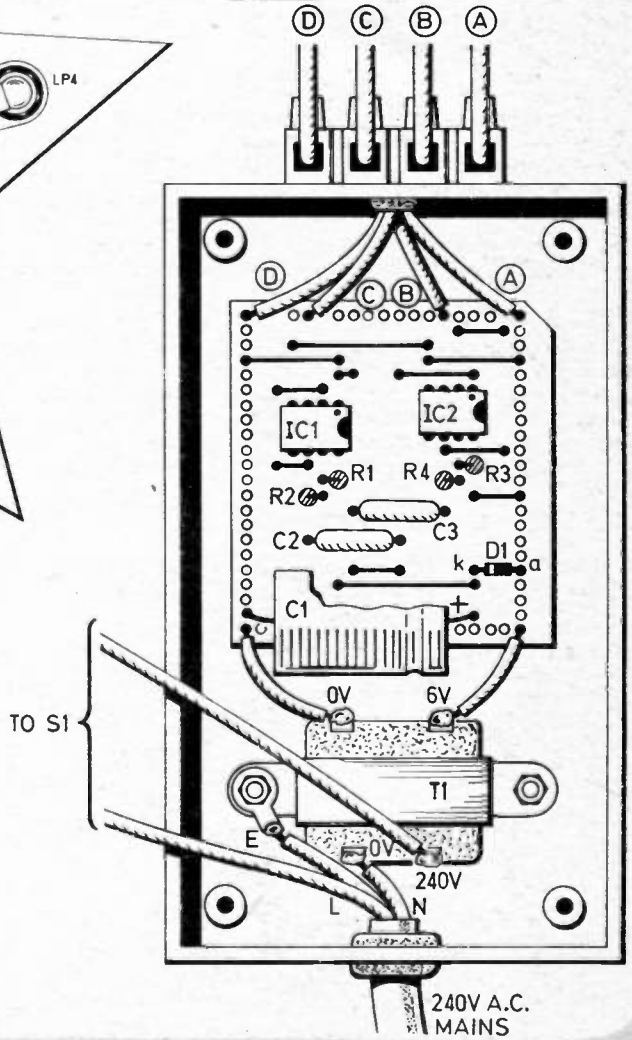
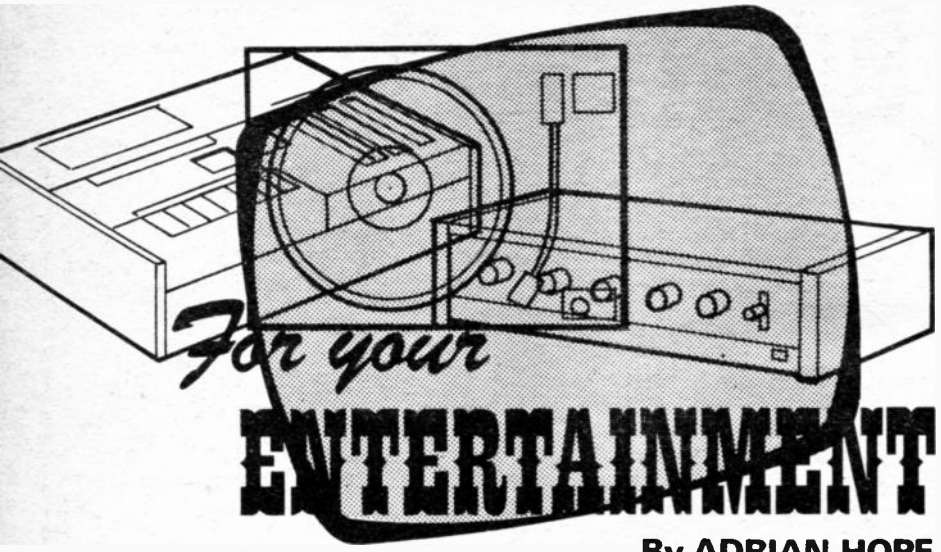


Fig. 3. (Above and right). Shows the layout of the components on the topside of the board (and breaks to be made on the underside) fitted in the case with complete interwiring details.



For your ENTERTAINMENT

By ADRIAN HOPE

Choosing Your Game

The world of video games is now moving so fast that almost anything written about specific brand name products and their price is likely to be out of date before it's published. Here then are some more general guidelines which could help anyone thinking of buying a game for themselves or their children.

First and foremost the word "game" is now a misnomer; many video games or toys could equally well be called "educational aids". But advertising men know full well that the word "education" is the kiss of death to large sales.

So microprocessor-based fully programmable systems which can be used for education will often be sold under the generic label "TV Game". Children and adults who would normally run a mile at any suggestion that they should take up home computing, can be hooked on the idea while thinking that they are simply playing games with a toy.

It's fascinating for instance to watch children in a modern amusement arcade striving to beat the ever more sophisticated computer games that are appearing. Without realising it they are learning to interface with a computer display screen and thereby learning skills that will be of real value to them in this modern age.

In the beginning, which in this fast moving field of technology is only about five years ago, all TV games were built up from literally dozens of discrete chips and transistors. After 1976, when GI produced a single i.c. (integrated circuit) offering six games, the price fell significantly.

Dedicated Game

But all those early games, whether based on discrete circuitry or the single chip, were "dedicated" i.e. completely inflexible over the choice of game. To extend the choice of games, and to make the games more complicated, required the provision of more digital memory to store more game instructions.

One early idea was to store the game instructions on a cassette tape and this approach was patented by Sanders Associates. This is the American research firm who invented and patented the original concept of TV games, but subsequently sold the licensing rights to Magnavox (the North American subsidiary of Philips).

Brain Power

The idea of taped game instructions didn't catch on and designers came up with the idea of a semi-programmable game. The basic game circuit contains very little memory and is thus like a body without a brain.

The brain power comes in cartridges, each with enough ROM (or Read Only Memory) to instruct the game body how to play one or more specific games. The more complicated the games and thus the more instructions needed, the fewer the games that can be stored in a single cartridge.

Semi-programmable games of this type tend to be fairly cheap, currently as low as £30 for the game body and around £10 a time for each cartridge of brain power. A major disadvantage is the lack of long term flexibility.

Fully Programmable

A fully programmable game costs more because the body contains a microprocessor and is thus really a mini-computer. One of the cheapest is the Philips Videopac G7000 which is made by Magnavox in the USA and sold here for around £150.

Fully programmable games are very flexible and thus of greater long term value to the owner.

The microprocessor has a Random Access Memory or RAM. The instructions necessary for programming the micro to play a TV game are stored in a ROM contained in a cartridge superficially similar to that used for a semi-programmable game.

When the cartridge is plugged into the game, its ROM dumps programming instructions for the game into the micro RAM.

In the Philips-Magnavox game the microprocessor has an 8K bit ROM of its own which permanently offers enough basic memory to generate characters and graphics on the screen under the control of whatever game instructions are fed into the microprocessor RAM by the cartridge ROM. The micro RAM has a capacity of 2K bits and the cartridge ROM has a 16K bit capacity.

The instructions are grouped in 8 bit words and transferred from the cartridge ROM to the micro RAM at a rate of around 5 Megabits per second. So although the cartridge is programming the micro-processor like a human operator, it's far, far faster than any human could ever hope to be.

In practice it takes an eight man team at Magnavox around a month to write the programme for each new game and the cartridge ROM dumps them into the micro RAM in well under a second!

Because the cartridge ROM has a greater capacity than the micro RAM, each cartridge can contain several different games, for instance several versions of car racing and moon landing, or one much more complex, multi-stage game like golf or baseball which is continually scanned by the micro while the game is played. With a fully programmable game it is theoretically possible to use something other than a cartridge ROM to supply the micro RAM with instructions.

Cable Games

One idea currently gaining support in the USA is for cable TV stations to pipe not just TV entertainment into the home, but a choice of TV game programmes. Several of the British TV companies are working on the idea of transmitting game programmes over the air.

A special interface cartridge links the micro RAM to the cable TV outlet or TV receiver and in a split second the micro is programmed to play a completely new game. And of course the game needn't be a game. If the unit has a typewriter style keyboard, as well as ordinary joystick game controls, it can be used in the manner of a budget computer and even used as a video film titling machine.

You type out a phrase on the keyboard and connect the system output to the input of a video recorder; the phrase is then "written" directly onto video tape. There's also the possibility of interface with an ordinary audio cassette recorder, to enable information typed into the keyboard to be stored as a digital recording on an audio cassette.

Making a Choice

Indeed, the possibilities with a fully programmable video games system are virtually limitless. But how does a customer know whether a game is fully- or only semi-programmable?

Obviously prices are one indication. At current levels a games unit costing around £30 will almost certainly be only semi-programmable. But how to tell whether a unit costing around £150 is a good-value for money fully-programmable unit or an overpriced semi-programmable?

Unfortunately, there's no really foolproof rule of thumb. The best guide is availability or otherwise of a keyboard. If the unit either has a built in alpha-numeric (i.e. typewriter style) keyboard, or if such a keyboard can be used as an optional extra, then it will be fully programmable.

If there is no keyboard facility possible, and the game has just fader or joystick controls, it's an odds on certainty that it's only semi-programmable.

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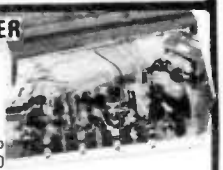

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30 x 30 WATT AMPLIFIER KIT
with BSR P200 belt drive deck and Shure M75 cartridge.

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Stereo pair 350 kit System consists of 13" x 8" approx woofer with rolled surround, 2½" approx Audax tweeter, crossover components and circuit diagram. Frequency response 20 Hz to 20 KHz Power handling 15 watts RMS. 20 watts max 8 ohm impedance.

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Per stereo pair
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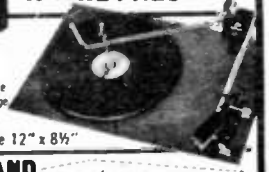
Belt drive chassis turntable unit semi-automatic, cueing device **£25.50** p&p £2.60

A.O.C. OLM 30 Mk III Magnetic Cartridge to suit. **£7.95**

BSR Manual single play record deck with auto return and cueing lever, fitted with stereo ceramic cartridge 2 speeds with 45 r p m spindle adaptor ideally suited for home or disco use

OUR PRICE **£11.25** p&p £2.75

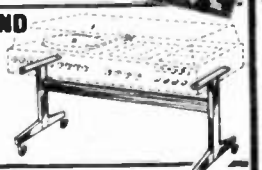
GARRARD DECK MODEL CC 10A



Record changer with cueing device fitted with stereo ceramic cartridge ready to fit into your own plinth

£8.15 p&p £2.05 Size 12" x 8½"

UNIT AUDIO STAND



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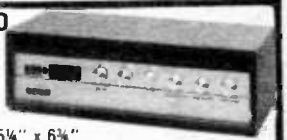
Size approx 14" x 4" x 10"
Brushed aluminium fascia and rotary controls

Five vertical slide controls, master volume, tape level, mic level, deck level PLUS INTER DECK FADER for perfect graduated change from record deck No 1 to No. 2 or vice versa Pre fade level control (PFL) lets YOU hear next disc before fading it in VU meter monitors output level Output 100 watts RMS 200 watts peak

p&p £4.05 **£66.45**

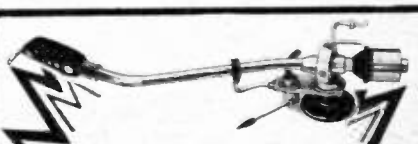
50 WATT MONO DISCO AMP



£30.60
p&p £2.70

Size approx. 13⅜" x 5¼" x 6¾"

50 watts rms. 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.



Ariston pick-up arm manufactured in Japan. Complete with headshell! Listed price over £30.00.

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SQUARE one

This month we show some of the circuit symbols and circuit references used in E.E. circuit diagrams to represent components and their interconnections.

CAPACITORS

Fixed value capacitor

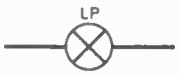
Fixed value electrolytic capacitor

Variable capacitor

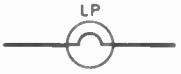
Capacitor with pre-set adjustment (trimmer)

MISCELLANEOUS

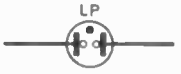
Battery with more than one cell



Indicating or signal lamp



Illuminating lamp

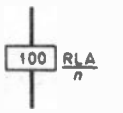


Neon lamp or indicator

Single pole single throw switch

Rotary switch, single pole three way

Single pole push to make switch

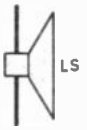


Relay with coil resistance of 100 ohms with *n* contacts

Relay make contact Additional sets of contacts are annotated RLA1, RLA2, etc

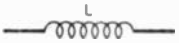
Fuse

Single terminal socket and plug

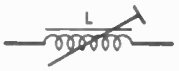


Loudspeaker

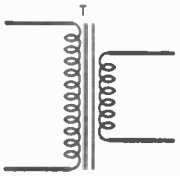
Light dependent resistor



Fixed value inductance



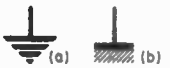
Variable inductance coil with ferrite core



Transformer with laminated core, no tappings


Two conductors crossing with no connection


Junction or connection of three conductors



"Earth" connection: (a) to earth (b) to chassis


Continuous screened lead

EE CROSSWORD No 22 BY D. P. NEWTON

ACROSS

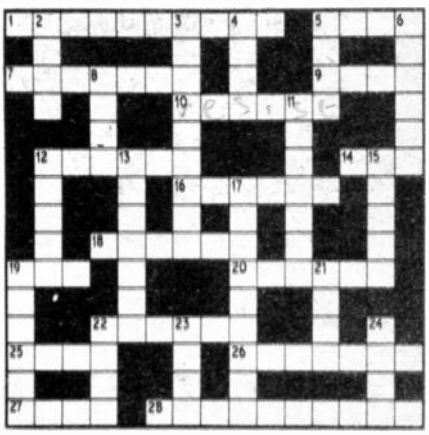
1 & 5 Means of preventing alternative circuits (10, 4).
7 Random electrical discharge produces sound action in such a manner.
9 Personal induction.
10 To oppose electrically.
12 Coulombs per volt.
14 Use X-rays for creative activity.
16 Roof cover.
18 Vegetative vehicle decay basically caused by electrolytic action.
19 Specialises in entertainment by means of electronic display.
20 Descriptive of one who is rather rude and basic.
22 Valve interior, possibly needed for 14 across unless you are 20 across.
25 To run lazily.
26 I moan Ma, about a gas (Anag.).
27 100db?
28 

(5, 5,).

DOWN

2 Discharge tube shows a red light.
3 

4 Volts per amp.
5 Examination intended to indicate a fault, even, perhaps, a soaking.
6 The output end of lines of force?
8 Equine goad of circuit extension.
11 Creator of electrical embarrassment, possibly by 20 across.
12 1dB?
13 Galvo which is never ecstatic.



Solution on page 730

15 & 24 Communications satellite which got the worm? (5, 4).
17 Selection of one and then the other by means of a.c?
19 Element designed to respond to waves.
21 The triode provides an entertaining group.
22 Small unit of plant life.
23 Relaxation, but not a circuit.

TEACH-IN 80

Part 3

By S. R. Lewis, B.Sc.

IN THE first part of this series, the simplest electric circuit was described. This consisted of a piece of wire connected to a battery. We saw how the electromotive force of the battery supplied electric charge to maintain the field across the wire.

In real life, it would be unwise to connect a wire directly across a battery, since either the wire or the battery would be damaged by the large current which would flow.

Electric current has already been defined as the rate of flow of charge. Since the wire across the battery caused too much current to flow, let us instead consider a resistor placed across the battery terminals (Fig. 3.1). The resistor/battery combination forms a closed loop and since we know that charge cannot build up in one place, an imaginary cross-section taken anywhere in the loop would show the same number of electrons crossing it per second.

The actual rate of flow of charge (current) can be calculated as we know both the voltage across the resistor and the value of the resistor. The resistance in the loop due to the connecting leads and the battery itself we will ignore for the moment.

From Ohm's Law the current is found to be V divided by R, where V is the battery voltage and R is the resistance. If the units we measure in are volts and ohms respectively then the current will be in amperes.

We now have a complete description of the circuit—all currents and voltages have been specified.

TWO RESISTOR CIRCUIT

Let us add one step of complication to the circuit by connecting another resistor in the circuit as shown in Fig. 3.2.

Again we have a simple loop so we must again deduce that the current in any part of the circuit must be the same. Hence the current in resistor R_A is the same as that in R_B. If we call the current I we should be able to calculate it from a knowledge of the values of the two resistors and the battery voltage.

The electromotive force of the battery V must be exactly equal to the sum of the potentials across the two resistors. Mathematically we can state this as

$$V = V_A + V_B$$

But for any resistor the potential difference between its ends is equal to the current flowing through it multiplied by the resistance. So

$$V_A = I \times R_A \text{ and } V_B = I \times R_B$$

Combining these three equations we get

$$V = (I \times R_A) + (I \times R_B)$$

or

$$V = I \times (R_A + R_B)$$

To get I we simply divide both sides of the equation by $(R_A + R_B)$ obtaining

$$I = V/(R_B + R_A)$$

Stated in words this equation indicates that the current in this circuit is exactly the same as that which would flow if a resistor whose value was equal to that of the values of the two resistors added together was used in their place.

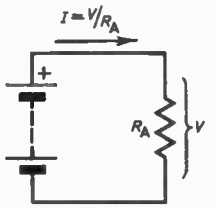


Fig. 3.1. (left) In this simple circuit all the voltages and currents are defined by application of Ohm's Law. An imaginary cut at any point in the circuit would show the same number of electrons crossing per second i.e. the same current.

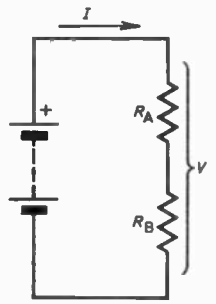


Fig. 3.2. This circuit shows two resistors in series with the battery.

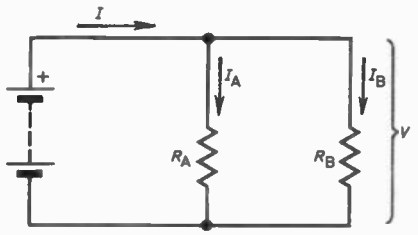


Fig. 3.3. The two resistors in the circuit shown here are in parallel.

When the same current flows through two (or more) circuit components we say that the two components are in **series**.

We can use the same sort of reasoning as used above to derive the result that if any number of resistors are placed in series then their overall resistance is equal to the sum of all the individual resistances.

TWO LOOP CIRCUIT

There is an alternative way of connecting a second resistor in the circuit and this is shown in Fig. 3.3.

Here we have a new situation as we have departed from the simple single-loop circuit. The current from the battery now divides into two paths, some of it flowing in resistor R_A and some in resistor R_B; but how much in each?

Since charge cannot accumulate in any part of the circuit the current measured at the battery terminals must be equal to that flowing in the two resistors. Mathematically,

$$I = I_A + I_B$$

Both resistors have the same voltage across them so each of the currents can be simply derived.

$$I_A = V/R_A \text{ and } I_B = V/R_B$$

Combining these two equations we get

$$I = V/R_A + V/R_B$$

or

$$I = V/\left(\frac{1}{R_A} + \frac{1}{R_B}\right)$$

We call the reciprocal of resistance (one divided by the resistance) the conductance of a resistor. The equation we have obtained can thus be stated in words by saying that the total current flowing in the circuit is the same as that which would flow if a resistor whose conductance is the sum of the two individual conductances is used in their place.

When two (or more) components have the same potential across them we say that they are in **parallel**.

For the case of two resistors in parallel we can find the value of the single resistor which could replace them. Its conductance ($1/R$) must be equal to the sum of the two conductances.

So:

$$1/R = 1/R_A + 1/R_B$$

But

$$1/R_A + 1/R_B = \frac{R_A + R_B}{R_A \times R_B}$$

Thus

$$\frac{1}{R} = \frac{R_A + R_B}{R_A \times R_B}$$

Inverting both sides gives the required value of the equivalent resistance:

$$R = \frac{R_A \times R_B}{R_A + R_B}$$

When there are more than two resistors in parallel, it is not so simple to find the equivalent single resistance. It is necessary to take the reciprocal of each of the resistors, add them together and then take the reciprocal of the sum.

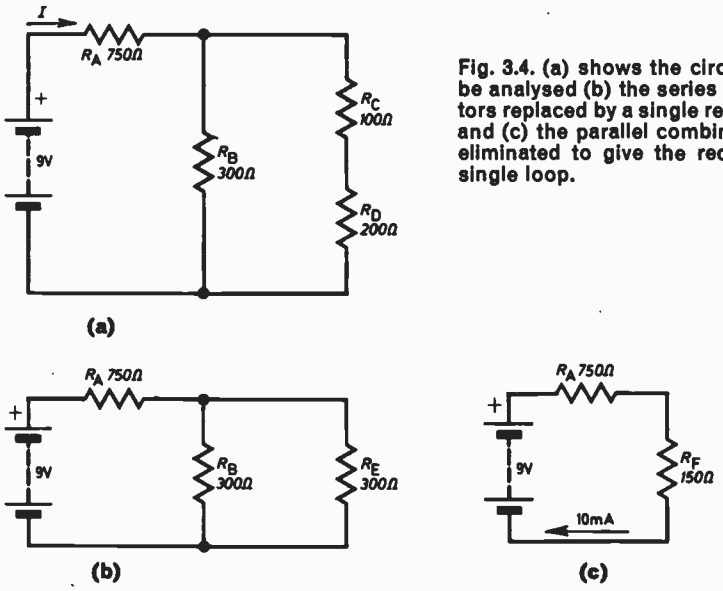


Fig. 3.4. (a) shows the circuit to be analysed (b) the series resistors replaced by a single resistor and (c) the parallel combination eliminated to give the required single loop.

MORE COMPLEX CIRCUITS

It is worthwhile studying the results obtained above since the concepts of series and parallel elements are very useful in understanding how electronic circuits operate. Very often one will come across a fairly complex looking circuit but on inspection it appears to be simply a combination of series and parallel connections.

It should be noted that not all circuits are capable of being analysed into series and parallel units but it is unusual to find a circuit with no components or groups of components in one or other of these arrangements.

Let us look at a circuit which, while appearing complex at first sight, in fact breaks down into easily studied sub-units.

The circuit is shown in Fig. 3.4 and consists of four resistors connected to a battery. We want to find the current flowing from the battery.

Inspection shows that resistors R_C and R_D must be in series since they both have the same current flowing through them. They could therefore be replaced with a single resistor of value ($R_C + R_D$), see Fig. 3.4b.

Let us call this new resistor (or imaginary resistor) R_E. It now becomes apparent that resistors R_B and R_E are in parallel, the value of the equivalent resistor being $(R_E \times R_B)/(R_E + R_B)$.

Let us redraw Fig. 3.4b inserting a new resistor R_F in the place of the parallel combination, see Fig. 3.4c. Now R_F is in series with R_A, the equivalent resistance being $R_A + R_F$. We can now find the battery current by simply dividing the battery voltage by $R_A + R_F$.

Let us insert some values into the circuit to see how the calculation goes.

$R_E = 100 + 200 = 300$ ohms

$$R_F = \frac{300 \times 300}{300 + 300} = 150 \text{ ohms}$$

$R_F + R_A = 150 + 750 = 900$ ohms

$I = 9/900 = 0{\cdot}01\text{A}$ or 10mA

Knowing the battery current we can now work backwards and calculate all the voltages and currents in the circuit. We know the current in R_A is 10mA so the potential difference across it must be $750 \times 0{\cdot}01$ volts, that is 7·5V. The voltage across R_F must therefore be $9 - 7{\cdot}5 = 1{\cdot}5$V.

The current through R_B is 5/300=5mA and the same current must flow through (R_C+R_D). The voltage across R_C is therefore $100\times0{\cdot}05=0{\cdot}5V$ and that across R_D must be $200\times0{\cdot}05=1V$.

BRIDGE CIRCUITS

Take a look at the circuit in Fig. 3.5. It consists merely of four resistors connected to a battery with a meter placed across the junctions of the two pairs of resistors. At first sight one would not think this a very useful circuit but it is one that turns up a great deal in electronics.

we make the currents flowing in the rest of the circuit large as compared to the current in the meter then the error caused by neglecting the meter will be minimal.

If no current flows in the meter then it is effectively an **open circuit**. The circuit is thus reduced to a parallel arrangement of two sets of resistors in series.

The current flowing in the left-hand arm is given by $V/(R_A+R_B)$. The voltage at the junction of R_A and R_B is therefore given by

$$V_A = R_B \times I_B = R_B \times \frac{V}{(R_A + R_B)}$$

The voltage measured by the meter is V_A-V_B which is

$$\frac{V \times R_B}{R_A + R_B} - \frac{V \times R_D}{R_C + R_D}$$

$$\text{or } V \times \left(\frac{R_B}{R_A + R_B} - \frac{R_D}{R_C + R_D}\right)$$

An interesting situation occurs when $V_A=V_B$ for we obtain

$$\frac{V \times R_B}{R_A + R_B} = \frac{V \times R_D}{R_C + R_D}$$

Now since V appears on both sides of the equation we can cancel it out, finally arriving at

$$\frac{R_B}{R_A + R_B} = \frac{R_D}{R_C + R_D}$$

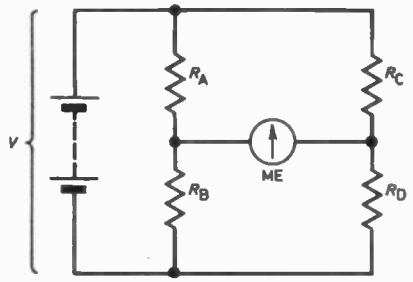


Fig. 3.5. A simple Wheatstone bridge circuit.

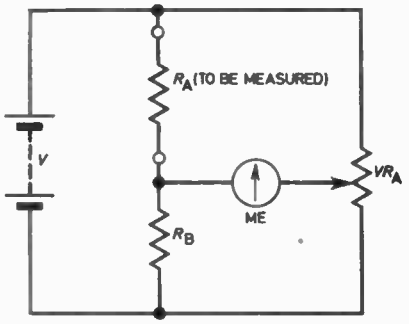


Fig. 3.6. The simple bridge can be converted into an ohmmeter by using a potentiometer and fixing R_B.

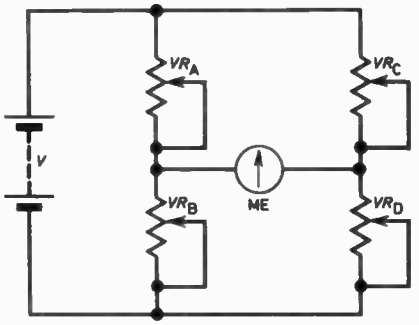


Fig. 3.7. A simple electronic slide-rule can be achieved using four variable resistors (or potentiometers connected as variable resistors).

Let us make a few calculations so that we know exactly what is going on in the circuit. We will assume that the meter can measure voltage without any current passing through it. This may seem unrealistic but as long as

Similarly the current through the right-hand arm is $V/(R_C+R_D)$ and the voltage at the junction of R_C and R_D is

$$V_D = R_D \times I_D = R_D \times \frac{V}{(R_C + R_D)}$$

Cross multiplying gives

$$(R_C \times R_B) + (R_D \times R_B) = (R_D \times R_A) + (R_D \times R_B)$$

Cancelling $R_D\times R_B$ gives

$$R_D \times R_A = R_B \times R_C$$

$$\text{or } \frac{R_A}{R_B} = \frac{R_C}{R_D}$$

The circuit we have been looking at is known as a **Wheatstone bridge circuit**; "Wheatstone" after its inventor and "bridge" from the appearance of the meter as a "bridge" between the two sides of the circuit. When the meter is made to read zero we say that the bridge is balanced. The important fact to note is that when the ratio of the four resistors is chosen so as to balance the circuit it does not matter what the battery voltage is, the meter will still read zero.

What use is the circuit? First let us fix the value of R_B and instead of two resistors let us replace R_C and R_D by a potentiometer. We now have a way of

PART 3 QUESTIONS

3.1. To reduce the current in a resistor should another resistor be placed:
(a) in parallel
(b) in series
(c) either
(d) neither

3.2. The following are sets of values for R_A, R_B, R_C and R_D in the bridge circuit of Fig. 3.3. Which will form a balanced circuit:
(a) 1000, 2000, 2000, 4000
(b) 1000, 2000, 3000, 4000
(c) 1000, 2000, 1, 2
(d) 100, 1, 100, 100

3.3. What resistance could be used in place of 80, 100 and 400 ohms in parallel:
(a) 580
(b) 40
(c) 80
(d) 32

3.4. What value must be placed in parallel with 100 ohms to give an equivalent resistance of 90 ohms:
(a) 10
(b) 100
(c) 900
(d) 9000

PART 2 ANSWERS

2·1 a) 2·2 b) 2·3 b) 2·4 b) 2·5 a)

EXPERIMENT 3.1: SERIES AND PARALLEL

Components required: 10kΩ resistors (4 off), 100kΩ resistor

Connect the circuit as shown in Fig. 3.8a, the component layout being shown in Fig. 3.8b. Resistors R3 and R4 should not be inserted at this stage.

Adjust the setting of VR1 until the meter reads zero. The reading on the scale of VR1 should be very close to "5".

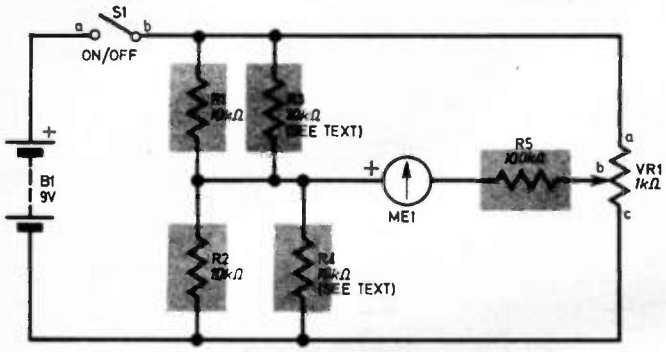
Next insert the resistor marked R3 into the circuit and again adjust the potentiometer until the meter reads zero. Note the new reading. Remove R3 and fit R4. Adjust the potentiometer and note this third reading. Finally insert both R3 and R4 and again find the new balance point.

Work out why the readings changed as they did and see if the calculated readings match your measured readings.

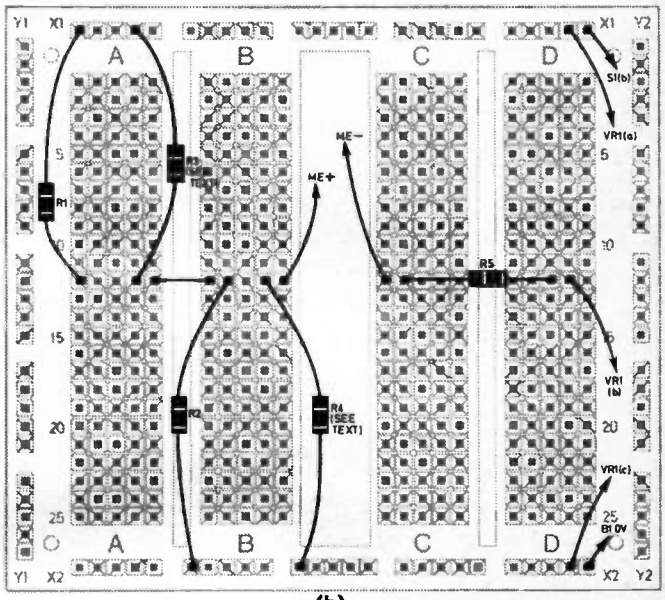
The readings, in order, should be: 5, 6·6, 3·3 and 5.

ADDITIONAL CONNECTIONS FOR BOTH EXPERIMENTS

On right hand panel of Tutor Deck: link S1(a) to B1 +9V



(a)



(b)

Fig. 3.8. (a) Circuit diagram of the experiment for investigating series and parallel connections. (b) layout of the components on the Tutor Deck.

EXPERIMENT 3.2: SIMPLE OHMMETER

Components required: 10kΩ resistor, 100kΩ resistor

The circuit of a simple ohmmeter is shown in Fig. 3.9a with the component layout on The Tutor Deck in Fig. 3.9b.

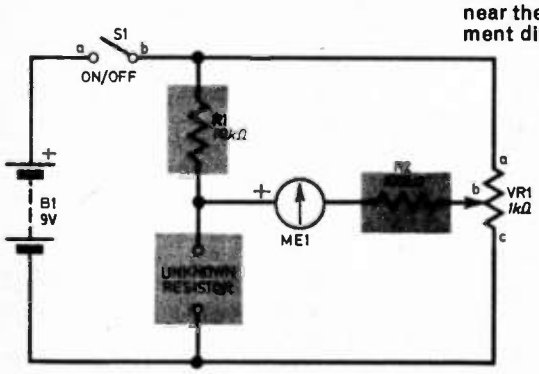
This ohmmeter can measure resistances from about 1kΩ to 100kΩ. Outside this range the potentiometer will be very near the end of the track making measurement difficult.

The unknown resistor should be placed in the deck and the potentiometer adjusted until the meter reads zero. The value of the unknown resistor will then be given by

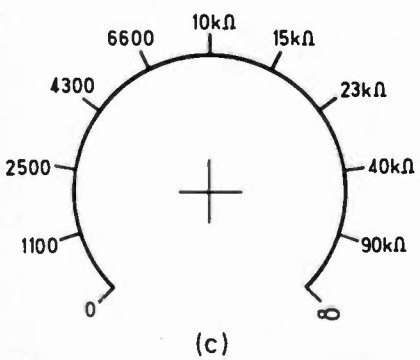
$$R = \frac{S}{10 - S} \times 10\text{k}\Omega$$

where S is the scale reading of the potentiometer.

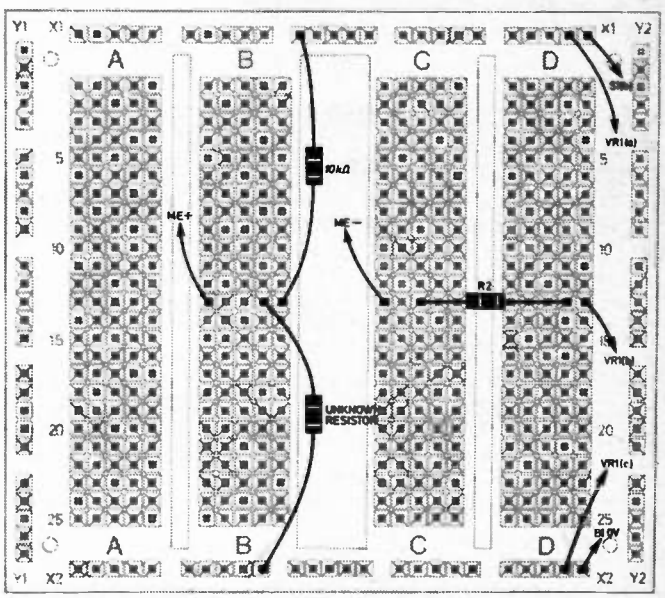
Alternatively, the scale of the potentiometer can be marked so that it reads resistance directly, see Fig. 3.9c.



(a)



(c)



(b)

Fig. 3.9. (a) Circuit diagram of the simple ohmmeter (b) Layout of the components on the Tutor Deck. (c) Scaling for the potentiometer so that resistance can be measured directly.

varying the ratio R_C/R_D since R_C is now the resistance from the wiper to the top of the potentiometer and R_D is the resistance from the wiper to the bottom of the potentiometer—both varying as the wiper is moved. Imagine the scale of this potentiometer calibrated so that the ratio R_C/R_D can be read directly. We have now built a simple ohmmeter.

The unknown resistor is simply placed in the position of R_A and the potentiometer adjusted until the meter reads zero. By reading the potentiometer scale and knowing the resistance R_B it is a simple matter to calculate R_A.

$$R_A = R_B \times \frac{R_C}{R_D}$$

SIMPLE SLIDE-RULE

Another use of the Wheatstone bridge is as a simple electronic slide-rule for doing simple multiplications and divisions. All four of the resistors in the bridge circuit are now replaced with variable resistors whose scales are calibrated from zero to 10. To do division we set variable resistor R_B to "1". The divisor is set on R_D and the dividend on R_C. The variable resistor R_A is then adjusted to make the meter read zero, its scale then showing the answer.

To do multiplication, R_A is set to "1" and the two numbers to be multiplied are set on R_B and R_C. R_D is then adjusted to make the meter read zero when its scale should indicate the answer. Of course, this "computer" is really only of limited use since it is restricted to positive numbers below ten.

Many pieces of test equipment have been produced using the principle of the Wheatstone bridge. Some use fluctuating voltages to power the bridge with a speaker or earphone to monitor the balance of the bridge. It does not matter that the voltage is fluctuating since when the bridge is balanced the current in the balance monitor, be it meter or earphone, will be zero.

Next month we will meet the simplest semiconductor device, the diode.

By Dave Barrington

Two small mail order catalogues have been received this month from TK Electronics and Ace Mailtronix.

The TK Electronics catalogue consists of 28 pages and contains a useful selection of integrated circuits. Also, there are some interesting circuit diagrams with suggested applications.

Copies of the TK Electronics catalogue are available free of charge from TK Electronics, Dept EE, 106 Studley Grange Road, London, W7 2LX. A 230 × 152mm stamped addressed envelope is required.

Only 7 pages make up the Ace Mailtronix catalogue, but most components called for in our projects are listed. They are also prepared to obtain some of the more difficult components

Cost of the catalogue is 30p which is redeemable with orders over £5.

CONSTRUCTIONAL PROJECTS

Looking through the components list, we do not envisage any component buying problems for our special Christmas projects, *Peg-A-Hole*, *Everlasting Candle* and *Twinkling Star*.

Most readers will, no doubt, use their own ingenuity for the housing of the *Everlasting Candle* (an old torch perhaps?), however Home Radio are able to supply a complete kit, including ceiling rose and plastic tubing.

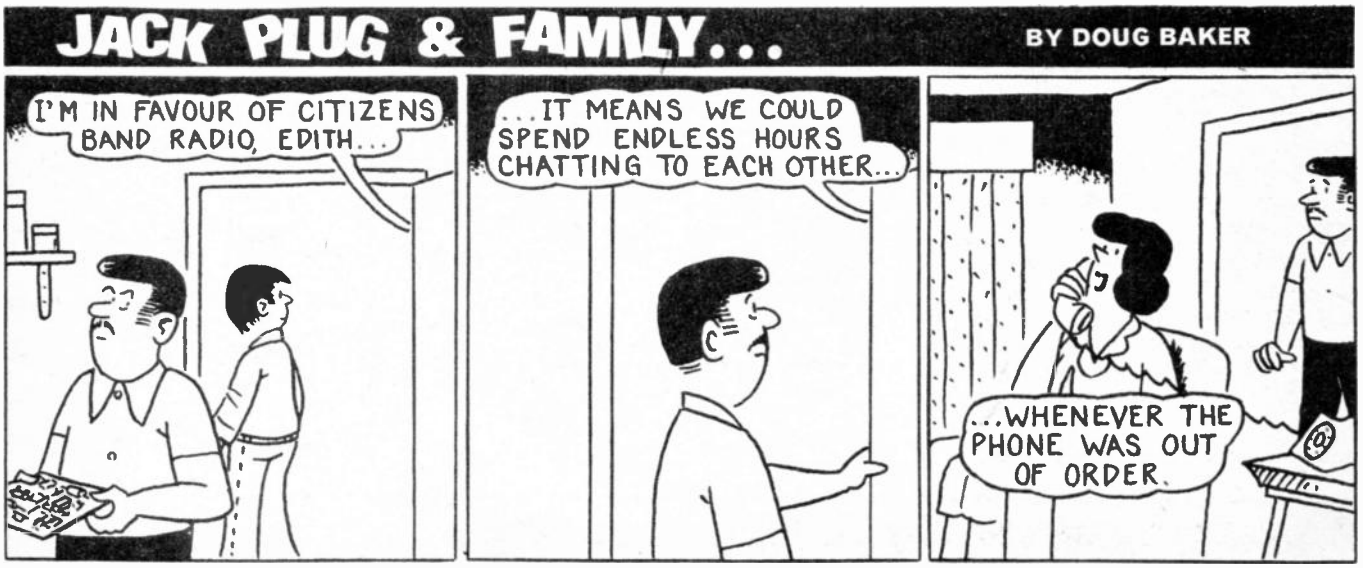
All the "specials" for the *EE Radio Control System* were covered last month. The additional components, including crystals, listed this month should be available from most advertisers.

The only item likely to be difficult in our *Uniboard Burglar Alarm* project, is the thyristor MCR102. This would appear to be only available from Maplin. However, the 2N5060, 2N5061 or 2N5062 could be used.

The components for the *Modulated Tone Generator* should present no buying problems. The power transistor specified can be substituted by many other power types, for example the common 2N3055. Plastic types are not essential since TO-3 and TO-66 cased versions can easily be mounted "off-board" on heatsinks (required for higher power outputs) and connected by leads to the board positions.

Any type of miniature or sub-miniature relay capable of operating at 9V, with a coil resistance of approximately 185 ohm, should be suitable for the *Lightcall* project. However, the relay contacts must be rated at 240V current as required.

The relay used in our prototype model was the RS Components 12V 185Ω, stock No. 348 980.



LIGHTCALL

visual back-up for your doorbell

By T. R. de Vaux-Balbirnie

THIS PROJECT was designed to give a visual indication when a caller operated the doorbell. It was originally intended to enable someone working in the garden to be aware of a caller and this was achieved by operating a bright bulb in a prominent position.

The author quickly realised that the same system could benefit deaf people or could be used in any situation where either, distance or extraneous noise prevented the bell or chimes from being heard.

FEATURES

The Lightcall has the following features.

First, it is an add-on unit with its own power supply. Only two simple connections are made to the existing doorbell circuit, the operation of which is quite unaffected. Secondly, the circuit is designed to switch on one or more *mains* voltage bulbs. Small bulbs operated by a battery are not really bright enough to attract attention. Thirdly, there is a variable time delay element which switches the bulb, or bulbs on for a preset interval. This is quite independent of the length of time the bell push is operated.

TIME DELAY

The prototype gives delays as short as two or three seconds and as long as one minute. If a longer time interval is required this is easily obtained by increasing the value of C1. A push button switch on the unit, or indeed elsewhere may be used to cancel the light at any time. Finally, it does not matter what type of bell or chimes are used. They may be battery or mains operated.

If desired, the Lightcall may be built complete but without the mains wiring. An electrician may be called in to do this work and the wires simply connected to the terminal block on the unit. This might be the best plan where several lamps are to be run in different locations or where weatherproof housings are required for outside use.

CIRCUIT DESCRIPTION

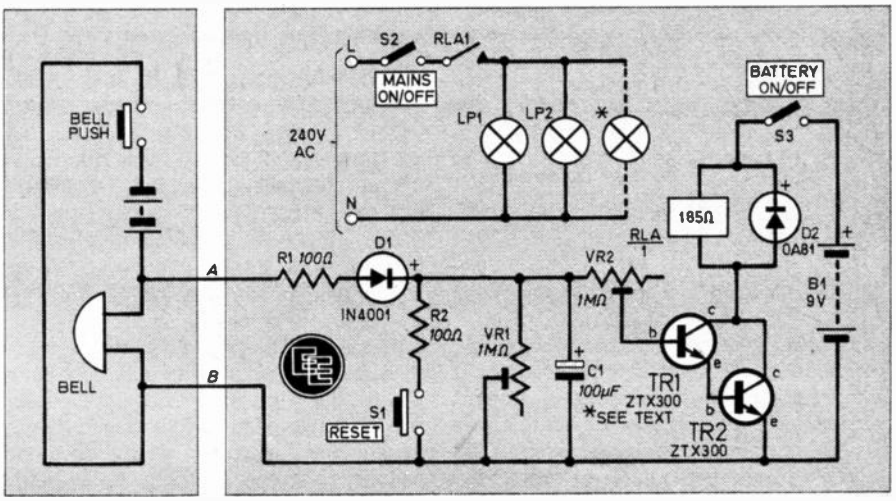
The full circuit of the unit appears in Fig. 1. When the bell push at the door is pressed, current flows momentarily through a current-limiting resistor, R1, and diode D1. It then flows to the electrolytic capacitor C1. This charges rapidly and cannot discharge through the bell because of the action of D1. Current may "bleed" from this charged capacitor by two paths.

First, it may pass through the high value preset variable resistor VR2 to the pair of transistors TR1 and TR2. These transistors are therefore held on as long as C1 can supply the necessary current.

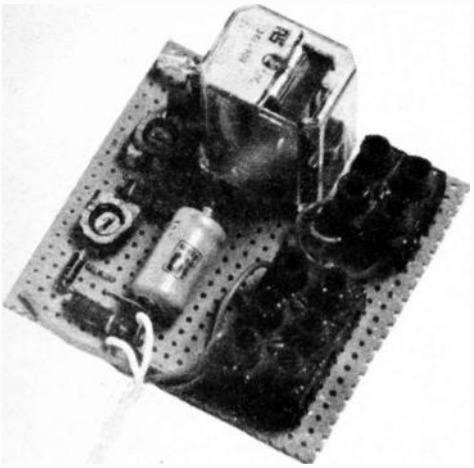
DARLINGTON PAIR

Two transistors connected together directly in this way are called a Darlington pair. They behave as one transistor with very high current gain so that a very small base current in the first transistor will turn or hold the second one on. If only one transistor were used, C1 would not be able to keep up the necessary current for long. As it is, C1 can supply the current for one minute or so. When the transistors are on

Fig. 1. Circuit diagram of the Sight and Sound Doorbell.



valuable aid for the hard-of hearing



the relay, RLA is energised and a pair of normally open contacts switch on the mains bulbs. There is a second discharge path for C1. This is through the variable resistor VR1. This gives the variable time setting.

The cancelling switch, S1 is of the push to make type and allows for rapid discharge of C1 through the current limiting resistor R2.

If it is anticipated that longer timing periods will be required then a higher value for C1 should be used from the outset. A value of 470 or even 1000 microfarads will greatly increase the maximum times available. Short periods will become very tricky, however.

CONSTRUCTION starts here

CIRCUIT BOARD

Construction is very straightforward and is based on 0·1 inch matrix stripboard. A suggested layout is given in Fig. 2 but it is not critical. The copper strips must be cut in the places indicated on the diagram and care must be taken to avoid bridging between the strips during the soldering stage.

In the prototype a square hole was cut in the stripboard to allow all the terminals of the relay to pass through. This will depend to a large extent on the relay used. A relay socket may be used if desired but this was not considered necessary for the prototype. It is not a good idea to use the copper strips for mains connections and all relay connections are made direct. To avoid possible trouble, the copper strips should be broken in the vicinity of the relay connections.

COMPONENTS

The relay deserves special mention. This must operate reliably from a 9 volt supply. Many relays sold as 6/12 volt types are suitable but if in doubt the manufacturer's specification should be checked. It is essential that the relay should have at least one set of normally open contacts. The current handling capacity should be at least one amp at mains voltage for up to 240 watts of load—say 4 off—60 watt bulbs. If a greater load is anticipated then contacts with a greater current capacity will be needed, 3 amps for up to 720 watts, etc. There is no harm, of course, in the relay having contacts with a current rating greater than that required. The important point is that the contacts must be suitable for *mains* use.

The resistance of the coil of the relay used in the prototype was 185 ohms but this is not thought to be particularly critical. The purpose of diode D2 is to prevent back e.m.f. as the magnetic field collapses in the relay. Without it there is a possibility of damage to the transistors. The author left D2 out originally without damage but it is certainly advisable to include it. Note the way in which D2 is connected—not in the direction of battery current but *against* it.

EXTERNAL CONNECTIONS

External connections are made to two miniature terminal blocks Fig. 2. It was thought best to use a separate 2-way block for the mains connections and a 3-way for the other connections. This was to avoid as far as possible any mains connections being made wrongly. This could prove disastrous.

Although a small self contained battery could give reasonable service, it was decided to use a larger 9V battery outside the case. During periods of non-use the battery drain is exceptionally low, but of course there is a drain each time the relay operates in the course of service. For periods of absence, a toggle switch, S3, is provided in the battery positive line. When switched off the device is totally inoperative. A mains switch S2 should also be provided to give isolation from the mains when required to do so. This will not normally be used but it would be bad practice to omit it.

COMPONENTS approximate cost £2.50 (excluding bulbs)

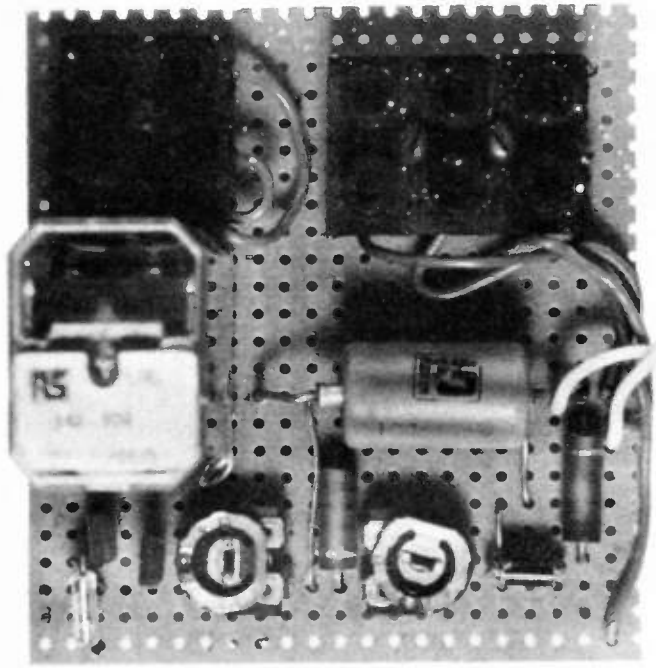
It would also be possible to use one double-pole mains switch to fulfil both functions but possible confusion over connections makes this an unattractive idea. Two separate switches are definitely advised. The two switches just mentioned together with the cancelling switch, S1, will be mounted on the front panel of the unit. As mentioned previously, S1, could be placed elsewhere or even several switches in parallel could be used. This would mean that the unit could be cancelled from various locations. A small plastic box was used to house the circuit in the prototype.

When connecting C1 it is essential to observe polarity. In other words, its positive and negative connections must be made the correct way round. This is because C1 is an electrolytic capacitor and damage results if these are incorrectly connected. The polarity is indicated on the body of the capacitor. Any voltage rating over about 12 volts will be satisfactory.

TESTING

After construction, the unit should be tested in the following way.

For a start, no mains connections should be made, only the battery leads. Presets, VR1 and VR2 should be initially set to about mid position. The battery positive terminal should then be connected temporarily to connection *A* on the terminal block. A distinct click should be heard from the relay. Some time will elapse before it clicks back again. Some variation of VR2 may be needed for proper operation, whilst VR1 will alter the time interval.



The complete circuit board for the Lightcall showing the layout of components and mounting of the terminal strips.

COMPONENTS

Resistors
R1, 2 100Ω (2 off)
Both ½W carbon ± 5%

Potentiometers
VR1, 2 1MΩ miniature horizontal preset (2 off)

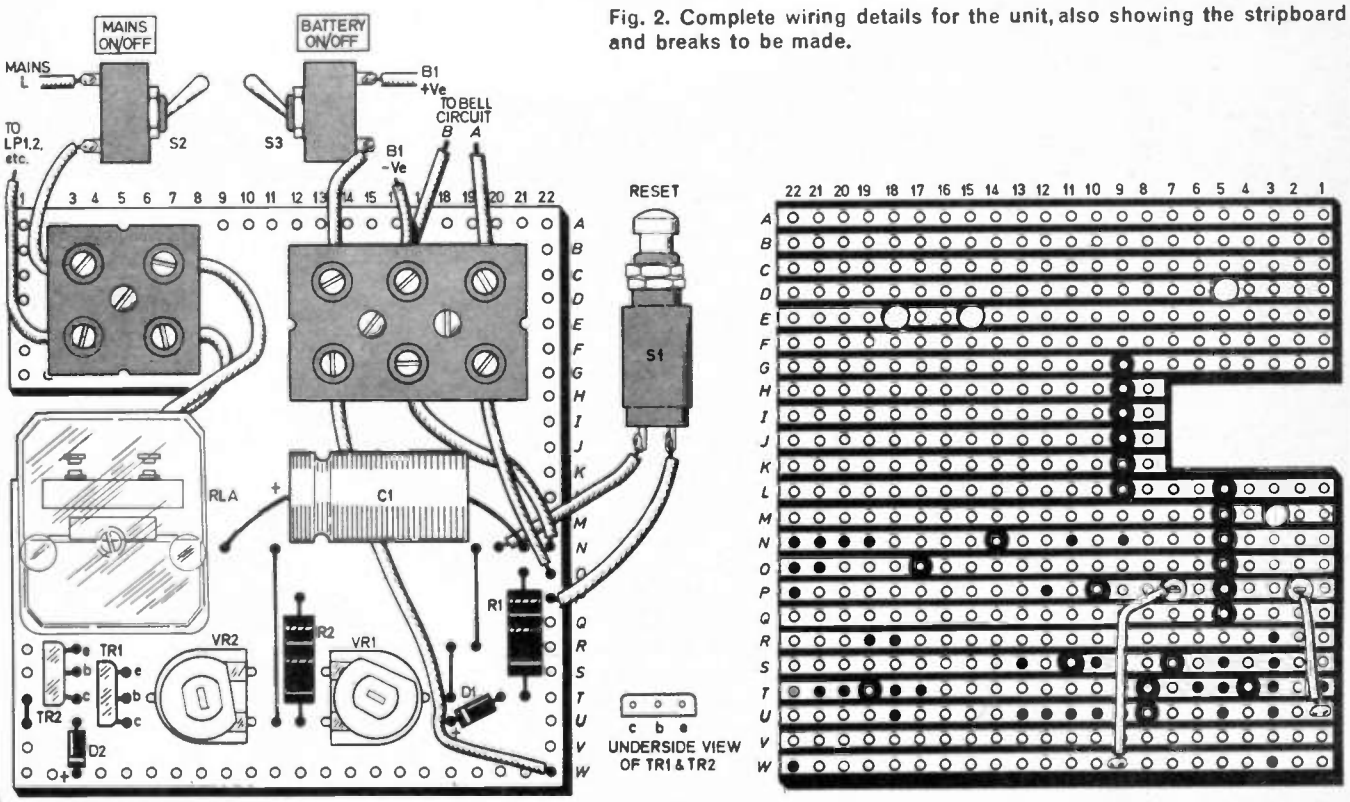
See Shop Talk page 798

Capacitor
C1 100μF 12V elect.

Semiconductors
TR1, 2 ZTX300 silicon *npn* (2 off)
D1 1N4001 silicon
D2 OA81 germanium

Miscellaneous
S1 push to make press switch
S2, 3 standard single pole toggle
RLA 9V relay, 185Ω coil with one make contact
LP1, 2 240V 60W bulbs as required
B1 PP6 9V battery
Stripboard: 0·1 inch matrix 23 strips × 22 holes; small plastic terminal blocks, 1 off 3 way, 1 off 2 way; battery connector for B1; small plastic case, size as required; connecting wire.

Fig. 2. Complete wiring details for the unit, also showing the stripboard and breaks to be made.



It will be noted that the setting of VR2 has some effect on the time interval as well as VR1 as this controls the current flowing to the transistors. It is important, whilst experimenting with the settings of VR1 and VR2, not to set VR2 to too low a value i.e. on anti-clockwise rotation of VR2 a small margin must always be left before the end of the track. If this is not done, damage may occur to the transistors due to excessive base current flowing.

IN USE

Assuming all is well, the leads *A* and *B* are connected to the doorbell. If the doorbell is battery operated it is necessary to connect lead *A* to the positive terminal. It is not harmful to do the opposite but the project will not work as current will not then flow through D1. If uncertain about the polarity, then the best plan is to connect *A* and *B* by trial and error. If the doorbell is transformer operated it does not matter which way round *A* and *B* are connected as the diode D1 will conduct on the positive half cycles of the alternating current.

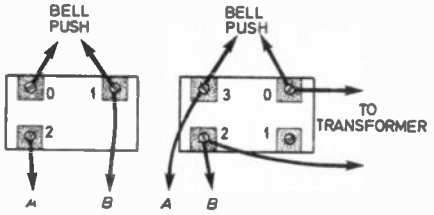


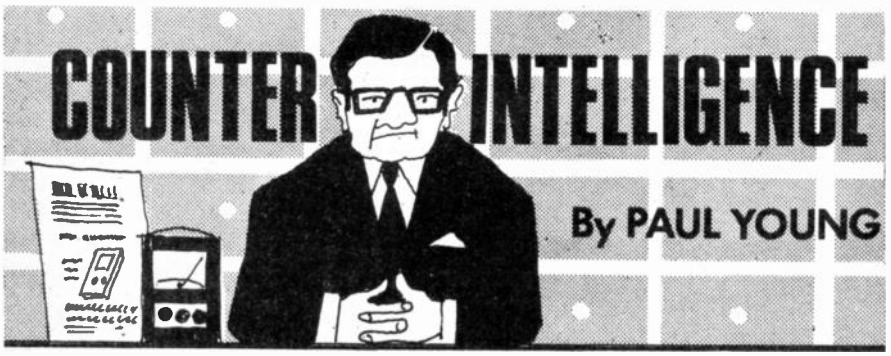
Fig. 3. Typical connections to two of the most popular types of bell systems. These connections are for guidance only and will not necessarily be correct in all cases.

There are many types of doorbells and chimes in use today so specific details of the connections cannot be given. It is largely a matter of common sense finding the connections which are directly across the bell. In an effort to help some readers, connections for two popular units are illustrated in Fig. 3.

If the circuit functions correctly it is suggested that a simple battery and bulb circuit should be used to check the action of the relay contacts. If this works correctly, the mains part may then be completed. It is important to remember that the mains circuit should be protected with a fuse according to the current requirements of the bulbs. This far is not shown in the circuit diagram, but should be wired in the live lead of the mains. Alternatively connection to the mains could be made via a fused plug.

This little device lets you know visually when a caller is there. You may heed it or ignore it as you please.

⌑



New ideas

IN SPITE of my gentle leg pulling, I am all for new ideas, and I think it is only right and proper, that us chaps who sell the electronic hardware for, what is after all, the most advanced science, in the world, should be. I certainly have never shirked my duty in this respect or even put personal safety first.

I must have bought the first pressure cooker ever offered for sale. I bought it, and let my wife try it, while I stood outside the house with my fingers in my ears. Well after all you cannot be too careful!

I rushed out and bought one of the first quick heat soldering irons. "Heats Up In Ten Seconds" said the makers and so it did. Unfortunately, I was building a Quality Amplifier at the time and only when I was half way through, did the truth dawn on me, that if you have to wait ten seconds before you can make each joint, a conventional iron is ten times faster!

I think I must have had the first turntable for playing long playing records and one of the first stereo "out-fits".

Even so I have occasionally had my doubts, a case in point being digital presentation instead of analogue, particularly for watches and test gear, and in this respect it looks as though time is proving me right. It seems that even the power station engineers get dizzy seeing numbers flash before their eyes instead of a large black pointer making a leisurely sweep, to the right or left and in America the conventional watch face is making a come back.

It is strange how the human eye or the mind, prefers the analogue view. The reason for it, may be just this, we have been looking at analogue presentation for over 5000 years. I am thinking of course of sundials.

Another recent invention I am not happy about, is the Microwave cooker. For a start I am always suspicious of loud proclamations made by Government Departments or powerful manufacturers and if either of them tell me something is perfectly safe, I immediately assume it isn't!!! There have been cases of radiation leakage with these cookers and the consequences can be very serious.

While we are being told they are perfectly safe, I now see special depots are being set up to check them, and someone is even offering for sale a pocket radiation leakage tester, so you can test your own! Nuff said!

Don't suffer in silence

I am sure half our troubles today are caused by lack of communication. This aspect is particularly applicable to the home constructor who so often relies on mail order for the supply of his bits and pieces.

Every firm makes mistakes, but I know of none, who would not go to great lengths to put them right, once they know, and this is the operative phrase. I am bound to admit that the post today leaves a lot to be desired and this does not help the situation, but as my dear old medico used to tell me, "Don't suffer in silence".

In other words if something has gone wrong write or telephone your supplier, tell him concisely what your complaint is and he will put it right as quick as he can. Most of you I know are very good in this respect, although, a very small minority regard the postal service as perfect and accuse us of making it a scapegoat for any delays.

Try and remember (I am sure you do) that most of us are short staffed and time is precious, so short letters are our favourites. Above all do not put technical queries in with orders or complaints, and if it is about a project, do not send it to us at all, but to the appropriate source.

Sometimes, but fortunately only about once or twice a year, I get a customer who seems to have all the time in the world on his hands, as a result, if he gets one incorrect item in his parcel he sends me a four page letter. I had one recently, and I wrote a letter simply asking him how much we owed him on the postage for returning the wrong part and what did he want us to send him.

Back comes another four page letter telling me how superior all my competitors are and how wicked I was for trying to blame the PO for the delays. This time in desperation I wrote and told him that during the War, Churchill made an agreement with Russia on half a sheet of notepaper, would he please be a good fellow and follow his example!

MODULATED TONE GENERATOR

by R. A. PENFOLD

THIS UNIT provides a very effective audible alarm signal which consists of an audio tone of rapidly changing pitch. The output power of the unit depends upon the supply voltage and speaker impedance selected, and varies from about 112mW with a 6 volt supply and 80 ohm speaker to approximately 4·5W with a 12 volt supply and 8 ohm impedance speaker.

The alarm is therefore suitable for use in fairly high power applications such as burglar alarm systems, as well as in lower power circuits such as timers.

In order to aid the selection of a suitable supply voltage and speaker impedance, Table 1 is provided. Apart from giving the nominal r.m.s. output powers for various speaker impedance and supply voltage combinations, it also gives the approximate mean current consumption.

The circuit has a gating input which can, if required, be used to electronically control the alarm, rather than simply switching it on and off by means of the power source. This enables the unit to be easily controlled by many circuits without the need for a relay or other form of driver circuit.

It should be possible to use it as an add-on alarm, perhaps for a circuit which already has an alarm, but one which proves to be ineffective for some reason.

THE CIRCUIT

The complete circuit diagram of the Modulated Tone Generator appears in Fig. 1. This is based on two oscillators: one to generate an audio tone, and the other to frequency modulate the tone generator. This gives a much more noticeable sound than that given by a single tone.

Both oscillators are based on the same integrated circuit, which is a CMOS Quad 2-input NOR gate (IC1). Two gates are used in each oscillator. Although this device is not specifically designed for use in oscillator circuits, it lends itself well to such applications and is often used in this mode.

The output of a NOR gate assumes the high logic state (virtually equal to the positive supply rail voltage) unless one of the inputs is taken to the high state. The output then goes to the low logic state (virtually equal to the negative supply potential).

In this case, one input of each gate is taken to the control input, and if this input is high, the output of each gate must be low and the other four inputs will have no effect on the circuit. With the outputs low, TR1 and TR2, which are connected as a Darlington pair, will be cut off and no significant current will be supplied to the speaker. The circuit will be blocked and only small leakage currents of about 1μA in total will be drawn from the supply lines.

With the control input at the low state, the output state of each gate will depend upon the logic state of its second input. If this input is low, the output will go high, and if it is high, the output will go low. In other words, there is a simple inverter action between the input and output.

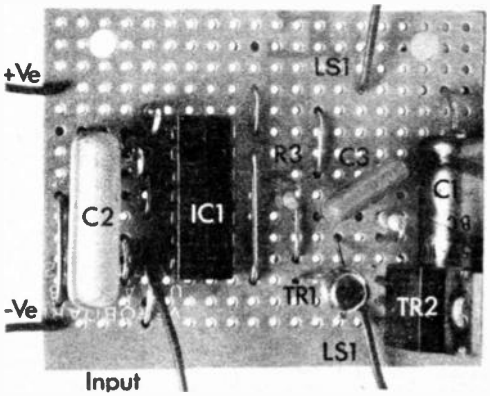
INVERTERS AS OSCILLATORS

Now CMOS inverters are easily made to function as oscillators by adding two stages in series, biasing the first stage with a resistor connected between its input and output, and using a capacitor to provide a positive feedback path between the output of the second stage and the input of the first stage. This configuration is used for both oscillators in this circuit.

Inverters G1c and G1d are used in the tone generator oscillator, and the specified values for R3 and C3 give a nominal operating frequency of about 800Hz. A square-wave is produced at inverter G1d output, and on positive excursions TR1 and TR2 are switched hard on

Table 1. Table showing r.m.s. output power and mean current consumption for various speaker impedances and supply voltage options.

LOUDSPEAKER IMPEDANCE (Ω)	SUPPLY VOLTAGE (V) 6	9	12
8	1·125W 375mA	2·53W 562mA	4·5W 750mA
16	562mW 187mA	1·27W 281mA	2·25W 325mA
25	360mW 120mA	810mW 180mA	1·344W 240mA
40	250mW 75mA	506mW 112mA	1W 150mA
80	112mW 37·5mA	253mW 56mA	500mW 75mA



The completed prototype board.

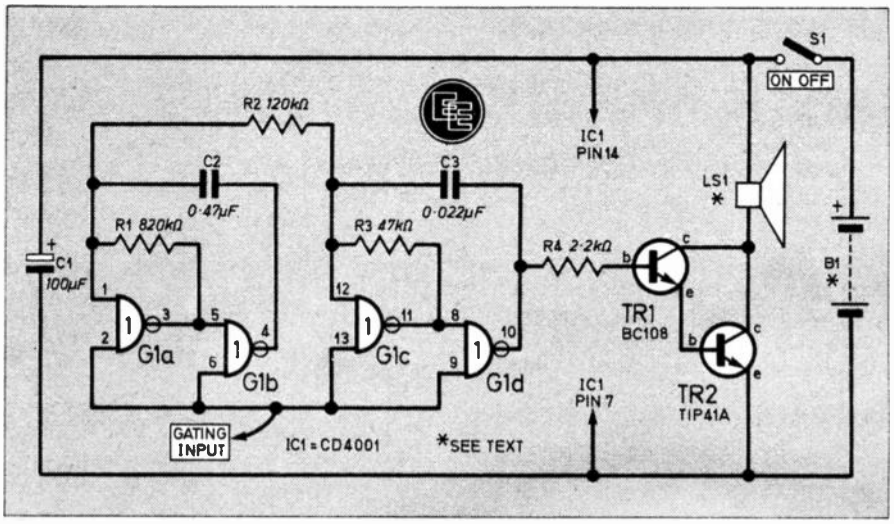


Fig. 1. The complete circuit diagram of the Modulated Tone Generator.

by the base current they receive via R4. This causes a series of pulses to be fed to the speaker and an audio tone to be generated.

The modulating oscillator uses inverters G1a and G1b. The bias resistor (R1) and feedback capacitor (C2) have much higher values than their equivalents in the tone generator circuit, and this gives a much lower operating frequency of only about 1 to 2Hz.

The waveform at pin 1 of G1a is a form of sawtooth signal, and it is this that is used to modulate the tone generator. The necessary coupling between the two oscillators is provided by R2.

As the modulating signal's voltage rises and falls, the current flowing through R2 alters the timing of the tone generator circuitry, and sweeps the output tone up and down in frequency.

Capacitor C1 is merely a supply decoupling capacitor.

If the gating facility is not required, the gating input is permanently wired to the negative supply rail so that the unit always operates when the power is switched on.

CONSTRUCTION starts here

The unit is assembled on a piece of 0·01inch matrix stripboard, 15 strips by 20 holes. The component layout is shown in Fig. 2. There are eight breaks in the copper strips, as detailed in the diagram, and it is advisable to make these before soldering in the various components. If the appropriate tool is not available, they can be made using a hand held twist drill of about 4mm in diameter, or using a sharp modelling knife.

The components and link wires are then soldered into position, the integrated circuit being left until last. This is a CMOS device which can be damaged by high static voltages. It should be supplied in some form of protective packaging, and should be left in this until it is to be soldered into position. It should then be handled as little as possible and soldered in place using a soldering iron having an earthed bit.

An i.c. socket could be used for this component, of course, but the CD 4001 is such an inexpensive device that this is probably not worthwhile.

COMPONENTS

Resistors

R1	820kΩ	R4	47kΩ
R2	120kΩ	R5	2·2kΩ
R3	47kΩ		

All ¼ Watt carbon ±5%.

Capacitors

C1 100μF 12V elect.
C2 0·47μF polyester (C280)
C3 0·022μF polyester (C280)

Semiconductors

IC1 CD4001BE Quad 2-input NOR gate
TR1 BC108 silicon *npn*
TR2 TIP41A silicon *npn*

Miscellaneous

LS1 8Ω to 80Ω loudspeaker (see text)
B1 6V to 12V (see text)
Stripboard: 0·1 inch matrix 15 strips × 20 holes; connecting wire.

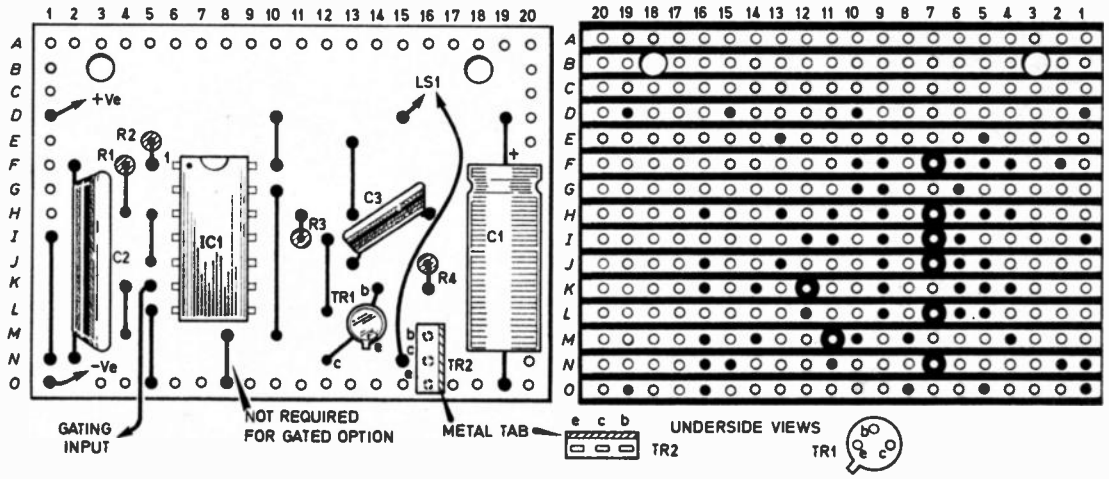
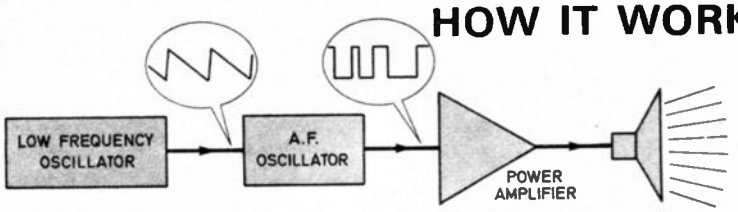


Fig. 2. The layout of the components on the topside of the stripboard and the breaks to be made on the underside.

HOW IT WORKS



The circuit utilizes two oscillators; one to produce an audio tone, and the other to automatically vary the pitch of this tone. The modulating oscillator operates at a frequency of about 1 to 2Hz, and its output therefore causes the pitch of the tone oscillator to rise and fall about once or twice per second. This rapidly varying of the output note produces a very noticeable and effective alarm signal.

Only a low power signal is generated by the oscillators, and this is considerably amplified to produce a very loud tone via a loudspeaker.

COMPONENTS approximate cost £2

USING THE UNIT

It is important to ensure that the loudspeaker employed with the alarm has a suitable power rating, although slightly exceeding this rating is unlikely to have any detrimental effects in this particular application. If the highest possible volume is required it is advisable to use a fairly large speaker since these generally have higher efficiencies than smaller types.

If the alarm is being controlled by the gating input, it must be borne in mind that the alarm is switched on when this input is low, and turned off when it is high. If the opposite of this is required, it will be necessary to add an inverter stage at the input. Incidentally, in this case the low logic state means less than one third of the supply voltage, and the high state means more than $^2/_3$ of the supply potential.

This unit is compatible with the popular NE555V timer i.c. and many other devices and circuits.

If the alarm is supplying an output power of more than about 2 watts it is advisable to fit TR2 with a small finned heatsink, as it might otherwise overheat and be destroyed.

The frequencies of the modulator and tone oscillators can, if desired, be altered by changing the values of C2 and C3 respectively. Decreasing the value proportionately increases the frequency of operation, and vice versa.

No case fixing details are supplied as it is likely that this device will be added to existing units. ⌑

By L. ARMSTRONG • H. DICKINSON • W. WILKINSON

PART TWO

EE RADIO CONTROL SYSTEM

TRANSMITTER CONSTRUCTION & FIELD STRENGTH METER

AS EXPLAINED in Part 1, the first major concern before starting construction is to decide how many channels you are going to have; remember you can have any number up to seven. Having decided, there is one more option to decide upon: that is the plug-in channel facility which requires the 3-pin plugs and sockets.

HARDWARE

As was mentioned in the Introduction last month the whole of this R.C. system has been based where possible on commercially available parts, this is especially so in the case of the transmitter where the sticks, case and plugs and sockets and other sundry items are manufactured by S.L.M. (Model) Engineers Ltd. of Cheltenham. It is strongly recommended that these identical parts (especially the case) are used in order to have a neat and tidy system as an end-product.

We will describe the construction from the point of view of using these parts. However, should you decide to make your own case, purchase the sticks, meter, switch, etc., *before drilling and bending* so that their position can be chosen to enable the p.c.b. to be mounted on the back of the sticks.

The S.L.M. case as specified comes ready bent with plastic sides and holes punched for a pair of open gimble sticks, so if you require more than four channels then extra holes and slots will have to be cut where required. However, the case does have holes cut for the aerial socket, meter, Noble switch and charger socket.

PRINTED CIRCUIT BOARD

Most of the transmitter circuit is built on a printed circuit board. A full-size pattern of the p.c.b. is given in Fig. 2.1 and the top view of the board showing the disposition of the components appears in Fig. 2.2.

Assembly of parts on to the p.c.b. should commence with the stick socket(s) SK1.

In the case of the full system this means the 7-way block, and for less than seven channels the single 3-pin sockets are used. Channel 1 is at the top and Channel 7 at the bottom of the board, so if only three channels are going to be used then the sockets should be inserted into the top three positions.

If you are not having the channel reverse option, that is no sockets, then leave the necessary spaces for the wires to be soldered directly to the board at a later date (Fig. 2.2). Unused channels will have wired in their place fixed resistors Ra and Rb as in Fig. 2.3a. These are positioned on the p.c.b. as in Fig. 2.3b in place of the sockets or wires.

Resistors R4 to R10 can now be inserted between the block and IC1. When inserting these resistors stand them up in the hole nearest IC1 then pass the other lead through either of the holes in the island next to the block then loop under and solder to the centre pin of the block and to the island itself (Fig. 2.4).

Where the Ra and Rb resistors are used then the lead is cut off at the island as per Fig. 2.3b.

CRYSTAL SOCKET

The crystal socket SK3 can be inserted next by locating its two plastic lugs in the p.c.b. holes and melting them into place on the copper side using the side of your soldering iron bit. Small lengths of tinned copper wire are used to connect from the crystal socket pins to the p.c.b.

Insert the two links and the aerial loop using the same type of wire. Something in the region of 20 s.w.g. wire is best for these connections and links; however, if you do not already possess something suitable then use the chopped-off resistor leads.

CARE WITH ICS

The remaining components can now be inserted in any order providing the CMOS i.c.s IC1 and IC2 are left until last, as these can be damaged by static electricity.

For those constructors not familiar with CMOS there are two precautions to take that virtually eliminate any possibility of damage. The first of these is to ensure that your soldering iron is earthed correctly and the second is to keep the i.c.s in their black conductive foam until you are ready to insert them into the board and then to do so as quickly as possible with the least amount of handling; try to avoid touching the leads.

POTENTIOMETER CONNECTIONS

Having now completed the insertion of the components the connecting wires to the pots can be attached for

ADDITIONAL COMPONENTS REQUIRED FOR LESS THAN 7 CHANNELS

Resistors

Ra, Rb 2·7kΩ (one pair for each unused channel)
¼W ±10% carbon

Plugs and Sockets

3-pin plug and socket (one pair for each channel used—instead of 7-way block for full system)

Sticks

Single-axis sticks (for less than 4 channels—see Table 1·1)

CRYSTALS

X1, 2 pair of 27MHz band crystals with 455kHz spacing (one for transmitter and one for the receiver—see text)

NOTE—CIRCUIT DIAGRAM Fig. 1.3
Transpose SK2 pin numbers 1 and 3 to agree with Fig. 2.6.

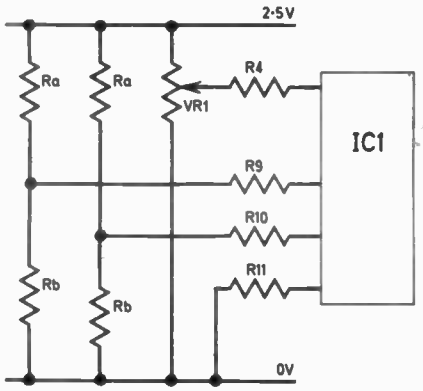


Fig. 2.3. (a) Part of channel switching circuit (see Fig. 1.3) showing additional resistors Ra and Rb fitted to unused channels.

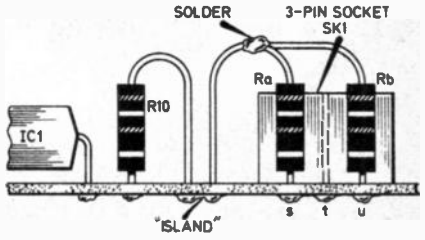


Fig. 2.3. (b) Edge-on view of p.c.b. showing how the additional resistors are mounted in place of the 7-way socket block. (Individual 3-pin sockets are installed for each channel used).

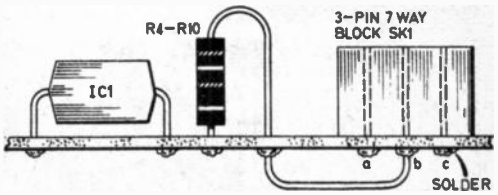


Fig. 2.4. Edge-on view of p.c.b. showing resistors R4 to R10 and their connection to the 7-way socket block.

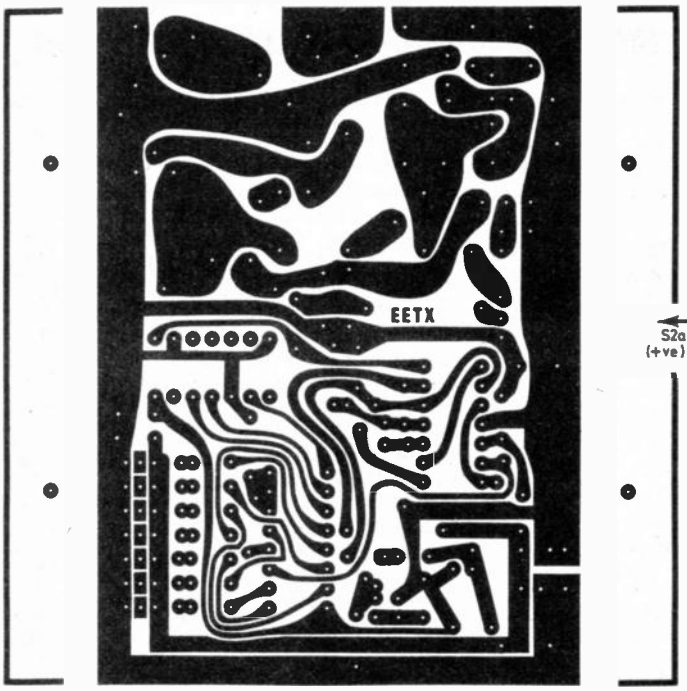


Fig. 2.1. Printed circuit board for the EE Radio Control Transmitter. This is actual size. Note the fixing holes on the outer "plain" or completely etched areas.

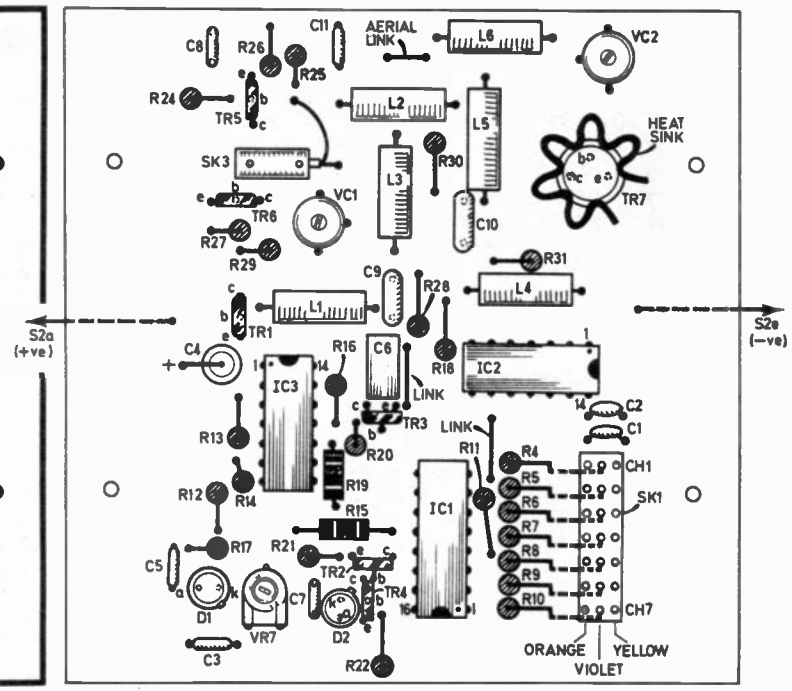


Fig. 2.2. Top view of the printed circuit board with all components in situ (full 7-channel version).

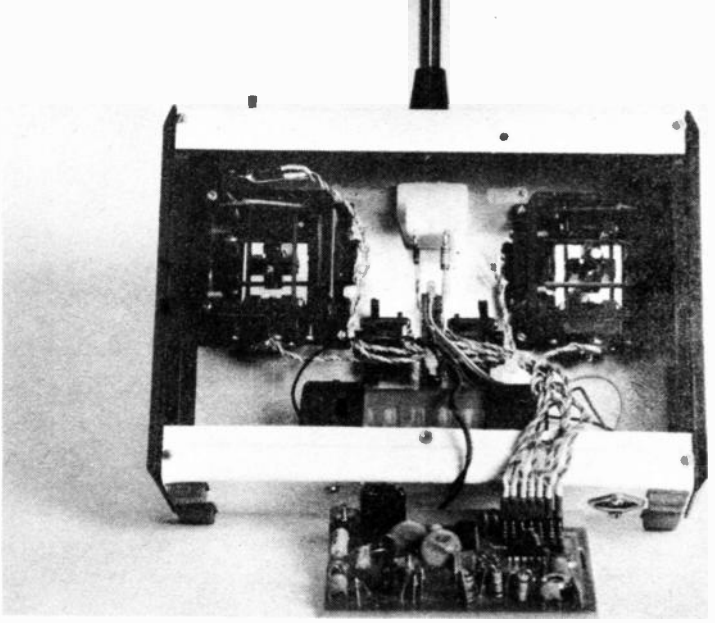
COST TO BUILD

Approximate cost for different-sized systems.

Two-channel version	*£75*
Four-channel version	*£110*
Seven-channel version	*£170*

The cost for each version includes all units specified in Part 1.

The EE Radio Control System is fully capable of expansion from two channels to seven channels at anytime, simply by fitting additional sticks and servos.



those constructors not using the sockets. Fig. 2.2 shows the points to connect to. For tidyness sake the wires should be twisted together to form a trio; 6in lengths should be sufficient to attach to the board for now, final trimming to length can be performed at a later date when the board is inserted into the case.

If you are using the sockets, then these 6in lengths of wire should be attached to a 3-pin plug as shown in Fig. 2.5a. The sleeving over these connections should be of the heat-shrink type to grip the wire securely, but should not exceed $^1/_4$in in length as it is possible to foul the back of the case when inserted into the socket on the board.

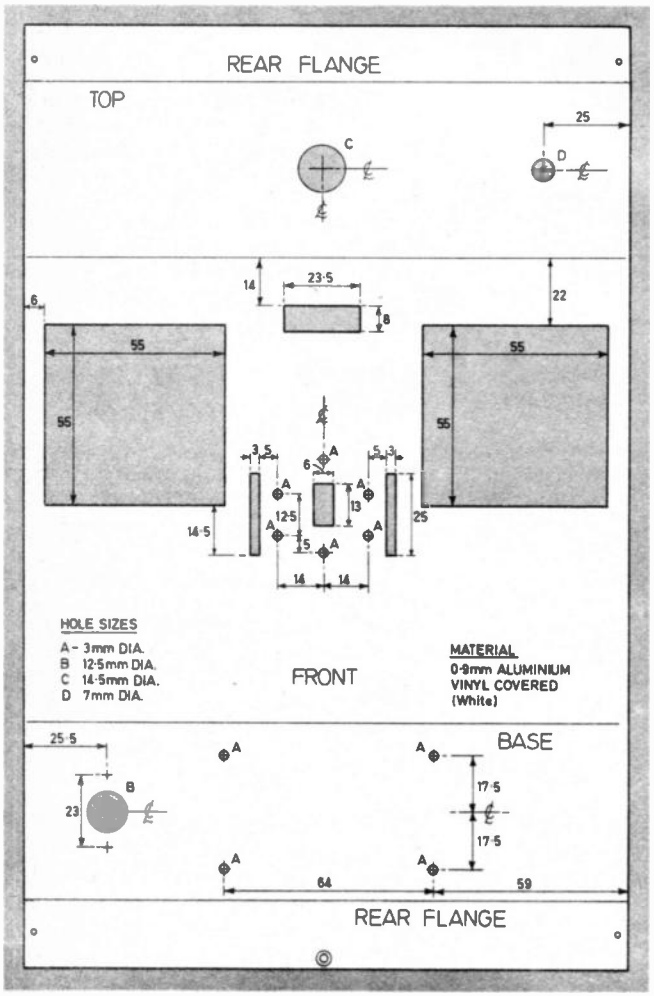


Fig. 2.5. Transmitter case panel opened out flat. Cut-out and drilling details to accommodate controls for seven channels.

CASE DRILLING

As already explained the case which comes from S.L.M. requires the extra holes to be cut for the 5th, 6th and 7th channels. So before construction decide upon the positions of these functions. See Fig. 2.5.

Fig. 2.7 shows the positioning of the two auxiliary function sticks on the front panel as used in the prototype. The 7th channel was a switch on the top panel positioned such that it was in easy reach of the right index finger. This requires a $^1/_4$in hole.

The only other drilling required is for the battery pack mounts which consist of two plastic end-caps for the button-type Nicad battery. These mounts require four 3mm dia. holes as in Fig. 2.5.

ASSEMBLY WITHIN CASE

Start assembly with the smallest parts (such as the switch and meter) first, as once the open-gimble sticks are in place there is not much room left for tightening nuts and screws.

Before the channel switch S1 is mounted it is best to solder on to this switch the resistors R1, R2 and R3 as in Fig. 2.5.

POTENTIOMETER ADJUSTMENT

Before the sticks can be inserted the pots need to be secured in the stick assemblies and for this you will require to have a multimeter to hand.

The pots are fitted in place with their fixing screws loose enough so the pot body can just be rotated; then, with the stick in the neutral position (don't forget the trim on the main sticks) the pot is rotated until the wiper of the pot is in the centre.

To do this set your multimeter to the resistance range and connect one lead to the pot wiper connection then take a reading of the resistance to each end of the pot and move the pot in the required direction until both readings are the same, then tighten the securing screws.

With the screws now tightened check the readings again to make sure that there was no movement during tightening. If there was then you will have to set up the pot again. **It is most important that the pot wiper is in the centre to ensure that all channels have the same neutral pulse width and to also ensure there is no offset when the plug is turned round for channel reversing.**

FIXING ARRANGEMENTS

All the parts except the meter are secured to the case with small screws. The meter requires to be glued in position, using either an epoxy or contact adhesive. When using the glue ensure that none comes into

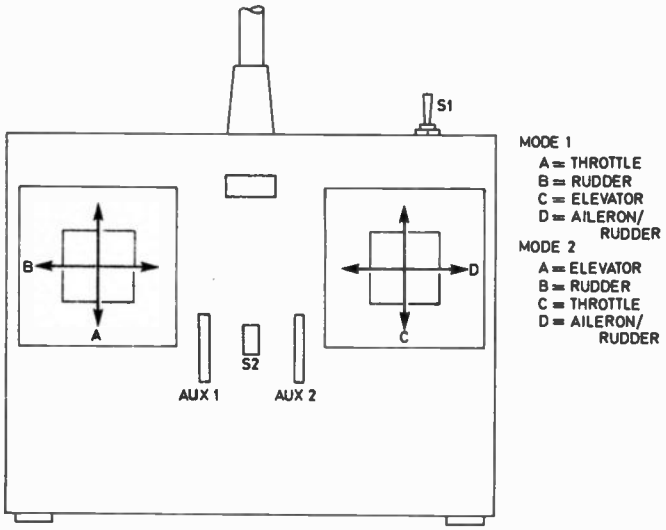


Fig. 2.7. Stick modes. Note: Throttle is usually a ratchet and all other functions are self-centering.

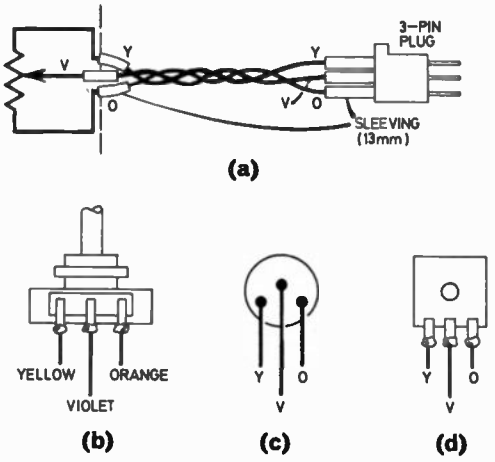


Fig. 2.8. Stick Potentiometers (a) connections to 3-pin plug (b) standard pot (c) cermet or plastic film pot (d) carbon film pot.

contact with the actual meter face as this will mar its appearance. All glueing should be done on its hidden face.

The aerial base should be bolted in place with a 6 B.A. nut and bolt of sufficient length such that it acts as the aerial locating screw as well. Position a solder tag on the bolt end, pointing out to the rear of the case so that it can be folded back down on to the loop of wire on the top of the p.c.b. when the board is in place.

With all the items now secured into the case the wiring-up can now proceed. Start with the supply connections as shown in Fig. 2.7. The voltage offset components D3 and R23 provide the connection between the meter and switch and their leads should be kept as short and as close to the case front as possible to avoid them coming into contact with the rear of the p.c.b.

Note that there is a central point for the ground leads on the switch S2, with the case earthed at the DIN socket SK2.

Now attach the wires to the stick pots. These wires were orginally left at a length of 6in. These can be trimmed to suit each stick such that they do not flop around and yet are not so short that they are a struggle to fit into the socket. A good idea, which was used on the prototype, is to use Ty-rap clips to hold the cables in one bunch to aid tidyness.

If you are not using the plugs and sockets then you should already have the wires connected to the p.c.b. so this should aid you to adjust the length correctly.

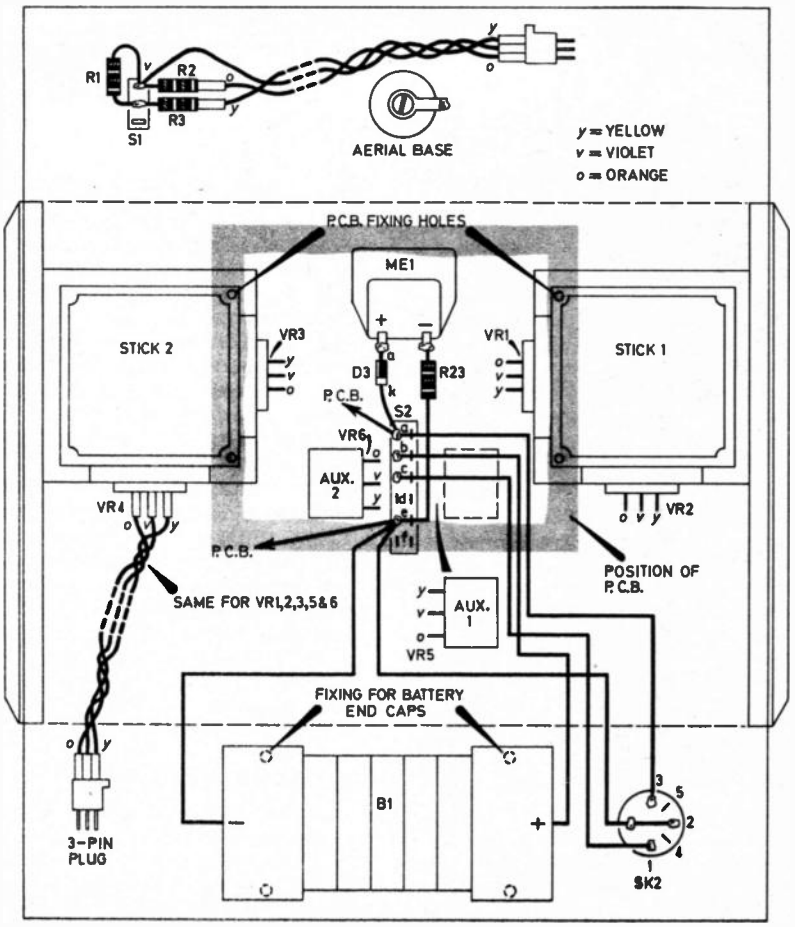


Fig. 2.6. Wiring within the case, to be completed before fitting the p.c.b.

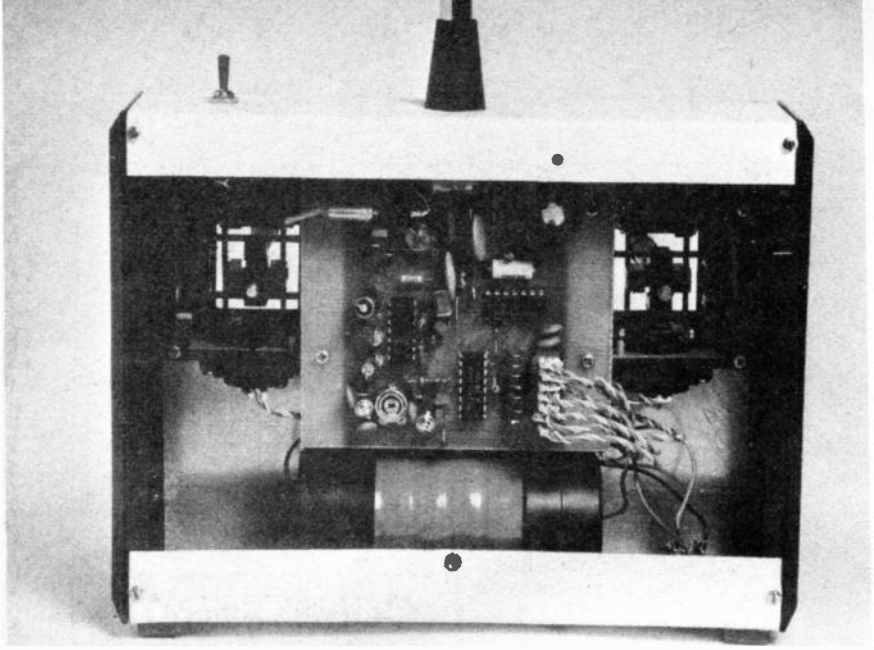
CHANNEL FUNCTIONS

An ideal order for the channels is to have the most used functions first as follows: (1) Aileron/Rudder, (2) Elevator, (3) Rudder, (4) Throttle, (5) Aux. 1, (6) Aux. 2, (7) Switch. Fig. 2.7 shows where these functions will appear on the sticks.

There are two basic modes used in radio control and there are advantages and disadvantages to both, however, the guide here is to find out from local modellers which system they use and then set up your system accordingly as this makes things easier when you ask them to test your model for you.

POTENTIOMETER VARIETIES

The stick assemblies available today come with several types of pot. Fig. 2.8 shows these different types and how to connect to them. If your stick assembly uses a standard pot then Fig. 2.8b is the wiring configuration, Fig. 2.8c is for the cermet or plastic film pot. Fig. 2.8d is another type of film pot available.

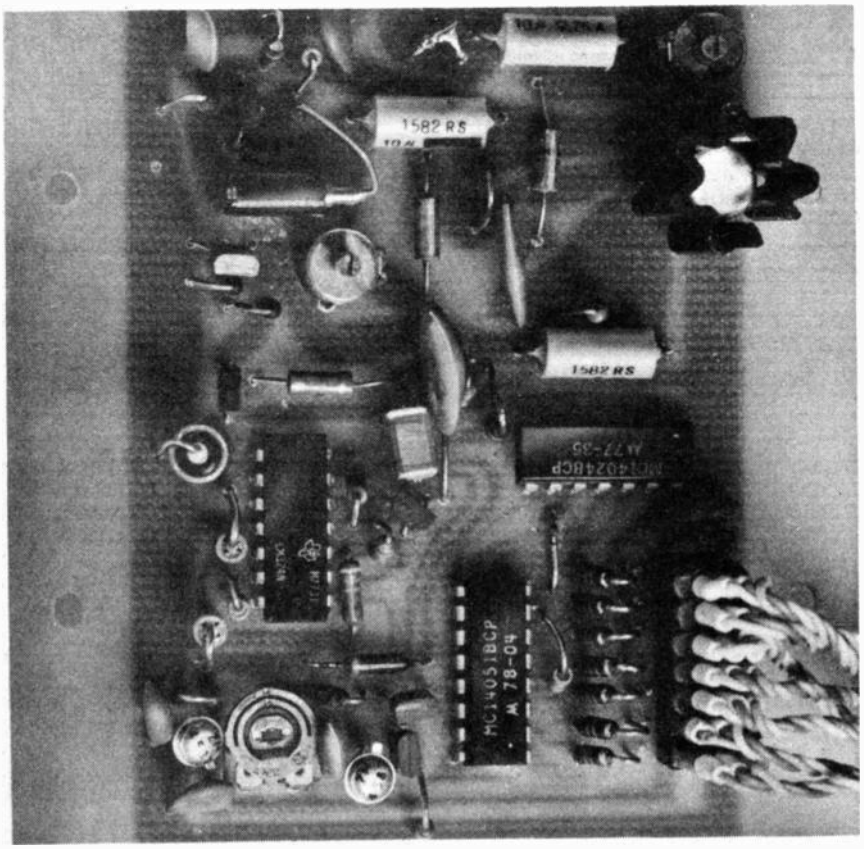


FIXING THE P.C.B.

The p.c.b. should now be ready for mounting. First ensure the switch S2 is off (switch knob down) then solder the two supply leads to the underside of the board.

To mount the board the two screws on each stick assembly nearest to the centre of the case require to be removed, then the p.c.b. can be placed components side to the rear of the case and located over the sticks such that the mounting holes coincide with the screw holes on the rear of the sticks. These screws can now be replaced and tightened so the p.c.b. is firmly mounted between the sticks.

The aerial is connected by folding the solder tag down on to the wire link at the top of the board and soldering well in place. The stick leads can now be plugged in the socket block on the board leaving only the crystal to be inserted to complete the transmitter.



CRYSTALS

Two 27MHz band crystals are required, one for the transmitter and one for the receiver.

The pair of crystals should have a difference of 455kHz between the values stamped on them, and it is the higher frequency of the two that is used in the transmitter. For example: 27·045 transmitter and 26·590: receiver.

Within the R.C. band there are 13 spot frequencies, each indicated by coloured pennants as in Table 2.1. You should always display the appropriate pennant on your aerial when using your transmitter to enable other modellers to recognise which frequency you are operating on.

TABLE 2·1
THE R.C. BAND SPOT FREQUENCIES

Transmitter Frequency (MHz)	Colour	Receiver Frequency (MHz)
26·970	Black	26·515
26·995	Brown	26·540
27·025	Brown/Red	26·570
27·045	Red	26·690
27·075	Red/Orange	26·620
27·095	Orange	26·640
27·125	Orange/Yellow	26·670
27·145	Yellow	26·690
27·175	Yellow/Green	26·720
27·195	Green	26·740
27·225	Green/Blue	26·770
27·245	Blue	26·790
27·275	White	26·820

TRANSMITTER SET-UP

The transmitter is tuned by adjusting the two variable capacitors VC1 and VC2. To help this operation we require to build the "tune-up" tuned circuit shown in Fig. 2.9. If an oscilloscope is available it could be used with advantage during the following setting-up operations.

The circuit in Fig. 2.9 is a simple tuned circuit which we will use to monitor the field strength of the transmitter output. (Full constructional details for this Field Strength Meter are given below.)

R.F. TUNING

With your multimeter set to d.c. volts (10V range) and connected to the output of the tuned circuit place the circuit with its aerial close to the fully extended transmitter aerial ready for switch on.

To adjust the variable capacitors you will require a small plastic blade trimming screwdriver, so with everything now to hand and having given the p.c.b. and wiring one last check through, switch the transmitter on and check that the battery voltage meter ME1 shows full scale.

FIELD STRENGTH METER

The Field Strength Meter circuit is built on a piece of 0·1in matrix stripboard. Two take-off points are provided for the meter. The coils L1 and L2 are wound round a 1in former, L1 first with L2 wound on top. VC1 will have to be adjusted for maximum reading on the meter during the transmitter tuning-up process.

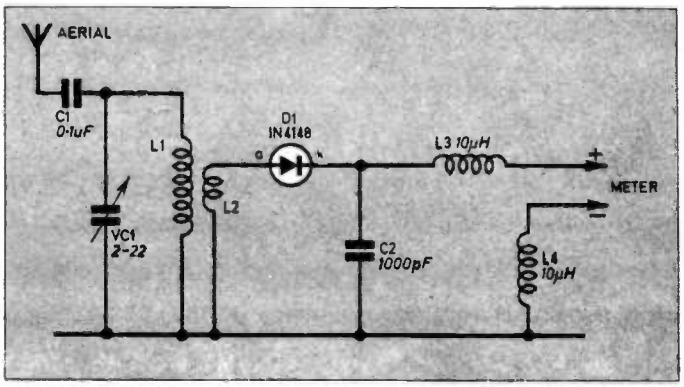


Fig. 2.9. Circuit diagram of the simple Field Strength Meter.

COMPONENTS

C1	0·1μF disc ceramic
C2	1,000μF polyester
VC1	2-22pF miniature polypropylene trimmer
D1	IN4148 diode
L1	6½ turns 22 s.w.g.
L2	2¼ turns 22 s.w.g.
L3	10μH r.f. choke
L4	10μH r.f. choke

Aerial 36 inch length of wire

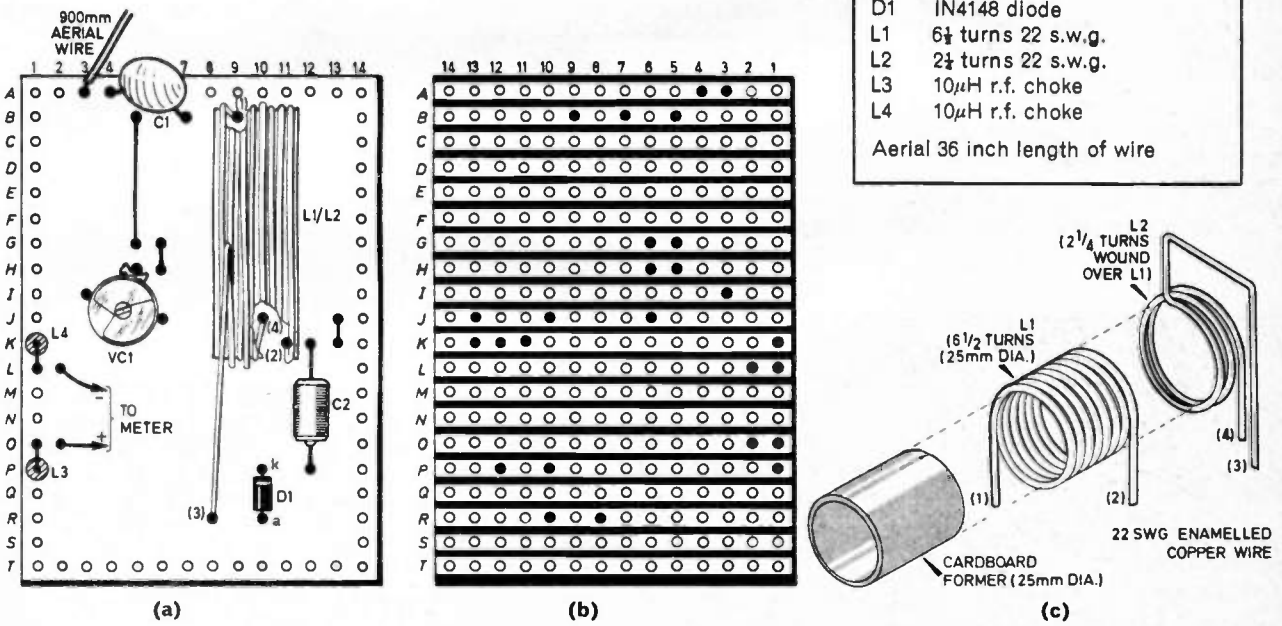


Fig. 2.10. Construction of the Field Strength Meter (a) top view of stripboard (b) underside of stripboard (c) details of coil construction.

With good batteries installed in the transmitter see if there is any reading on the multimeter, if not switch to a more sensitive range. If there is still no reading on the multimeter on its most sensitive range then the crystal oscillator is not running so you will have to turn VC1 until it does. Once you have a reading VC1 requires to be adjusted carefully until a peak is reached. If your multimeter goes to full scale reduce the sensitivity and adjust VC1 again for maximum reading.

Turn your attention now to VC2 and adjust this for maximum reading on your multimeter; again, you may have to reduce the sensitivity of your multimeter. With VC2 now adjusted go back and check VC1 and then come back to VC2 again for its last adjustment and you should now have a correctly tuned-up r.f. stage. As a further check remove the crystal and your multimeter should show zero; if not, then the circuit is oscillating on its own so go back and check the wiring on the p.c.b.

PULSE WIDTH ADJUSTMENT

The other adjustment to be made on the transmitter is to set up the pulse widths, this is done with VR7. If you have access to an oscilloscope then look at pin 14 on IC3 and you should see the inverse of the waveform shown in Fig. 1.5 (Part 1).

You now require to set the stick on the first channel to its neutral position and then to set-up the first pulse width to 1·5mS using VR7. Moving the stick on the first channel to its extremes should change the pulse width from a minimum of approximately 1mS to a maximum of 2mS.

If you have no access to any equipment other than your multimeter it is suggested that the pot VR7 is left in the centre position and any final setting up its left until the receiver and servos have been made and then the whole system can be set up correctly together.

Next Month: The receiver.

Everyday News

A ROYAL REWARD FOR THE YOUNG

The highlight for winning competitors in this year's finals of the "Young Engineer for Britain 1979" and the Design Council GEC Schools Design Prize "Tomorrows Designers" was to receive their prizes and diplomas from HRH The Prince of Wales and HRH The Duke of Edinburgh.

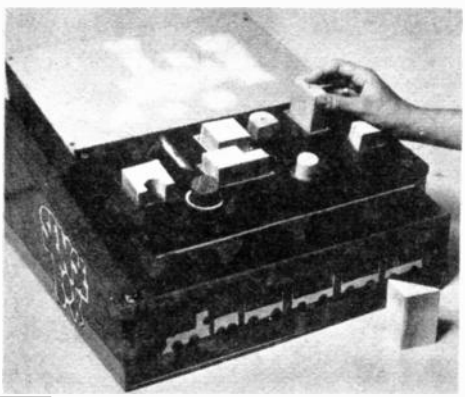
HRH The Prince of Wales presented the awards to find the "Young Engineer for Britain 1979" at a ceremony held in the Wembley Conference Centre, London, October 25.

A record entry of over 300 youngsters with some 180 projects joined the trail to become Young Engineer for Britain 1979. Amongst the class winners was a project for an electronic pelican crossing and a proximity alarm.

HRH the Duke of Edinburgh presented the young "designers of tomorrow" with their certificates at a ceremony at Buckingham Palace, October 18, and some of the class winners are shown below.

Sense Box

An educational toy primarily to entertain mentally - handicapped children was produced by five girls, Sharon Scandrett, Tracey Ellis, Beth Hall, Andrea Clark, Helen Taylor and three boys, Julian Mitchell, Adrian Taylor and Scott Kenney from Thomas Easterly Community College.



The Sense Box consists of a series of differently shaped holes into which corresponding wooden blocks have to be "posted". When a block is in place, its weight triggers a switch which lights a similar shape.

Dosimeter Recharger

Three students from St Austell College, Ian Grainger-Allen, Alan Varco and Philip Dover won a prize for their design of a re-charging unit for a dosimeter— an instrument which measures the amount of atomic radiation in the air.

The Students' prize-winning idea was easy to use, effective, and ergonomically designed. For their charging agent they used a piezo-electric crystal, taken from a cigarette lighter, and designed a pistol-shaped casing to contain it. The dosimeter fits on top, along the "barrel", and the user holds the unit up to his eye in order to read the scale which tells him when re-charging has been successfully completed.

Steam Engine Simulator

An interest in electronics rather than model trains brought a commission for Jonathan Stewart, Ampleforth College, to design a system which puts the "chuff" into a model railway steam engine.

Basing the sequence of sounds on a full scale steam engine, Jonathan's design also produces the noise of a feedwater pump, the safety valve and the air pumps. The effect of the "chuff" is obtained from bursts of white noise repeated at a rate dependent on the velocity of the engine. The sound is regulated by a switching device on the train's wheel breaking the contact at regular intervals.

The idea of a model steam engine making a sound is not new, but Jonathan's design has two major innovations. One is that the unit is designed to be housed in the locomotive rather than beside the track, with the speaker in the engine tender. secondly, the sounds are automatically controlled according to speed and load so that all the sounds, including starting and stopping, are realistic.

Although the design is currently only at the prototype stage with a large box containing the circuitry, the likelihood is that if it is taken up for production by a firm it can be incorporated into a micro-chip.

Space sell-out

The first 38 flights of the US Space Shuttle have been sold out reports John Yardley, director of the space transportation system at NASA.

First flight is now scheduled for mid-1980. The 38 flights will carry 62 individual payloads, many of them directly concerned with electronics such as satellites, or experiments in orbiting laboratories.

SPY RADIO

A new form of spy radio has been developed by Racal. It fits in an executive briefcase, is battery powered and self-tuning.

The message is converted into data and transmitted in a high-speed burst of code to avoid detection. Short messages can be sent in one or two seconds. A message of 204 five-figure groups only takes 20 seconds to transmit.

Micro Aid Cuts

Government spending economies have resulted in cut-backs in aid in the British microelectronics industry promotion programmes. Under the revised arrangements the Microprocessor Industry Support Programme will now receive £55 million and the Microprocessor Applications Project £25 million.

The Inmos microelectronics production project still goes ahead with £25 million of basic capital investment with a second tranche of £25 million currently under review.

On the plus side some £6 million is being made available from the EEC to promote the technology in Europe, a sum regarded as derisory by many industry commentators.

. . from the World of Electronics

ANALYSIS

THE WIRED COMMUNITY

Latterly there has been a huge expansion in information services. People can use the telephone for the latest test match scores, stock exchange index, today's food recipe and so on. With suitably equipped TV sets there is now access to data banks, constantly updated. And through merging the home telephone with radio, individuals are able to participate from their homes in live phone-in radio programmes.

Now the Japanese have taken community communications a whole stage forward by putting all such services into a single package which they call Hi-OVIS (Highly Interactive Optical Visual Information System). It took over two years in design and construction and came into service in July 1978. It is the prototype of the wired city of the future.

Technically it is of greatest interest through the exclusive us of fibre-optic communication lines rather than co-axial cable. Operationally its greatest feature is that all the homes linked into the system not only have a keyboard terminal for calling up the services required but also a monochrome TV camera and microphone through which they can participate in community discussions on live TV without visiting a studio.

The choice of optical fibre cables was based on large transmission capacity, low loss, freedom from electrical interference and economy. The cable is strung overhead using existing telephone and power line poles. Total length of cable connecting the present 158 "subscribers" to the Hi-Ovis centre is 350km.

Needless to say the whole system is computer-controlled from two sets of minicomputers which normally share the tasks involved in dealing with requests from subscribers. If one set breaks down the other carries on with all tasks so providing a fail-soft facility. Apart from responding to the requests of subscribers for national TV, local TV, films, data, weather and traffic news, shopping guide and dozens of other services, the computing system also generates statistics on the type and number of requests from the subscribers.

In fact Hi-Ovis is more a social than a technological experiment. The technology is available today and has been implemented, even though on a fairly small scale, in the Higashi-Ikoma District. But it is a modular system capable of easy expansion in sub-centre blocks of 168 home terminals.

The big question is whether people really need such comprehensive facilities for entertainment, information and two-way communication and how will it affect their lives—for good or for ill?

So the social consequences are being studied and analysed in depth and on an international scale. Well over 4,000 people from many countries and organisations have visited Higashi-Ikoma to see Hi-OVIS in action. Whatever the final outcome we should be grateful to the residents of the area for offering themselves as guinea-pigs in a live social experiment which may one day transform our style of living.

Brian G. Peck.

Energetic waves

The systems engineering and consultancy company EASAMS Ltd., has been awarded a contract from the Department of Energy to assess the viability of wave energy devices.

In the UK the most energetic wave fields are off the west coast of Scotland where it has been estimated that a wave power station 1000km long could yield 70 million megawatt-hours/year, about one third of the present UK demand for electricity.

MPUs in action

Of 66 equipments on show at the Racal Group's private exhibition Racalex 79 in London, 45 of them incorporated MPUs.

Among the new items was the first ever working demonstration of frequency-hopping v.h.f. military tactical radio which, by changing frequency several times a second, allows communications to continue successfully during heavy enemy jamming.

Videodiscs

Philips/MCA system videodiscs will be pressed at Mullard's plant at Blackburn. It will be the first plant outside the USA to make videodiscs and will employ about 200 people in the process.

The Philips/MCA videodisc system is to be launched in Europe in 1981. The videodisc players are being made at the Philips plant at Hasselt in Belgium.

British businessmen can now dial direct to Peking for sending telex messages, a big advantage now that trade with the People's Republic is increasing fast. China is the 129th country to which Britain's 80,000 telex users can directly dial.

A bubble memory module with a data capacity of 1,048,576 bits (128k bytes) has been introduced by Intel. Texas Instruments, however, also has a megabit memory which claims to have a faster access time. Other manufacturers are tooling up for the megabit market.

EARTH TERMINAL

A new Plessey company, Plessey Satellite Communications, got away to a good start with a £1·4 million order for an earth terminal for Western Samoa.

The earth terminal business world-wide is currently estimated at £100 million a year. Plessey hopes to secure a 10 per cent market share by 1985.

CHANNEL 4

The Independent Broadcasting Authority aims to have 30 main high-power transmitting stations for the new Fourth Channel colour television network completed and ready for simultaneous launch in all ITV regions (except Channel Islands) by November 1982.

From the outset the Fourth Channel will be available to over 80 per cent of the population of the United Kingdom, more than 40 million potential viewers. An additional 18 high-power main stations will then join the network as they are completed at the rate of one a month during 1983-84.

Priority for Wales

Priority is being given to Wales in two ways. All six main high-power stations serving Wales are included among the first 30 stations on which the Fourth Channel will be launched. These are Wenvoe, Llanddona, Carmel, Presely, Blaen-Plwyf and Moel-y-Parc.

Additionally, it is planned to equip some 80 local relay stations in Wales before November 1982. The population coverage in Wales, from the start, should be in excess of 90 per cent.

Contracts and Employment

The IBA has already awarded contracts totalling more than £16 million to Marconi Communication Systems Ltd, of Chelmsford and Pye TVT Ltd, of Cambridge for the supply and installation of the 48 sets of high-power transmitters. These contracts, for the latest generation of u.h.f. transmitters, are the most valuable ever placed by the Authority.

The new high-power transmitters will comprise the first major television network to be based on the latest generation of high-efficiency klystron amplifiers. Also, they will feature a novel microprocessor-based programmable transmitter control system which, in conjunction with control units to be supplied by the IBA, will provide automatic operation of the transmitters, together with external status indications and remote and supervisory functions at the IBA's new Regional Operations Centres around which the entire network will be built.

In placing these large orders, the first time all main transmitters for a large television network have been ordered at the same time, the IBA will not only simplify its own planning and building operations but will also help the British manufacturers to plan their production on a long-term basis, creating and ensuring steady employment.

Viewers sets

The Fourth Channel will be the first programme service in the history of British television for which the vast majority of viewers will already have suitable receivers and aerials at the time of the launching. While viewers will need to ensure that their sets are correctly tuned to the new channel, and some may need to have their aerials re-adjusted to achieve good balance of signals over all four channels, for many it will just be a matter of pushing their presently unused channel-selection button.

RADIO WORLD

By Pat Hawker, G3VA

Safety first

IN THESE days of growing awareness of environmental pollution and the health hazards lurking in so many formerly respectable substances, from lead to asbestos to cigarettes, it is perhaps not surprising that one has to admit that there are a few question marks hanging over some aspects of radio and electronic equipment and construction. And I do not mean the sort of cases that turn up in accident statistics that show that there are still people so foolhardy as to wear headphones inexpertly connected to mains equipment while taking a bath.

Electronic construction has, of course, become much safer in these days of low-voltage semiconductors. But there are still a few grey areas.

Some of the chemicals used in servicing aids can be tricky; for example carbon tetrachloride that at one time was liberally splashed around in switch cleaning fluids or used for cleaning the old style of non-plated quartz transmitting crystals. A recent editorial in *The Lancet* suggests that some people become over a period of time sensitive and allergic to solder-flux fumes and may develop asthmatic symptoms of coughing and wheezing; constructors who do a lot of soldering would be advised to heed the medical warning that there should be effective exhaust ventilation.

Then again some silicon planar transistors contain the very toxic substance beryllia *(do not crack open discarded transistors)* and this also turns up sometimes in the mounting washers that form part of the heat sinking for power transistors; beryllia is used because of its good thermal conductivity but it can be a hazard. The woolly white powder (cadmium salts of organic acids) that sometimes appears on cadmium-plated items of electronic equipment (screwheads, switches) is dangerous if ingested.

Mains-operated domestic equipment including radios, television sets, music centres, video-cassette and audio recorders as well as microphones, loudspeakers and the like is expected to conform to British Standard BS415. Most people agree that this is now a very tough specification indeed and there are likely to be few hazards for those using equipment that conforms to it.

A new edition has recently been issued, bringing the British standard more into line with the international standard IEC65. But the formidable BS415 is unlikely to be read by many consumers since it costs £10·70 a copy.

Curiously, imported amateur radio equipment seems to escape the safety net of BS415, at least in practice; a number of amateurs have recently brought to my attention some decidedly bad practices found in the mains-input circuits of imported transceivers and other equipment, including the use of single-pole switches in the "neutral" lead. On the other hand, a Brighton dealer was recently fined £160 for having on sale two secondhand refrigerators wired according to the old green/red/black colour code instead of the correct blue (neutral)/brown ("line")/yellow-green (earth) code for three-wire mains leads.

Building h.f. receivers?

My recent reference to the hobby of listening to DX (long-distance) short-wave broadcast stations and the deficiencies of most standard domestic receivers for this purpose has resulted in some readers wondering whether it would be possible for them to build a high-performance receiver at lower cost than the factory-built general-coverage communications-type receivers, now often based on the Wadley loop "triple-mixing" principle which allows receivers to be set quite accurately to the listed frequency of a wanted broadcast station rather than having to search across a crowded band.

This is not an easy question to answer. Really experienced constructors can certainly build good receivers, though I would hesitate before recommending them to use the Wadley loop which needs really good filtering and screening.

For an amateur-band receiver the "direct-conversion" approach can give excellent results and are simple to build. However, these designs are far more suited to reception of single-side-band and Morse transmissions on a single band, than for broadcast reception.

In these days of integrated circuits and pre-aligned ceramic i.f. filters the task of the home-constructor is simplified but even so this leaves the problem of stable and accurate calibration. It is still difficult to build from scratch a set capable of competing with some of the better factory-made sets, but I hope readers will tell me that I am wrong, and that they have done just this.

These examination results

Last month I referred to what seemed an unnecessarily long delay on the part of the City & Guilds in announcing the results of the May, Radio Amateur's Examination based, for the first time, on "multichoice" questions. A delay, incidentally, which in turn resulted in a sudden swamping of the Home Office licensing section when about 600 of the successful candidates all applied for licences at the same time. At some centres the pass-rate exceeded eighty per cent.

It is only fair to report that C&G subsequently wrote to the Radio Society of Great Britain apologising for the delay and explaining that this was due to problems with a new scanner which forms part of the modernisation programme. The Institute promises that this will not happen again.

This is good news although I still feel that with multichoice examinations it should be possible to hold frequent examinations and to tell the candidates how they have done within a few days at the most. The RAE is not a professional examination after all.

Another point arising: last month I mentioned that the GB2RS amateur news bulletins went out in the London area on 3650kHz at 9.30 a.m. local time on Sundays —and so for many years it did, until the new schedule was introduced during October. Now it goes out at 9 a.m. in this area.

Large means low

Most of us are aware that some creatures, such as bats and dogs, can hear high audio frequencies that we would consider ultrasonic. But I was interested to learn of some experiments that have proved that elephants have an audio range that extends a good deal lower than human hearing.

This is believed to be less because of the large size of their ears than the long distance between them. And how did the research team find this out? They trained an elephant to push a button whenever it heard a signal!

But I see that Philip Vanderlyn, one of the engineers who helped to develop stereo, has recently underlined some of the complex wonders of the human auditory system. He points out, for instance, that this responds vastly more rapidly than our eyes and can detect time differences of only a few tens of microseconds, setting a difficult problem for the designers of surround-sound systems.

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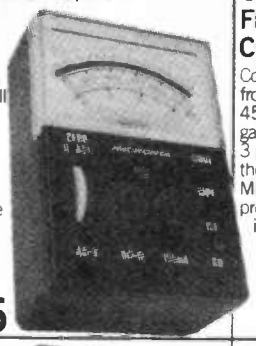

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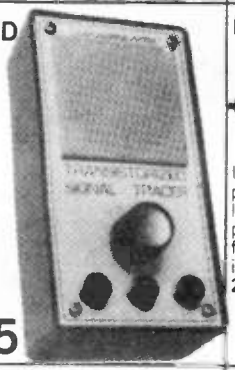

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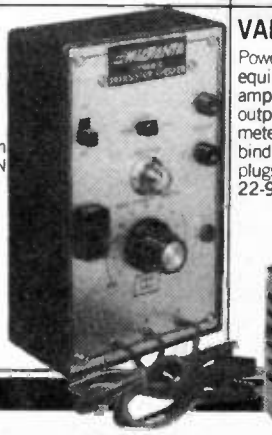

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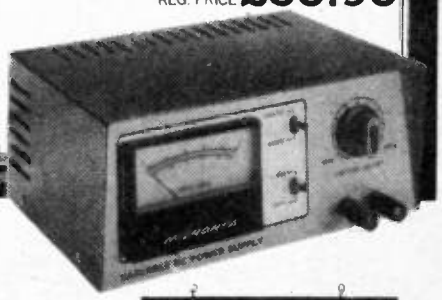

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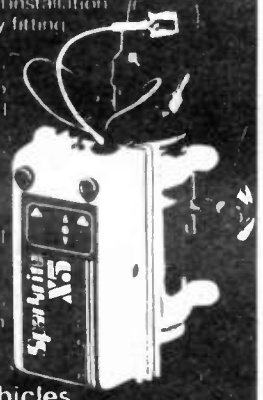

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The Extra-ordinary Experi-ments of Professor Ernest Eversure

by Anthony John Bassett

MAURICE dug deeply into his amazingly capacious duffel bag and eventually produced a couple of dishevelled fuzz boxes, part of the electronic equipment for the "Space Age Rock Band" which he and Tom are forming to play in support of various local charities.

WHAT'S ALL THIS FUZZ?

"These old fuzz boxes have been given to us and we wonder whether they're worth mending, also there are a few things we don't understand about fuzz boxes, and we would be very grateful if you could explain something of their principles."

"Yes, Prof.," Tom joined in, "One of the things that puzzle me most about fuzz boxes is that they all seem to sound different from one another.

"Although there are a few designs which sound nearly the same as each other and are probably almost identical copies inside, it seems to me that there are big ones, small ones, simple ones, complicated ones, expensive ones and cheap ones, some of which sound better than the expensive ones. When I plug my guitar in and try a few different fuzz boxes, the sounds I hear from some are so radically different from others, it has puzzled me for a long time how these mysterious electronic boxes can, magically it seems, alter the sound of my guitar in so many ways!"

"A very interesting question, Tom," The Prof. began to explain: "It's all to do with sound waves, which are represented inside audio equipment by changing voltage patterns which we can consider graphically as waveforms.

"I think we all know a little already about audio waveforms: the sinewave, Fig. 1, which sounds somewhat flute-like; square wave (Fig. 2) with a reedier sound; sawtooth waves (Fig. 3) which sound a little like violins, but without the rich resonance of a good instru-

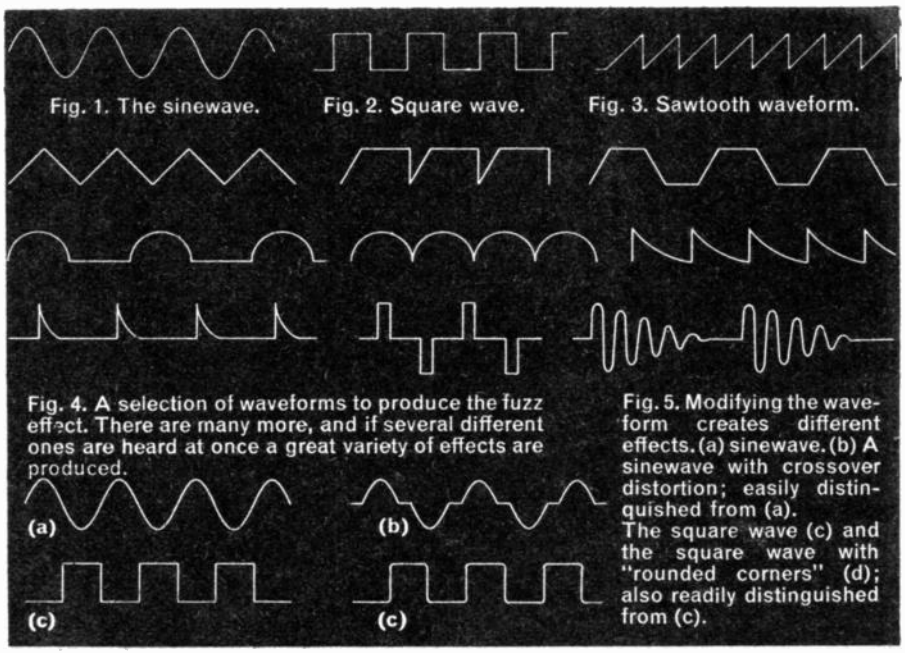

Fig. 1. The sinewave.

Fig. 2. Square wave.

Fig. 3. Sawtooth waveform.

Fig. 4. A selection of waveforms to produce the fuzz effect. There are many more, and if several different ones are heard at once a great variety of effects are produced.

Fig. 5. Modifying the waveform creates different effects. (a) sinewave. (b) A sinewave with crossover distortion; easily distinguished from (a). The square wave (c) and the square wave with "rounded corners" (d); also readily distinguished from (c).

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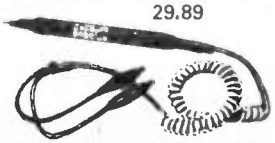

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ment, and there are a good many more different waveforms (Fig. 4), and all of them sound different. Our hearing can be so sensitive that a healthy human being can easily distinguish between waveforms which may appear to be only very slightly different from one another (Figs. 5a, b, c, d).

SAWMILL FUZZ

"A fuzz box will change the waveform of the electrical output from the pickups of your guitar. With some types of fuzz box the change may be quite subtle, but with our sensitive hearing, quite noticeable and often pleasant and interesting to listen to. Others produce a drastic change and may even cause a guitar which usually sounds mellow, to produce a harsh buzz like a sawmill!!

"Obviously a fuzz box which causes a guitar to sound like a sawmill will have processed the waveform in a manner quite different from that of one of the gentler types and this is why some guitarists have more than one fuzz box. One kind for use in ballads and quiet numbers, and another to really wake up their audience in heavy rock numbers.

FUZZY WRINKLES

"It is interesting to consider how fuzz effects have developed over a number of years. For instance, most modern fuzz boxes plug in between the guitar and the input of the amplifier. Some of the earlier ones did not connect like this at all, but went in between the amplifier speaker output and the loudspeakers."

The Prof. drew a few sketches of early fuzz circuits which connect to the speaker (Figs 6a, b, c, d).

"This one, Fig. 6a, gives an effect on the waveform similar to Fig. 5a, b which resembles crossover distortion, whilst Fig. 6b gives a smoother sound. In each of these circuits, different capacitor values may be tried for individually preferred effects; also the two circuits may be combined together.

"In Fig. 6c the signal from the amplifier is split between two speakers. The positive half of the waveform goes to one speaker and the negative half to another. Although one may well disapprove of the ultimate effects on the speakers, apparently some users of fuzz effects consider this worthwhile.

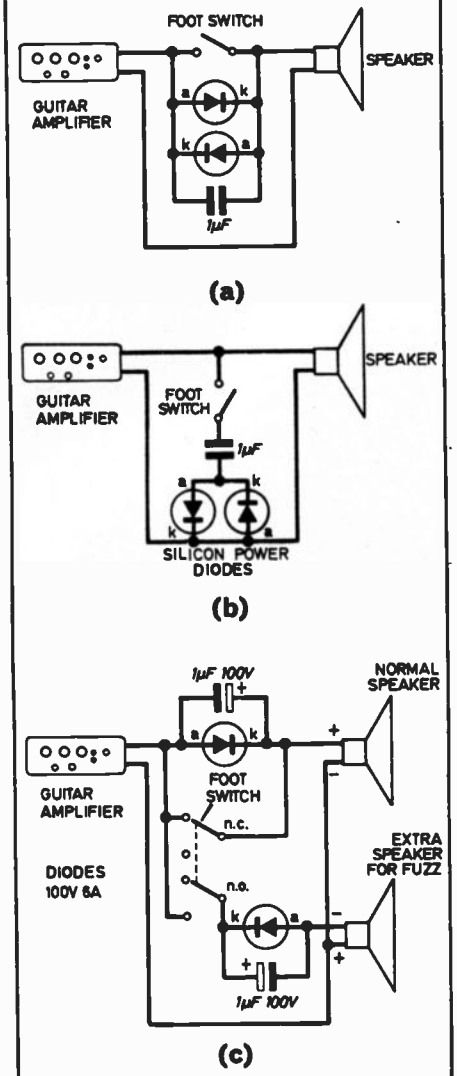

Fig. 6. Some early fuzz circuits which connect to the speaker. (a) Diode fuzz. The diodes should be capable of carrying the full speaker current. (b) The capacitor should be a reversible type 100V working or greater. (c) In this circuit the negative half of the waveform is fed to a separate speaker.

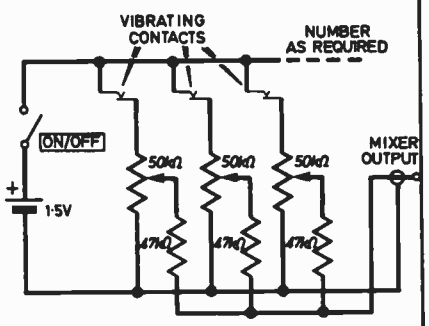

Fig. 7. An electromechanical fuzz. The contacts are caused to vibrate by a speaker.

MECHANICAL FUZZ

"Before we go on to consider a number of more modern fuzz boxes using transistors and integrated circuits, it is worth briefly mentioning mechanical fuzz and electromechanical fuzz; methods where the fuzz effects are mechanically produced and the only electronics being the amplifier!

"Perhaps the simplest 'mechanical fuzz' consists of a modification to a loudspeaker, the cone of which is pierced with a number of small holes. Through each small hole a split-pin or else a bifurcated rivet is threaded, and the tangs bent so that although it cannot come out, it will rattle freely when the speaker cone vibrates, rather like the rivets in a drummer's rivet cymbal. The holes in the speaker cone should be strengthened using metal or plastic eyelets or washers.

"I'll leave you to imagine what this might sound like, or else to try it if you've got a spare speaker to risk!

ELECTROMECHANICAL

An electromechanical method which does not involve such drastic alterations to the fabric of a loudspeaker cone involves a number of vibrating contacts, which are caused to vibrate by means of a diaphragm stretched over a hole in a speaker cabinet.

"A small additional amplifier and speaker are used to vibrate the contacts, and are fed with the signal from the guitar. Each contact pair is carefully adjusted so that any slight vibration of the speaker cone causes it to make and break. The contacts are mounted on springs of different lengths so that their natural frequencies are not identical and are connected through a passive mixer network of resistors and potentiometers to the input of the main amplifier (Fig. 7).

"There is a lot of scope for experiments on mechanical and electromechanical fuzz; using vibrating particles, carbon rods, and many other ingenious ideas, some of which have been tried—and some of which you could be the first to discover!"

To be continued.

WORKSHOP MATTERS

By Harry T. Kitchen

Fastenings

We have now arrived at the situation where we have a number of sheets of aluminium cut, drilled and bent, ready to form our cabinet. How do we secure them together? Well, as amateurs, we have three basic methods, all with advantages and disadvantages. We can use "pop" rivets, self tapping screws, and nuts with bolts.

Pop rivets are fine for fixing things that do not need to be taken apart easily, as the rivet has to be drilled out. Self tapping screws cut their own threads into any metal hole, and thus have a limited life if continual dismantling is involved. Nuts with bolts are fine where accessibility is reasonable.

My personal preference is for nuts and bolts for fixings of a semi-permanent nature, with self tapping screws for fixing the front panel. Many years' experience has taught me that, with care, self tapping screws can be used in the same hole being inserted and withdrawn many times without damaging the thread it has cut in the metal.

To take the case of our cabinet as an example, I would use nuts and bolts for securing the rear panel of the cabinet to the upper and lower halves —I make much use of two "U" shaped pieces for these as this simplifies construction—with self tapping screws being used for securing the front panel as this may require periodic removal for servicing, rebuilding etc.

Finishing

Now that we have our finished cabinet, do we leave it bare shining aluminium or do we paint it, or otherwise alter the finish? Personally, I have settled for a crackle black cabinet with a "brushed" aluminium front panel, a combination that looks very smart indeed, and assures continuity of appearance.

The black crackle paint is applied onto the aluminium, which is lightly sanded to provide a "key" or "tooth" for the paint. This preparation is essential if the cabinet is not to shower flakes of paint every time it is knocked.

One possible objection to the crackle finish paint is that it does provide lodging for dust; the better the crackle effect, the greater the amount of dust. An alternative which is free from this defect is the hammer finish paint.

If you do not like paint, you can cover your cabinets with materials such as Fablon, and this is available in various finishes; as such it is more suitable for equipment destined for the living room or lounge rather than the work shop. You are your own master here, and can choose the finish you like best, but be prepared to carry out some experiments to achieve optimum results.

Brushed aluminium

The brushed aluminium effect is simple to obtain, and requires nothing more elaborate than steel wool and elbow grease, aided by a little light oil, such as 3 in 1. One of the advantages of this finish is that it can delete careless markings on the panel provided these are not too deep.

To commence, put a few spots of oil on the panel then take a ball of steel wool and draw it across the length of the panel in as straight a line as you can. Repeat, a little further along, say equal to half the width of the ball of steel wool.

Continue doing so, turning the ball of steel wool so that fresh wool is always presented to the panel. You will probably have to repeat the whole operation a number of times. Eventually you should obtain the effect you want.

At this point you will have to wash off the oil and general aluminium/steel wool debris in which the panel is covered by a liberal application of washing up liquid and hot water. The panel must be really free from oil if the following processes are to succeed. Care is the watch word at all times.

Labelling

If our panel is at all complex, then it is well worth labelling all the controls to denote their functions; this not only provides instant recognition, but gives a more professional appearance.

Probably the simplest way of labelling the panel is by using transfers. These are available in various sizes and styles, and most good art shops sell sheets not only of lettering but also of words and symbols, so that you can, with care and discrimination, end up with a panel of distinction.

The letters are transferred onto the metal panel by rubbing the reverse of the sheet with a smooth rounded object; many ball point pens have caps that are ideally suited for this application. Having completed the lettering of the panel, it is now essential to protect the relatively fragile transfers.

There are essentially two ways of protecting the transfers. You can spray on a lacquer that, when dried thoroughly, gives a fair degree of protection, or you can use a clear Perspex cover. This is in essence another panel, since all the piercings in the panel have to be repeated here, so that it can fit over the panel proper. This is the more expensive and time consuming method, but it gives complete protection to the transfers.

Stencils

An intermediate method that I have occasionally used is to stencil the appropriate wording, using a suitable stencil and pen with black Indian ink, onto a sheet of white card. This is then sandwiched between the panel and the Perspex, and of course hides any scars appearing on the panel.

If you use the hints and tips contained in this short series on panel bashing, with care and patience you should be able to produce cabinets to be proud of. And you will have saved a great deal of money. Try it and I'm sure you will agree.

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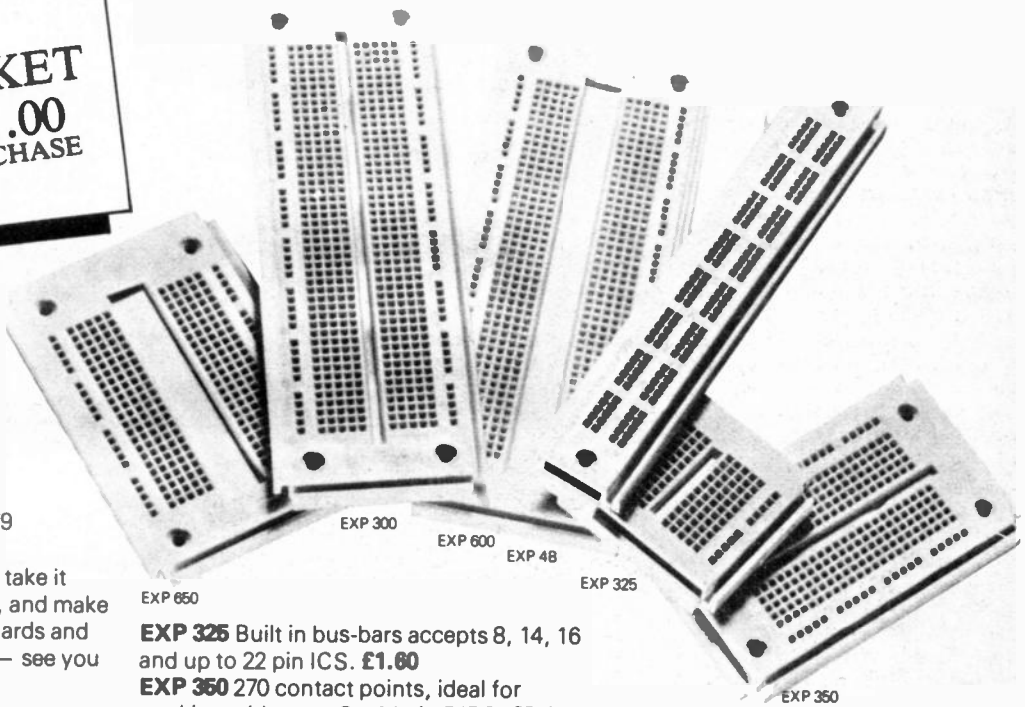

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SIMPLE TRANSISTOR DESIGNS

By A.R. Winstanley

2

BURGLAR ALARM

MANY designs have been published for burglar alarms which give comprehensive protection against intruders. Quite often, however, all that one may require is a very simple system such as the Burglar Alarm Module described here.

This device incorporates one n.c. (normally closed) and one n.o. (normally open) loop for the detection arrangement. Several switches could be placed in series or parallel—depending on the loop used—so that more than one potential break-in point could be monitored with just one loop, see later.

The system described operates from a 9V PP3 battery and as such is not intended for heavy use, although the circuit has been designed to draw as small a quiescent curent as possible (50 microamps). Battery life is therefore quite good, but if the module is to be used regularly, then it is advised that a mains derived power pack is used thereby obviating battery replacements.

CIRCUIT DESCRIPTION

The circuit diagram of the alarm is shown in Fig. 1. Resistors R1 and R2, being of equal value, form a potential divider clamping the base of TR1 to half the supply rail, i.e. 4·5V. The emitter TR1, therefore, will be 0·6V less than this—3·9V. The normally-closed loop is connected between TR1 base and 0V, so the base is normally grounded and TR1 is off, the emitter being low.

When the n.c. loop is broken, the base rises immediately to 4·5V and the emitter "follows" this, rising to 3·9V. This signal is transmitted through R4 and D1 to the gate of CSR1, thereby triggering this thyristor. The thyristor then completes the circuit to WD1 and R6, D2 and so WD1 sounds and D2 illuminates.

The alarm, WD1, is a miniature electronic audible warning device consuming only about 15mA when operating. Conventional electro-mechanical buzzers cannot be used because they can easily draw in excess of 500mA, the maximum forward current allowable in the thyristor. If a heavier alarm load needs to be switched, then WD1 could be substituted by a 9V relay with contacts rated to suit one's needs.

Light emitting diode, D2, indicates that the alarm is operating, but it also provides a minimum holding current for the thyristor, thereby preventing it from resetting undesirably.

The n.o. loop is connected between the positive rail and R5, a current limiting resistor for the gate of CSR1. When the loop is closed, even for a tiny fraction of a section, then CSR1 will trigger and operate the alarm. Diode D1 isolates the n.o. loop from R4 and R3. If it were not present then if the n.o. loop were closed, R5, R4 and R3 would form a potential divider holding the gate of CSR1 at exactly 0·5V—not enough to trigger the thyristor.

Capacitor C1 prevents the thyristor from triggering on initial power switch on. This particular design seemed prone to do this. Whilst it will slow down the response time of the circuit, this is not noticeable and the circuit still operates very fast.

Finally, S1 is a normally-closed switch incorporated into the n.c. loop but this switch is mounted in the module. When it is pressed it will cause the warning device to operate. The switch therefore provides an alarm/battery test facility, and enables a rough check on the battery condition to be made.

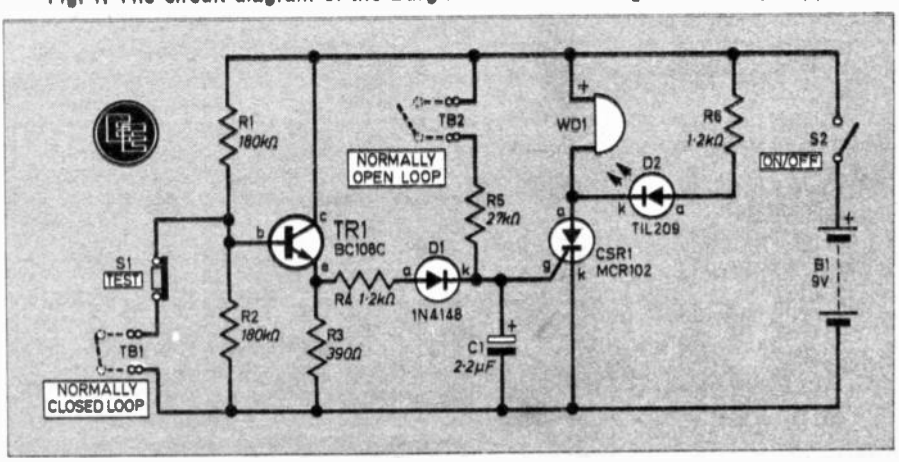
CONSTRUCTION starts here

CIRCUIT BOARD

The module is built into a plastic box type PB1, of dimensions 114×76×38mm. The circuit itself is built onto a piece of 0·1 inch stripboard measuring 24 holes×10 strips, see Fig. 2.

Construction is quite straightforward. Drill two holes as shown to take two 6BA mounting screws. Make all of the breaks in the copper strip using either a spot face cutter or a hand held twist drill, then proceed to solder in the components followed by suitable lengths of lead to reach the case mounted components.

Fig. 1. The circuit diagram of the Burglar Alarm with integrated battery supply.



The finished Burglar Alarm module. The base of the case becomes the "front panel" and components are mounted as shown, including the warning buzzer. Small terminal strips are mounted on the side of the case to take the closed and open loop wiring.

Components mounted on the circuit board.

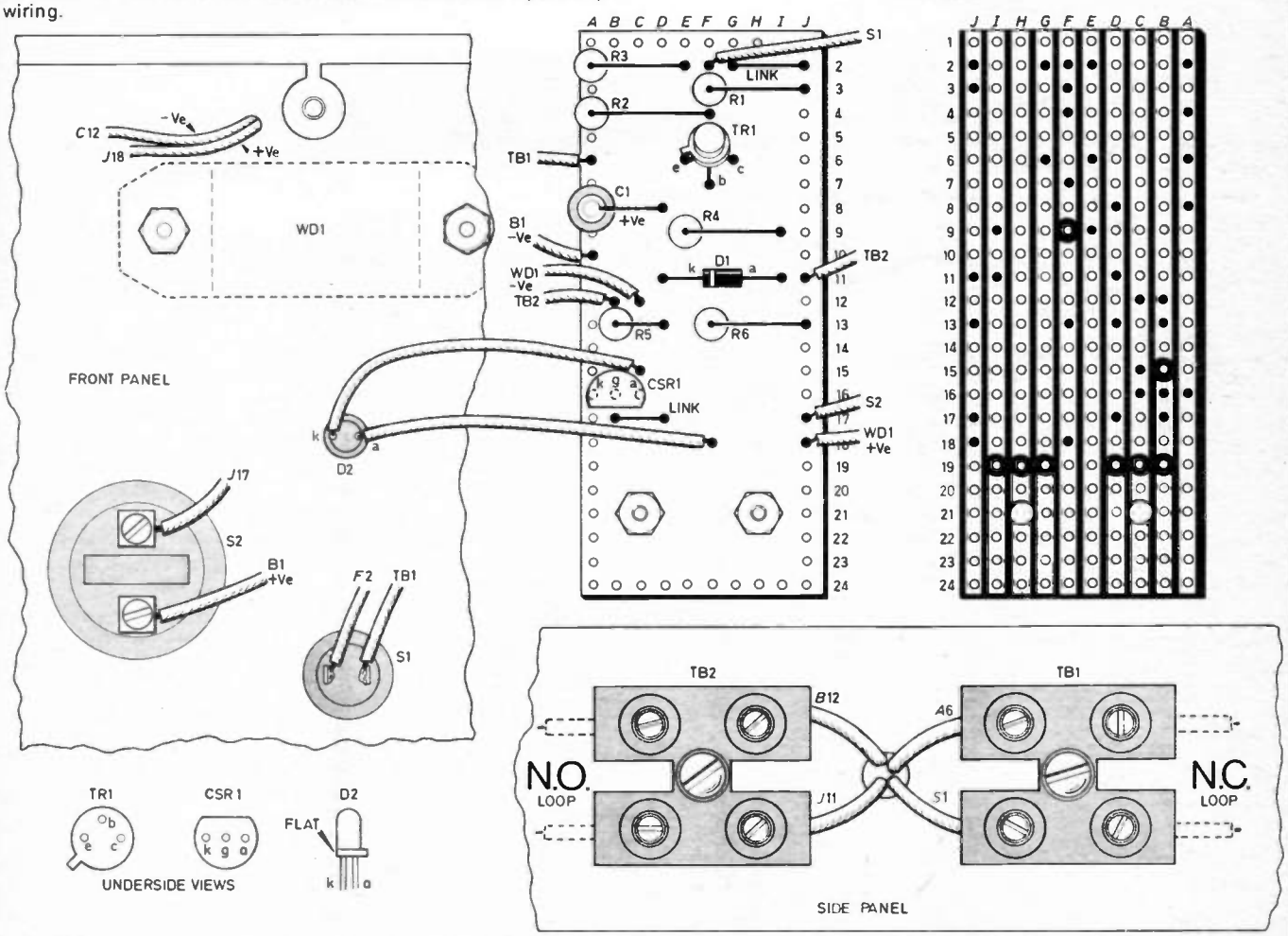


Fig. 2. Complete construction details showing interwiring between board and case mounted components, and layout of the components on the top side of the stripboard.

COMPONENTS

Resistors

R1	180kΩ	R4	1·2kΩ
R2	180kΩ	R5	27kΩ
R3	390Ω	R6	1·2kΩ

All ¼W carbon ±5%

Capacitors

C1 2·2μF 10V elect.

Semiconductors

TR1	BC108 *npn* silicon
D1	IN4148 or similar silicon diode
D2	TIL209 or similar red l.e.d.
CSR1	MCR102

Miscellaneous

S1	s.p.s.t. push-to-break, release-to-make
S2	s.p.s.t. rocker
B1	9 volt PP3 (preferably Duracell)
WD1	miniature 9V audible warning device

Stripnoard: 0·1 inch matrix, 10 strips × 24 holes; 4-way 2 Amp terminal block; PP3 connector; retaining clip for D2; case type PB1, approximately 110 × 73 × 35mm; 6BA nuts (8 off) bolts (6 off); washers (10 off), spacers (2 off); wire and switches for loops.

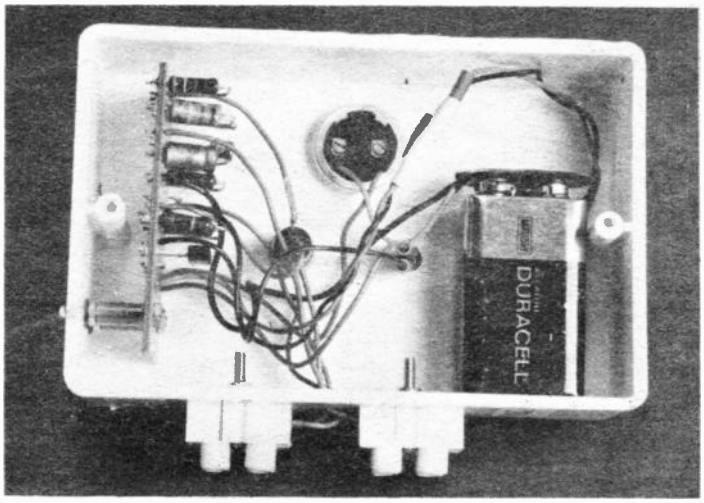
Approx. cost Guidance only £4.00 excluding loop components

The usual rules regarding soldering apply. Do not overheat any semiconductors and take care not to bridge adjacent copper strips with whiskers of solder, etc.

Prepare the case to accept the case mounted components and fix these in position and wire up to the board as shown in Fig. 2.

In the prototype, the board was fitted to the case by two 18mm long 6BA nuts and bolts and 12mm long spacers.

The audible warning device (WD1) is mounted on the front of the box using two 8BA bolts. A small hole is drilled nearby to take the leadouts from the buzzer to the circuit board.



Positioning of components, battery and circuit board within the case. The circuit board should be mounted on two small spacers. The battery can alternatively be held in place by glueing some sponge to the lid which when fitted, the sponge will compress and hold the battery in position.

The two "loops" are connected to the circuitry by means of terminal blocks mounted on the side of the case. The interior layout can be arranged to suit one's requirements but enough room must of course be left to take the battery which, incidentally, can be stuck down using a small piece of doublesided foam strip.

Complete the construction of the module and check the wiring carefully. If satisfactory, the panel mounted controls can then be lettered as required to indicate their functions.

TESTING

Short out the n.c. terminal block connector with a short piece of wire, clip on the battery and switch on. Press S1; this will cause the buzzer to operate and D2 should also illuminate. Reset the circuit at S2 and short the n.o. loop connector—this again should also operate the alarm. The device is then complete and ready to be connected to the "loops".

If the device is to be used with the *9V Power Pack* (to be described later in this series) then the battery clip will be omitted and a suitable connector used instead (e.g. a 3·5mm jack socket). However with a quiescent current of only 50 microamps, it might pay to try battery operation before building the power pack, to see if the battery power is feasible.

LOOPS AND SWITCHES

The alarm offers double loop protection but only a single loop can be used if desired. If the normally open version is chosen alone, then a permanent shorting link across TB2 is necessary.

The switches in the n.c. loop must have normally closed contacts and all be wired in series. In the n.o. loop, all the switches must have normally open contacts and be wired in parallel.

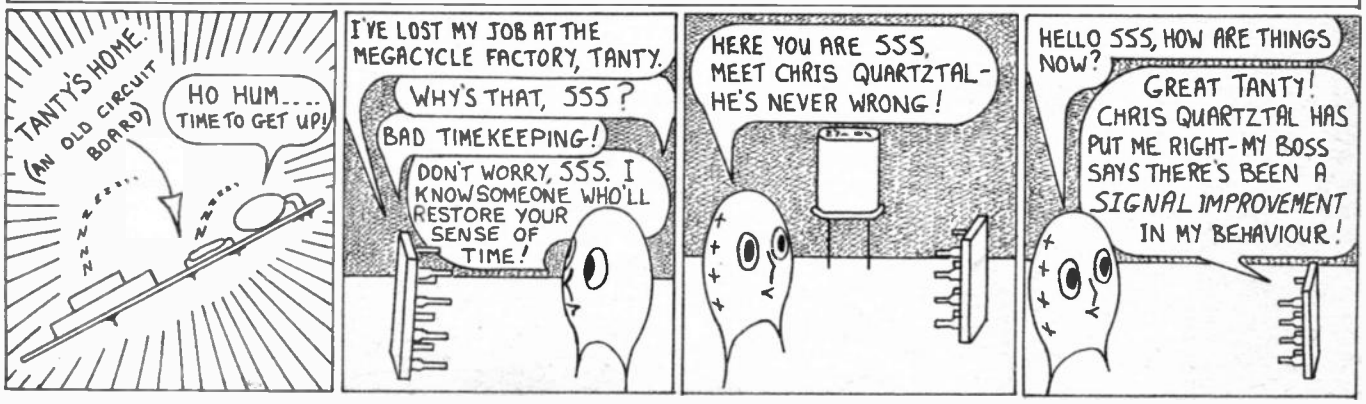
The constructor will have his own ideas regarding the type of switch to use but can be either miniature pushbutton, microswitch, reed/magnet, a pressure mat or home-made from brass strip or conductive tape.

For security reasons the switches and wires should be concealed. The framework between the hinges is a safe place to site the switches for doors and windows.

Next Month: 9V Power Supply.

The Adventures of Tanty Bead

By Matthew Reed



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4011	13p	4029	50p	4081	13p
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7413	22p	7493	25p	74170	100p
7414	39p	7494	45p	74174	55p
7420	12p	7495	35p	74177	50p
7427	20p	7496	45p	74190	50p
7430	12p	74121	25p	74191	50p
7432	18p	74122	35p	74192	50p
7442	38p	74123	38p	74193	50p
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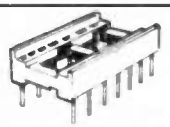

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		LM3911	100p	ZN414	80p
		MC1458	32p	ZN425E	390p
		MM57160	590p	ZN1034E	200p

TRANSISTORS

				ZTX500	16p
				2N697	12p
		BCY72	14p	2N3053	18p
AC127	17p	BD131	35p	2N3054	50p
AC128	16p	BD132	35p	2N3055	50p
AC176	18p	BD139	35p	2N3442	135p
AD161	38p	BD140	35p	2N3702	8p
AD162	38p	BFY50	15p	2N3703	8p
BC107	8p	BFY51	15p	2N3704	8p
BC108	8p	BFY52	15p	2N3705	9p
BC108C	10p	MJ2955	98p	2N3706	9p
BC109	8p	MPSA06	20p	2N3707	9p
BC109C	10p	MPSA56	20p	2N3708	8p
BC147	7p	TIP29C	60p	2N3819	15p
BC148	7p	TIP30C	70p	2N3820	44p
BC177	14p	TIP31C	65p	2N3904	8p
BC178	14p	TIP32C	80p	2N3905	8p
BC179	14p	TIP2955	65p	2N3906	8p
BC182	10p	TIP3055	55p	2N4058	12p
BC182L	10p	ZTX107	14p	2N5457	32p
BC184	10p	ZTX108	14p	2N5459	32p
BC184L	10p	ZTX300	16p	2N5777	50p
BC212	10p				
BC212L	10p				
BC214	10p				
BC214L	10p				
BC477	19p				
BC478	19p				
BC548	10p				
BCY70	14p				
BCY71	14p				

DIODES

1N914	3p	1N4006	6p
1N4001	4p	1N5401	13p
1N4002	4p	BZY88 ser.	8p

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4.7, 6.8, 10uF @ 25V	13p
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0.068, 0.1	4p

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0.33, 0.47	10p
0.68	14p
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			22	33	47	7p
	100					13p
			220			20p
25V	10	22	33	47		5p
	100					8p
		220				10p
				470		15p
	1000					23p

CONNECTORS

JACK PLUGS AND SOCKETS

	screened	unscreened	socket
2.5mm	9p	13p	7p
3.5mm	9p	14p	8p
Standard	16p	30p	15p
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DIN PLUGS AND SOCKETS

	plug	chassis socket	line socket
2pin	7p	7p	7p
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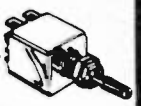
SWITCHES



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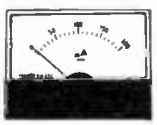

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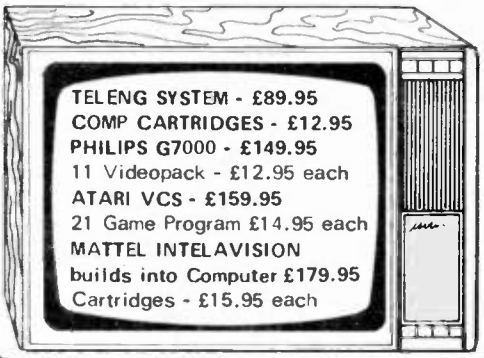

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SEMICONDUCTORS

AA119	0·12	ASY26	0·46	BC159	0·12	BCY71	0·20	BF184	0·29	BY126	0·16	OA70	0·35	OC82	0·74	ZS271	0·26	2N697	0·29	2N3055	0·81
AAY30	0·31	ASY27	0·46	BC167	0·14	BCY72	0·15	BF185	0·29	BY127	0·17	OA79	0·35	OC83	0·74	ZS278	0·65	2N698	0·35	2N3440	0·69
AAY32	0·48	ASZ15	1·44	BC170	0·13	BCZ11	1·72	BF194	0·10	BZX61	0·21	OA81	0·35	OC84	0·74	ZTX107	0·13	2N705	1·38	2N3441	0·92
AAZ13	0·21	ASZ16	1·44	BC171	0·12	BD115	0·52	BF195	0·10	Series		OA85	0·35	OC122	1·73	ZTX108	0·12	2N706	0·17	2N3442	1·26
AAZ15	0·39	ASZ17	1·44	BC172	0·12	BD121	1·50	BF196	0·12	BZY88	0·15	OA90	0·09	OC123	2·02	ZTX109	0·14	2N708	0·23		
AAZ17	0·31	ASZ20	1·72	BC173	0·14	BD123	1·50	BF197	0·14	Series		OA91	0·09	OC139	2·59	ZTX300	0·14	2N930	0·30	2N3614	1·73
AC107	0·69	ASZ21	2·30	BC177	0·17	BD124	1·50	BF200	0·31	CRS/140	0·69	OA95	0·09	OC140	3·16	ZTX301	0·15	2N1131	0·30	2N3702	0·13
AC125	0·23	AU110	1·96	BC178	0·16	BD131	0·40	BF244	0·23	CRS/340	0·86	OA200	0·10	OC141	3·74	ZTX302	0·17	2N1132	0·30	2N3703	0·15
AC126	0·23	AU113	1·96	BC179	0·18	BD132	0·44	BF244	0·32	CRS/360	1·04	OA202	0·10	OC170	1·15	ZTX303	0·20	2N1302	0·40	2N3704	0·15
AC127	0·23	AUY10	2·30	BC182	0·13	BD135	0·39	BF257	0·28	GEX66	1·73	OA211	1·15	OC171	1·15	ZTX304	0·22	2N1303	0·40	2N3705	0·15
AC128	0·23	BA145	0·15	BC183	0·12	BD136	0·39	BF258	0·30	GEX541	2·02	OAZ200	1·15	OC200	1·73	ZTX311	0·14	2N1304	0·52	2N3706	0·15
AC141	0·29	BA148	0·15	BC184	0·13	BD137	0·40	BF259	0·37	GJ3M	0·66	OAZ201	1·15	OC201	2·02	ZTX314	0·23	2N1305	0·52	2N3707	0·15
AC141K	0·40	BA154	0·10	BC212	0·15	BD138	0·46	BF336	0·35	GJ5M	0·86	OAZ206	1·15	OC202	2·02	ZTX500	0·15	2N1306	0·58	2N3708	8·12
AC142	0·23	BA155	0·12	BC213	0·14	BD139	0·49	BF337	0·35	GM0378	2·02	OAZ207	1·15	OC203	2·02	ZTX501	0·16	2N1307	0·58	2N3709	0·15
AC142K	0·35	BA156	0·10	BC214	0·17	BD140	0·51	BF338	0·36	KS100A	0·52	OC16	2·30	OC204	2·88	ZTX502	0·18	2N1308	0·63	2N3710	8·12
AC176	0·23	BAW62	0·06	4BC237	0·10	BD144	2·30	BFS21	4·55	MJE340	0·92	OC20	2·88	OC205	2·88	ZTX503	0·20	2N1309	0·63	2N3711	0·12
AC187	0·23	BAX13	0·07	BC238	0·14	BD181	1·26	BFS28	2·58	MJE370	1·35	OC22	2·88	OC206	2·88	ZTX504	0·23	2N1613	0·29	2N3771	2·02
AC188	0·23	BAX16	0·10	BC301	0·38	BD182	1·36	BFS61	0·23	MJE371	0·71	OC23	3·16	OC207	2·02	ZTX531	0·23	2N1671	1·73	2N3772	2·30
AC17	0·98	BC107	0·14	BC303	0·38	BD237	0·46	BFS98	0·23	MJE520	0·60	OC24	3·45	OCP71	1·44	ZTX550	0·18	2N1893	0·29	2N3773	3·45
ACY18	0·92	BC108	0·14	BC307	0·12	BD238	0·63	BFW10	0·74	MJE521	0·63	OC25	1·05	ORP12	1·15	TN914	0·06	2N2147	2·02	2N3819	0·41
ACY19	0·86	BC109	0·15	BC308	0·12	BDX10	1·05	BFW11	0·74	MJE295	1·44	OC26	1·04	R2008B	2·02	TN916	0·08	2N2148	1·89	2N3820	0·52
ACY20	0·80	BA113	0·14	BC309	0·15	BDX32	2·30	BFX84	0·25	MJE305	0·86	OC28	2·30	R2009	2·59	1N4001	0·07	2N2218	0·29	2N3823	0·83
ACY21	0·86	BC114	0·15	BC327	0·23	BDY20	1·44	BFX85	0·28	MPF102	0·35	OC29	2·30	R2010B	2·02	1N4002	0·07	2N2219	0·28	2N3866	0·83
ACY39	1·72	BC115	0·16	BC328	0·21	BDY60	1·72	BFX87	0·24	MPF103	0·35	OC35	1·73	T1C226D	1·38	1N4004	0·08	2N2220	0·21	2N3904	0·15
AD149	0·80	BC116	0·17	BC337	0·21	BF115	0·29	BFX88	0·24	MPF104	0·35	OC36	1·73	T1C44	0·35	1N4005	0·09	2N2221	0·21	2N3905	0·15
AD161	0·52	BC117	0·20	BC338	0·20	BF152	0·21	BFY50	0·30	MPF105	0·35	OC41	0·92	T1L209	0·23	1N4006	0·09	2N2222	0·21	2N3906	0·15
AD162	0·52	BC118	0·12	BC339	0·21	BF153	0·23	BFY51	0·30	MPSA06	0·28	OC42	0·86	T1P29A	0·47	1N4007	0·10	2N2223	3·16	2N4058	0·16
AF106	0·52	BC125	0·18	BC340	0·20	BF154	0·20	BFY52	0·30	MPSA56	0·30	OC43	2·59	T1P30A	0·48	1N4009	0·07	2N2368	0·20	2N4059	8·12
AF114	0·86	BC126	0·23	BCY30	1·15	BF159	0·26	BFY64	0·30	MPSU01	0·41	OC44	0·69	T1P31A	0·51	1N4148	0·07	2N2369A	0·24	2N4060	0·14
AF115	0·86	BC135	0·16	BCY31	1·15	BF160	0·18	BFY90	1·44	MPSU06	0·53	OC45	0·63	T1P32A	0·55	1N5400	0·15	2N2484	0·23	2N4061	0·14
AF116	0·86	BC136	0·17	BCY32	1·15	BF167	0·20	BSX19	0·24	MPSU56	0·56	OC71	0·63	T1P33A	0·79	1N5401	0·15	2N2646	0·63	2N4062	0·15
AF117	0·86	BC137	0·17	BCY33	1·04	BF173	0·23	BSX20	0·23	NE555	0·52	OC72	0·63	T1P34A	0·84	1S44	0·05	2N2904	0·29	2N4124	0·17
AF139	0·46	BC147	0·10	BCY34	1·04	BF177	0·28	BSX21	0·23	NKT401	2·30	OC73	1·15	T1P41A	0·72	1S920	0·08	2N2905	0·29	2N4126	0·17
AF186	1·38	BC148	0·09	BCY39	3·45	BF178	0·28	BT106	1·44	NKT403	1·99	OC74	0·74	T1P42A	0·81	1S921	0·08	2N2906	0·24	2N4286	0·23
AF239	0·52	BC149	0·10	BCY40	1·15	BF179	0·29	BTY79/40	3·67	NKT404	1·99	OC75	0·74	T1P2955	0·77	1S921	0·08	2N2907	0·24	2N4288	0·25
AF251	3·16	BC157	0·10	BCY42	0·29	BF180	0·35	BU205	2·02	OA5	1·09	OC76	0·63	T1P3055	0·64	2G301	1·15	2N2924	0·24	2N4289	0·28
AFZ11	3·16	BC158	0·09	BCY43	0·29	BF181	0·35	BU206	2·59	OA7	0·63	OC77	1·38	T1S43	0·52	2G302	1·15	2N2925	0·25	2N5457	0·45
AFZ12	3·16	BC159	0·12	BCY58	0·18	BF182	0·35	BU208	2·30	OA10	0·74	OC81	0·74	ZS140	0·29	2G306	1·27	2N2926	0·16	2N5458	0·40
		BC167	0·14	BCY70	0·17	BF183	0·29	BY100	0·52	OA47	0·16	OC81Z	1·38	ZS170	0·24	2N404	1·15	2N3053	0·29	2N5459	0·40
		BC169	0·14											ZS178	0·62	2N696	0·29	2N3054	0·58		

VALVES

AZ31	1·26	ECC83	1·01	EL32	1·73	KTW63	2·02	PL36	1·38	UBF89	1·38	5Z4GT	1·75	6BN6	1·89	6L6GA	1·73	12AU6	2·83	92AG	9·15
CBL31	2·30	ECC84	1·36	EL33	4·02	MU14	1·73	PL81	1·38	UCC84	1·26	6-30L2	1·79	6BQ7A	4·14	6L6GT	2·24	12AU7	0·83	92AV	9·15
CL33	2·30	ECC85	1·38	EL34	2·53	N78	10·35	PL81A	1·38	UCC85	1·38	6AB7	1·73	6BR7	4·60	6L6GC	2·24	12AV6	2·30	95A1	5·98
CY31	1·15	ECC88	2·07	(Thorn)		OA2	1·78	PL82	1·38	UCF80	1·32	6AC7	1·61	6BR8	4·02	6L7	3·30	12AV7	3·98	150B2	2·76
DAF91	0·46	ECC91	8·72	EL34	2·57	OB2	1·44	PL83	2·55	UCH42	1·38	6AF4A	1·84	6BS7	4·60	6N2P	1·21	12AX7	1·01	150B3	5·06
DAF98	1·15	ECC189	1·90	Mullard		OC3	2·20	PL84	1·24	UCH81	2·67	6AG7	2·30	6BW6	4·60	6N3P	1·21	12AY7	5·24	150C2	1·73
DF91	0·46	ECF80	1·24	EL41	1·44	OD3	2·20	PL504/5001	1·61	UCL82	1·20	6AH6	5·52	6BW7	1·75	6N7	1·73	12B4A	3·50	150C4	2·19
DF96	1·15	ECF82	1·38	EL42	2·02	OZ4	1·84	PL508	2·07	UCL83	1·66	6AK5	3·98	6BX7GT	5·70	6P25	4·14	12BA6	2·42	211	6·90
DK91	1·21	ECH35	2·30	EL81	1·25	PC86	1·61	PL509	3·45	UF41	1·15	6AK6	2·81	6BZ6	2·62	6Q7	2·53	12BE6	2·55	723AB	40·25
DK92	1·44	ECH42	1·32	EL84	1·15	PC88	1·61	PL519	3·73	UF80	1·66	6AL5	1·01	6C4	1·01	6R7	2·07	12BH7	1·29	807	2·30
DK96	1·26	ECH81	1·38	EL86	2·48	PC97	1·38	PL801	1·27	UF85	1·66	6AM4	2·65	6CB6A	2·86	6SA7	1·67	12BY7	3·01	B11A	9·78
DL92	1·26	ECH83	1·44	EL91	7·44	PC900	1·38	PL802	3·40	UF89	1·66	6AM5	4·43	6CD6GA	5·64	6SC7	1·73	12E1	8·17	812A	9·60
DL94	1·38	ECH84	1·47	EL95	1·51	PCC84	1·15	PY33	0·92	UL41	2·88	6AM6	2·07	6CG7	2·55	6SF7	1·84	19H4	28·75	813	36·80
DL96	1·26	ECL82	1·15	EL360	6·32	PCC88	1·38	PY81	0·81	UL84	1·38	6AN5	6·12	6CH6	7·48	6SH7	1·73	30C15	1·84	833A	86·25
DY86/7	0·73	ECL83	1·73	EM34	5·75	PCC89	1·58	PY82	1·01	UM80	1·15	6AN8A	3·80	6CL6	4·12	6SJ7	1·84	30C17	1·84	866A	8·61
DY802	0·96	ECL86	1·38	EM80	1·26	PCC189	1·61	PY83	2·07	UY41	1·44	6AQ5	1·10	6CW4	8·33	6SK7	1·50	30C18	1·84	872A	15·81
E80CC	9·27	EF37A	4·02	EM81	1·15	PCF80	1·15	PY88	1·01	UY85	1·20	6AR5	1·84	6D2	1·01	6SL70T	3·08	30F5	1·93	931A	14·08
EABC80	1·38	EF39	3·16	EM84	1·15	PCF82	1·15	PY500A	2·07	Z803U	9·09	6AS6	6·42	6DK6	2·59	6SNG7	1·84	30FL1/2	1·28	2050	8·00
EAF42	1·44	EF40	1·32	EM85	1·44	PCF86	1·84	PY800	0·97	1B3GT	2·58	6AS7GA	7·76	6DQ6B	4·49	6SQ7	1·50	30FL12	2·07	5642	8·05
EAF801	2·02	EF41	1·38	EM87	1·73	PCF87	1·84	PY801	0·97	1R5	1·21	6AT6	0·98	6EA8	3·31	6SR7	1·73	30FL14	1·84	5654	4·05
EB41	2·30	EF42	2·30	EN91	2·94	PCF200	2·82	QQV02-6	13·10	1S5	0·46	6AU5GT	4·81	6EB8	2·44	6SS7	2·07	30L1	1·15	5651	2·87
EE91	1·01	EF50	1·73	EY51	2·02	PCF201	2·45	QQV03-10	5·44	1T4	0·46	6AU6	1·24	6EW6	1·73	6U5G	2·30	30L15	2·07	5670	5·29
EBC33	2·02	EF80	0·92	EY86	0·96	PCF801	1·84	QQV03-20	20·13	2AS15	11·50	6AV5GA	4·35	6F6	2·02	6U8	0·92	30L17	2·07	5814A	4·81
EBC41	1·44	EF83	2·02	EZ80	0·96	PCF802	1·82	QQV06-4	40·25	2D21	2·94	6AV6	0·98	6F23	1·84	6U84	3·24	30P4	1·08	6080	7·88
EBC81	1·26	EF85	0·92	EZ81	0·96	PCF805	1·84	R17	1·88	3A5	1·55	6AX5GT	3·57	6F26	1·33	6V6GT	1·84	30P19	1·38	6146A	5·89
EBC90	0·97	EF86	1·74	EZ90	1·38	PCF806	1·84	R20	1·66	3CX100A	23·00	6B7	1·73	6H2N	1·21	6X4	1·38	30PL1	1·52	6146B	8·42
EBF80	0·58	EF89	1·84	GZ32	1·44	PCF808	1·84	U18-20	2·88	3S4	1·26	6B8	2·02	6H3N	1·21	6X5GT	0·87	30PL13	2·07	6159	9·18
EBF83	1·44	EF91	2·07	GZ34	2·18	PCL82	1·15	U25	1·53	4CX2508	28·53	6BA6	1·15	6H6	1·73	7B7	1·96	30PL14	1·93	6973	4·05
EBF89	0·97	EF92	6·03	KT61	4·02	PCL83	1·82	U26	1·66	5R4GY	2·30	6BA7	5·89	6J4	6·10	7C5	2·02	30PL15	2·07	7586	13·09
EBL31	2·88	EF98	1·44	KT66	7·18	PCL84	1·15	UABC80	1·44	5U4G	4·35	6BA8A	4·31	6J6	6·21	7C6	1·44	35W4	8·69	7587	22·54
ECC40	1·44	EF183	0·92	KT88	9·20	PCL85	1·24	UAF42	1·44	5U4GB	2·60	6BC4	4·27	6J7	9·04	7H7	2·30	50C5	0·81	7868	4·53
ECC81	1·01	EF184	0·96	KTW61	2·02	PCL805/85	1·24	UB41	1·44	5V4G	1·75	6BE6	1·24	6K4N	1·44	7R7	1·73	85A2	2·19	8068	6·33
ECC82	0·82	EH90	1·61	KTW62	2·02	PD500	4·24	UBC41	1·73	5Y3GT	0·98	6BH6	1·75	6K6GT	1·50	7S7	2·59	90AG	9·15	8136	2·81
						PFL200	2·07			5Z3	1·72	6BJ6	1·24	6K7	1·73	7Y4	1·84	90AV	9·15	4CX 250B	5·75
										5Z4G	1·75	6BK4	4·84	6K8	2·02	7Z4	2·13	90C1	2·24		
												6BL6	87·25	6KD6	7·08	12AT6	1·38	90CG	15·73	Tested ex equipment	
												6BL7GT	4·44	6L6G	2·88	12AT7	1·01	90CV	15·30		

INTERGRATED CIRCUITS

7400	0·18	7410	0·18	7428	0·49	7450	0·21	7483	1·04	74109	0·81	74132	0·81	74156	0·97	74191	1·73	TAA700	4·50	TBA920Q	3·34
7401	0·18	7412	0·30	7430	0·20	7451	0·21	7484	1·15	74110	0·58	74136	0·63	74157	0·86	74192	1·55	TBA480Q	2·12	TBA990Q	3·34
7402	0·18	7413	0·37	7432	0·35	7453	0·21	7486	0·40	74111	0·81	74141	0·92	74159	2·42	74193	1·55	TBA520Q	2·65	TCA270Q	3·34
7403	0·18	7416	0·37	7433	0·41	7454	0·21	7490	0·60	74116	2·02	74142	2·65	74170	2·65	74194	1·44	TBA530	2·28	TCA760A	1·59
7404	0·20	7417	0·37	7437	0·37	7460	0·21	7491	0·92	74118	1·15	74143	2·88	74172	5·06	74195	1·15	TBA540Q	2·65		
7405	0·18	7420	0·26	7438	0·37	7470	0·40	7492	0·69	74119	1·73	74144	2·38	74173	1·61	74196	1·38	TBA550Q	3·70		
7406	0·46	7422	0·23	7440	0·21	7472	0·38	7493	0·69	74120	0·95	74145	1·04	74174	1·73	74197	1·26	TBA560C	3·70		
7407	0·46	7423	0·37	7441AN	0·97	7473	0·41	7494	0·92	74121	0·46	74147	2·30	74175	1·04	74198	2·59	TBA673	2·52		
7408	0·23	7425	0·35	7442	0·83	7474	0·46	7495	0·83	74122	0·69	74148	2·02	74176	1·26	74199	2·59	TBA700	1·75		
7409	0·23	7427	0·35	7447AN	1·04	7475	0·62	7496	0·92	74123	1·15	74150	1·84	74178	1·44	76013N	2·02	TBA720Q	2·65		
						7476	0·46	7497	3·45	74125	0·63	74151	0·97	74179	1·44	LM309K	1·75	TBA750Q	2·38		
						7480	0·63	74100	1·73	74126	0·63	74154	2·02	74180	1·32	TAA570	2·85	TBA800	1·38		
						7482	0·36	74107	0·52	74128	0·68	74155	0·97	74190	1·73	TAA630S	4·02	TBA920	3·34		

BASES

B7G unskirted	0·17
B7G skirted	0·35
B9A unskirted	0·17
B9A skirted	9·35
NUVISTOR	0·86
Int Octal	0·29
Loctal	0·63
8 pin DIL	0·17
14 pin DIL	0·17
16 pin DIL	0·20
Valve screening cans all sizes	0·35

CRT'S

1CP31	35·65
2AP1*	9·78
2BP1*	10·35
3BP1	9·20
3DP1*	5·75
3EG1*	8·05
3FP7	6·90
3GP1	6·90
3JP1*	9·20
3JP2*	9·20
3JP7*	11·50
3KP1*	17·25
3RP1*	40·25
3WP1*	23·00
5ADP1	40·25
5BP1*	11·50
5CP1*	11·50
5CP1A	46·00
5FP15A	17·25
5UP7	16·10
DG7-5	28·75
DG7-32	41·40
DH3-91	35·65
DH7-11	78·20
VCR97*	13·80
VCR138*	11·50
VCR138A*	14·38
VCR139A*	9·20
VCR517A*	11·50
VCR517B*	11·50
VCR517C*	11·50

Tube Bases
* = Surplus P.O.A.

Mu-Metal Screens 3·45

REFERENCE BOOKS

BP1	First Book of Transistor Equivalents & Substitutes	0·60
BP2	Handbook of Radio, TV and Industrial & Transmitting Tube and Valve Equivalents	0·60
BP7	Radio and Electronic Colour Codes & Data Chart	0·25
BP11	Practical Transistor Novelty Circuits	0·40
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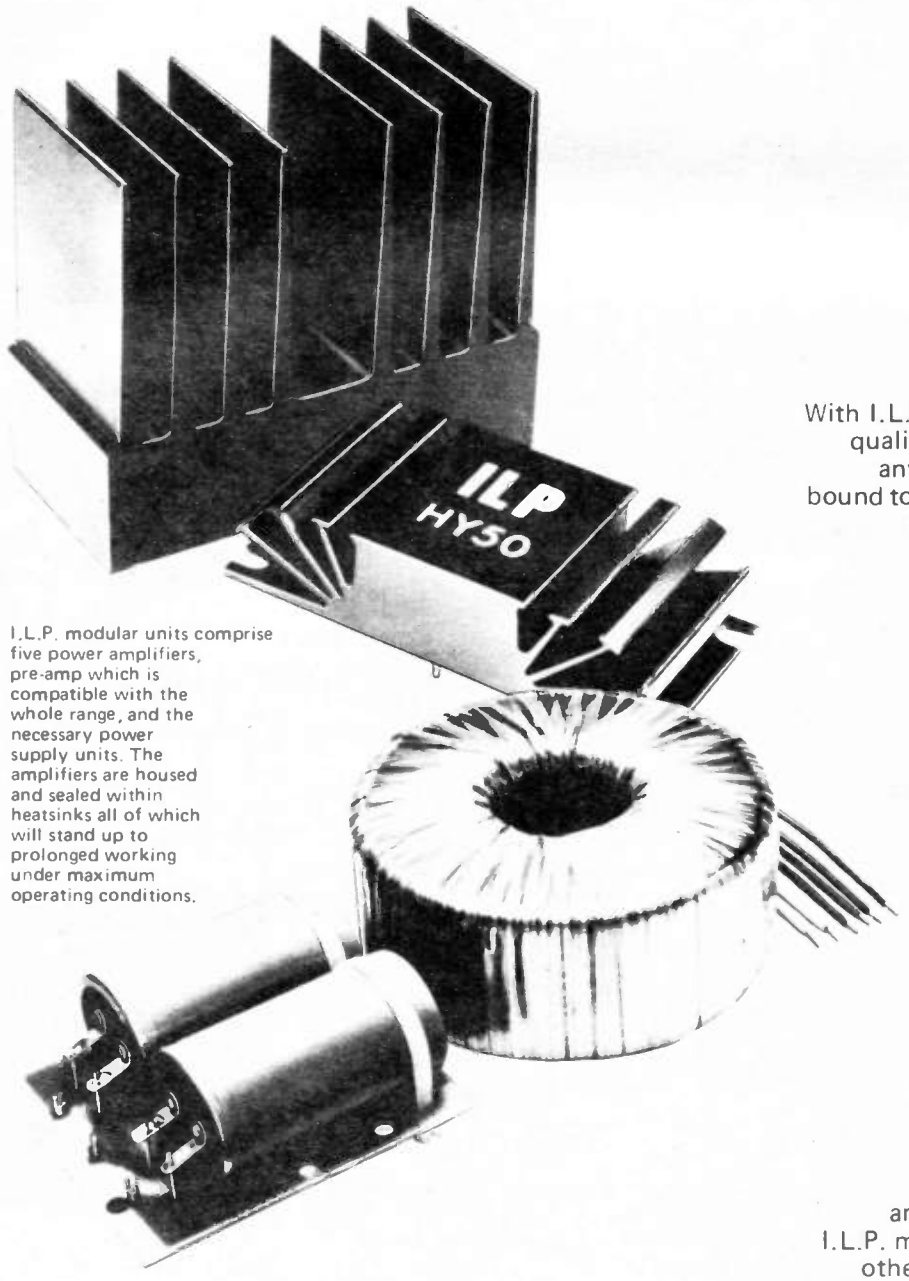

I.L.P. modular units comprise five power amplifiers, pre-amp which is compatible with the whole range, and the necessary power supply units. The amplifiers are housed and sealed within heatsinks all of which will stand up to prolonged working under maximum operating conditions.

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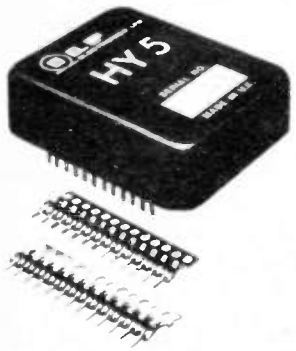

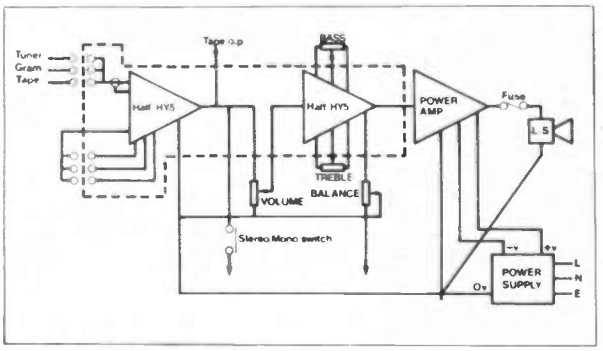

The HY5 pre-amp is compatible with all I.L.P. amplifiers and P.S.U.'s. It is contained within a single pack 50 x 40 x 15 mm. and provides multi-function equalisation for Magnetic/Ceramic/Tuner/Mic and Aux (Tape) inputs, all with high overload margins. Active tone control circuits; 500 mV out. Distortion at 1KHz—0.01%. Special strips are provided for connecting external pots and switching systems as required. Two HY5's connect easily in stereo. With easy to follow instructions.

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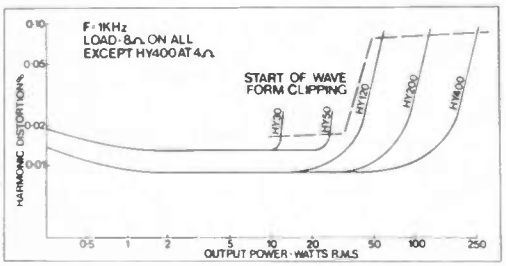
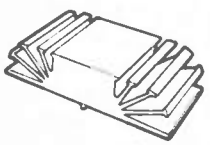
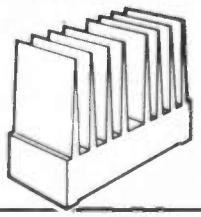
THE POWER AMPLIFIERS



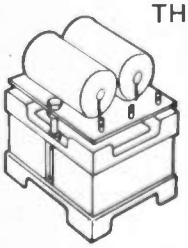
Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 Ω	0.02%	80dB	-20 -0- +20	105x50x25	155	**£6.34** + 95p
HY50	30 W into 8 Ω	0.02%	90dB	-25 -0- +25	105x50x25	155	**£7.24** + £1.09
HY120	60 W into 8 Ω	0.01%	100dB	-35 -0- +35	114x50x85	575	**£15.20** + £2.28
HY200	120 W into 8 Ω	0.01%	100dB	-45 -0- +45	114x50x85	575	**£18.44** + £2.77
HY400	240 W into 4 Ω	0.01%	100dB	-45 -0- +45	114x100x85	1.15Kg	**£27.68** + £4.15





Load impedance — all models 4 - 16 Ω
Input sensitivity — all models 500 mV
Input impedance — all models 100 K Ω
Frequency response — all models 10Hz - 45KHz - 3dB

THE POWER SUPPLY UNITS



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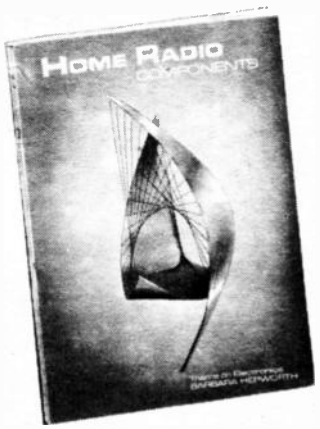

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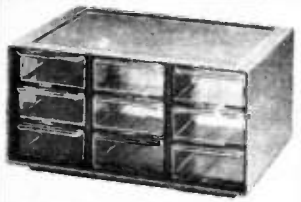

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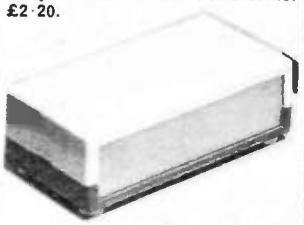

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Type No	Size	Price
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21052	154×85×60mm	£1·70
21053	125×65×40mm	£1·40

1A 400V RECTIFIERS

Plastic, like 1N4004, type 388F these diodes have preformed leads for horizontal mntg (15mm FC). Supersaver price—100 for £2·30; 500/£10 1000/£18

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Z401 Powerful 6V DC, all metal construction 50mm dia × 20mm **70p.**
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TEACH IN 80

We are again supplying all parts required for this major series which started in October. The price for all the Tutor Deck parts is **£19·50.** Also supplied *without* breadboard for **£13·50.** The price for the additional components required for Parts 1-6 is **£2·00.** All prices include VAT and Postage. Reprints of Oct & Nov parts 30p ea.

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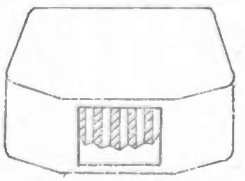

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POLYESTER CAPACITORS: Axial lead type (Values are in μF)
400V: 1nF, 1n5, 2n2, 3n3, 4n7, 6n8, 10m, 15n 9p; 18n 10p; 22n, 33n 11p; 47n, 68n 14p; 100n 17p; 150n, 220n, 24p; 330n, 470n 41p; 680n 52p; 1μF 64p; 2μ 82p.
160V: 39μF, 100n, 150n, 220n 11p; 330n, 470n 18p; 680n, 1μF 22p; 1μ5, 2μ2 32p; 4μ7 36p.
1000V: 10nF, 15n, 20p; 22n 22p; 47n 26p; 100n 38p; 470n 53p; 1μF 175p.

POLYESTER RADIAL LEAD CAPACITORS (250V)
10nF, 15n, 22n, 27n, 5p; 33n, 47n, 68n, 100n 7p; 150n 10p; 220n, 330n 13p; 470n 17p; 680n 19p; 1μF 22p; 1μ5 30p; 2μ2 34p.

FEED THROUGH CAPACITORS
1000pF 350V 8p

ELECTROLYTIC CAPACITORS: Axial lead type (Values are in μF) 500V: 10 40p; 47 68p; 250V: 100 85p; 63V 0·47, 1·0, 1·5, 2·2, 2·5, 3·3, 4·7, 6·8, 8 10, 15, 22 8p; 47, 32, 50 12p; 63, 100 27p 50V 50, 100, 220 25p; 470 32p; 1000 50p; 40V: 22, 33, 9p; 100 12p; 2200, 3300 85p; 4700 98p; 35V: 10, 33 7p; 330, 470 32p; 1000 49p; 25V: 10, 22, 47 6p; 80, 100, 160 8p; 220, 250 13p; 470, 640 25p; 1000 27p; 1500 30p; 2200 45p; 3300 62p; 4700 85p; 16V: 10, 40, 47, 68 7p; 100, 125 8p; 220, 330 14p; 470 18p; 1000, 1500 20p; 2200 34p; 10V: 100 6p; 640 12p; 1000 14p.
TAG-END TYPE: 450V: 100μF 180p; 70V: 4700 165p; 64V: 3300 130p; 2500 98p; 50V: 3300 105p; 2200 99p; 00V: 15,000 399p; 4700 120p; 4000 92p; 3300 93p; 2500 85p; 2200 85p; 2000 + 2000 120p; 30V: 4700 90p; 25V: 6400 105p; 4700 85p; 3300 80p; 2200 60p.

TANTALUM BEAD CAPACITORS 35V: 0·1μF, 0·22, 0 33, 0·47, 0·68, 1·0, 2·2μF, 3·3, 4·7, 6·8 25V: 1·5, 10 20V: 1·5 16V: 10μF 13p each 47, 100 40p. 10V: 22μF, 33 20p 6V: 47, 68, 100, 30p 3V: 68, 100μF. 20p

MYLAR FILM CAPACITORS
100V: 0·001, 0·002, 0·005, 0·01μF 6p
0·015, 0·02, 0·04, 0·05, 0·056μF 7p
0·1μF, 0·2 9p 50V: 0·47 12p

MINIATURE TYPE TRIMMERS
2-5·6pF, 3-10pF, 10-40pF 22p
5-25pF, 5-45pF, 60pF, 88pF 30p

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3-40pF, 10-80pF 30p; 25-190pF 33p
100 500pF 45p 1250pF 58p.

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10pF to 1nF 8p; 1·5nF to 10nF 10p.

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1000, 1200, 1800, 2000 20p each

CERAMIC CAPACITORS: 50V 0·5pF to 10nF 4p; 22n to 100n 6p.

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POTENTIOMETERS: (ROTARY) Carbon Track. 0·25W Log & 0·5W Linear Value.
500 Ω, 1 K & 2K (Lin. only) Single 27p
Dual 50K Ω–1 M Ω single gang 27p
5K-2 M Ω single with DP switch 65p
5K-2 M Ω double gang 78p

SLIDER POTENTIOMETER
0·25W log and linear values 60mm
5K Ω–500K Ω single gang 70p
10K Ω–500K Ω dual gang 80p
Self Stick Graduated Bezels 25p

PRESET POTENTIOMETERS
Vertical & Horizontal
0-1W 50 Ω–5MΩ Miniature 7p
0-25W 100 Ω–3·3M Ω Horiz 10p
0-25W 200 Ω–4·7MΩ Vert 10p

RESISTORS: Carbon Film, High Stability, Low Noise, Miniature Tolerance 5%.

Range	Val.	1-99	100+
¼W 2Ω2–4M7	E24	2p	1p
¼W 2Ω2–4M7	E12	2p	1p
1W 2Ω2–10M	E12	5p	4p
2% Metal Film 10Ω–1M		6p	4p
1% Metal Film 51Ω–1M		8p	6p

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TIL209 Red	13
TIL211 Grn	17
TIL212 Yellow	18
.2" Red	15
2" Yellow Green	18
Square LED	36
ORP12	63
2N5777	45
7 Seg Displays	
LS400	255
TIL312 C An 3"	105
TIL313 C Cth 3"	105
TIL321 C An 5"	115
TIL322 C Cth 5"	115
DL704 C Cth .3"	99
DL707 C.A. .3"	99
DL747 C.A. .6"	180
FND357	120
MAN3640	175
LCD 3½ digit	875
TIL307	675

SWITCHES
TOGGLE 2A 250V
SPST 28p
DPDT 38p
4 pole on/off 54p

SUB-MIN TOGGLE
SP changeover 58p
SPST on/off 54p
DPDT 6 tags 70p
DPDT c/off 79p
DPDT Biased 115p

SLIDE 250V:
1A DPDT 14p
1A DP c/off. 15p
½A DPDT 13p
4 pole c/over 24p

PUSH BUTTON
Spring Loaded
SPST on/off 85p
SPDT c/over 70p
DPDT 6 Tag 85p

SWITCHES Miniature Non-Locking
Push to Make 15p Push to Break 25p
ROCKER: SPST on/off 10A 250V 23p
ROCKER: Illuminated (white) Lights when on: 3A 240V 70p
ROTARY: (ADJUSTABLE STOP) 1 pole/ 2-12 way 2p/2-6W, 3p/2-4W, 4p/2-3W. 41p
ROTARY: Mains 250V AC, 4 Amp 45p

DIL SOCKETS ★ (Low Profile – Texas)
8 pin 10p; 14 pin 12p; 16 pin 13p; 18 pin 16p; 20 pin 22p; 24 pin 25p; 28 pin 39p; 40 pin 50p.

VOLTAGE REGULATORS*

	TO3	+ve	−ve	
1A				
5V	7805	145p	7905	220p
12V	7812	145p	7912	220p
15V	7815	145p		—
18V	7818	145p		—

1A	TO220 Plastic Casing		
5V	7805 65p	7905	75p
12V	7812 65p	7912	75p
15V	7815 65p	7915	75p
18V	7818 65p	7918	75p
24V	7824 65p	7924	75p

100mA	TO92 Plastic Casing		
5V	78L05 30p	79L05	65p
6V	78L62 30p		—
8V	78L82 30p		—
12V	78L12 30p	79L12	65p
15V	78L15 30p	79L15	65p

CA3085	95	LM323K	625	MVR5	150
LM300H	170	LM325N	240	MVR12	150
LM305H	140	LM326N	240	TAA550	50
LM309K	135	LM327N	270	TBA625B	95
LM317K	350	LM723	39	TDA1412	150



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Dielectric 100/300pF	175p	0 2 365pF with slow motion Drive	325p
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0-1·365pF	245p	'L' 3 x 310pF	550p
00 2 365pF	275p	00·3 x 25pF	430p

DENCO COILS

RDT2	98p	'DP' VALVE TYPE	RFC 5 chokes 88p
Range 1 to 5 Bl., Rd., Yl. Wht.	92p	RFC (19mH)	102p
6–7 B.Y.R.	85p	I FT 13; 14; 15; 16; 17	92p
1·5 Green	99p	I FT 18/1·8	104p
'T' 1 to 5 Bl., Yl., Rd., Wht.	1·05p	I FT 18/465	109p
B9A Valve Holder	28p	TOC 1 MWSFR	92p 112p
		MW/LW 5FR	120p

VEROBOARD

	0·1 (copper clad)	0·15 (plain)	0·15
2½ × 3¾	46p	39p	24p
2½ × 5	55p	50p	31p
3¾ × 3¾	55p	50p	—
3¾ × 5	62p	67p	43p
2½ × 17	169p	135p	92p
3¾ × 17	218p	180p	120p
4½ × 17	280p	—	183p
Pkt of 35 pins			22p
Spot face cutter			85p
Pin Insertion tool			120p

DIODES

AA119	25
AA129	20
BA100	10
BY126	12
BY127	12
CRO33	148
OA9	75
OA47	12
OA70	12
OA79	15
OA81	15
OA85	14
OA90	7
OA91	6
OA95	8
OA200	8
OA202	8
IN914	4
IN916	5
IN4001/2	5
IN4003	6
IN4004/5	6
IN4006/7	7
IN4148	4
IS44	20
3A/100V	18
3A/400V	20
3A/600V	27
3A/1000V	30

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NOISE
25J 160

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1A/50V	20
1A/100V	22
1A/200V	25
1A/400V	29
1A/600V	34
2A/50V	35
2A/100V	44
2A/200V	46
2A/400V	53
2A/600V	65
4A/100V	72
4A/200V	75
4A/400V	76
4A/600V	105
4A/800V	120
6A/100V	73
6A/200V	78
6A/400V	85
BY164	56
VM18 DIL	40

SCRs Thyristors

0·6A/200V	30p
0·8A/100V	30p
0·8A/200A	35p
1A/600V	70
5A/300V	35
5A/600V	43
8A/300V	48
8A/500V	58
8A/600V	85
12A/300V	56
12A/500V	92
15A/700V	195p
2N4444	140p
BT106	150
C106D	38
TIC44	25
TIC45	45

TRIACS

3A/100V	48
3A/200V	48
3A/400V	50
8A/100V	54
8A/400V	64
8A/800V	108
12A/100V	60
12A/400V	70
12A/800V	130p
16A/100V	95
16A/500V	150
25A/800V	295
25A/1000V	480p
T28000D	120

DIAC
ST2 25

TTL 74		74126	57	74LS47	63	74LS365	65	4078	21	CA3123E	200
7400	11	74128	74	74LS51	24	74LS366	65	4081	20	CA3130	85
7401	11	74132	73	74LS54	28	74LS367	65	4082	21	CA3140	70
7402	11	74136	65	74LS55	30	74LS368	66	4085	74	ICL7106E	795
7403	12	74141	56	74LS63	150	74LS373	180	4086	73	ICL7107	875
7404	12	74142	209	74LS73	46	74LS375	160	4089	150	ICM7205	1150
7405	18	74143	314	74LS74	41	74LS374	155	4093	85	ICM7217A	790
7406	28	74144	314	74LS75	48	74LS378	184	4094	190	ICM7555	89
7407	38	74145	65	74LS76	40	74LS670	248	4095	105	LD130	452
7408	17	74147	175	74LS78	40	74LS673	1050	4096	105	LM300H	170
7409	17	74143	109	74LS83	115	74LS674	1450	4097	372	LM301A	30
7410	11	74150	99	74LS85	118			4098	110	LM308	110
7411	20	74151	64	74LS86	43	**CMOS**		4099	145	LM318	205
7412	17	74153	64	74LS90	38	4000	13	4160	109	LM324	68
7413	30	74154	96	74LS91	104	4001	13	4161	109	LM339	70
7414	45	74155	53	74LS92	89	4002	15	4162	109	LM348	90
7416	30	74156	80	74LS93	89	4006	87	4163	109	LM379	375
7417	30	74157	67	74LS95	116	4007	18	4174	110	LM380	80
7420	16	74159	185	74LS96	116	4008	82	4175	99	LM381	145
7421	29	74160	82	74LS107	44	4009	33	4194	108	LM381AN	248
7422	17	74161	92	74LS109	55	4010	38	4408	720	LM382	125
7423	27	74162	92	74LS112	55	4011	18	4409	720	LM1458	50
7425	27	74163	92	74LS113	50	4012	18	4410	720	LM3900	60
7426	38	74164	105	74LS114	50	4013	45	4411	958	LM3909N	70
7427	27	74165	105	74LS123	70	4014	80	4412V	1380	LM3911	125
7428	35	74166	140	74LS124	180	4015	82	4415F	795	M253AA	795
7430	17	74167	200	74LS125	60	4016	45	4415V	795	MC1304P	260
7432	25	74170	185	74LS126	60	4017	82	4419	220	MC1310	148
7433	40	74172	625	74LS132	95	4018	87	4422	545	MC1312P	195
7437	30	74173	120	74LS136	55	4019	48	4433	995	MC1488	85
7433	33	74174	87	74LS138	85	4020	99	4435	825	MC1489	90
7440	15	74175	87	74LS139	85	4021	85	4440	1275	MC1495	350
7441	74	74176	75	74LS151	90	4022	85	4450	295	MC1496	92
7442	68	74177	78	74LS153	78	4023	22	4451	295	MC1710	78
7442	115	74178	153	74LS155	90	4024	66	490F	695	MC3340P	120
7444	112	74180	85	74LS156	90	4025	18	4490V	525	MC3360P	120
7445	84	74181	165	74LS157	78	4026	180	4501	18	MC3401	52
7446	84	74182	88	74LS158	90	4027	45	4502	120	MC3403..	135
7447	57	74184	135	74LS160	128	4028	81	4503	69	MFC6040	97
7448	51	74185	135	74LS161	98	4029	99	4506	51	MK50362	870
7450	17	74188	275	74LS162	138	4030	58	4507	55	MK50398	635
7451	17	74190	95	74LS163	102	4031	205	4508	298	MM5303	635
7453	17	74191	95	74LS164	114	4032	100	4510	99	MM5307	1275
7454	17	74192	98	74LS165	75	4033	145	4511	150	NE518	210
7460	17	74193	98	74LS168	155	4034	116	4512	98	NE543	210
7470	23	74194	98	74LS169	150	4035	111	4520	108	NE544	185
7472	25	74195	98	74LS170	288	4036	325			NE555	20
7473	32	74196	93	74LS173	105	4037	100			NE556	660
7474	25	74197	80	74LS174	106	4038	108			NE560	325
7475	38	74198	150	74LS175	110	4039	320			NE561	395
7478	38	7150	175	74LS181	398	4040	105			NE562	410
7480	48	75491	92	74LS183	298	4041	80			NE564	425
7481	86	75492	92	74LS189	430	4042	75			NE565	120
7482	69			74LS190	140	4043	94			NE566	160
7483	72			74LS191	140	4044	95			NE567	170
7484	95	74LS*		74LS192	132	4045	145			NE571	420
7485	75	74LS00	11	74LS193	130	4046	128			SAD1024	1350
7486	31	74LS01	11	74LS194	166	4047	87			SN76003	170
7489	140	74LS02	12	74LS195	138	4048	58			SN76013	140
7490	30	74LS03	12	74LS196	100	4049	48			SN76023	140
7491	75	74LS04	12	74LS197	140	4050	48			SN76033	175
7492	38	74LS05	23	74LS221	98	4051	72			SN76477	225
7493	32	74LS08	22	74LS240	236	4052	72			TAA621	250
7494	78	74LS09	22	74LS241	231	4053	72			TBA120F	70
7495	65	74LS10	20	74LS242	232	4054	110			TBA641	250
7496	57	74LS11	22	74LS243	232	4055	123			TCA965	120
7497	189	74LS12	23	74LS244	155	4056	134			TDA1008	310
74100	118	74LS13	36	74LS245	270	4059	480			TDA1022	575
74105	62	74LS14	75	74LS247	190	4060	115			TDA1024	105
74107	29	74LS15	30	74LS251	134	4061	1425			TDA2020	320
74109	54	74LS20	20	74LS253	142	4062	999			TLO61	76
74110	54	74LS21	22	74LS257	110	4063	110			TLO74	199
74111	68	74LS22	22	74LS258	110	4066	58			TLO81	48
74112	125	74LS26	48	74LS259	380	4067	380			TLO82	96
74116	198	74LS27	28	74LS261	450	4068	22			TLO83	105
74118	83	74LS28	48	74LS266	52	4069BE	20			TLO84	130
74119	149	74LS30	22	74LS273	244	4070	32			UAA170	198
74120	115	74LS32	27	74LS275	250	4071	21			UAA180	198
74121	25	74LS33	39	74LS279	66	4072	21			ZN414	85
74122	46	74LS37	39	74LS280	250	4073	21			ZN424E	130
74123	48	74LS38	39	74LS289	468	0475	23			ZN425E	415
74125	38	74LS40	28	74LS323	468	4076	85			ZN1034	200
		74LS42	98	74LS324	240	4077	40				

LINEAR IC's

702	75
709C 14 pin	35
710	67
723	38
733	125
741C 8 pin	17
747C	78
748C	36
753	150
810	159
8038CC	340
AY-1-0212	580
AY-1-1313A	660
AY-1-1320	315
AY-1-5050	198
AY-1-5051	145
AY-1-6721/6	195
AY-3-8500	390
AY-5-1224A	260
AY-5-1230	450
CA3011	100
CA3018	88
CA3020	170
CA3023	170
CA3028A	80
CA3035	240
CA3043	190
CA3046	71
CA3048	210
CA3080E	70
CA3081	190
CA3805	85
CA3809E	210
CA3090AQ	398

TRANSISTORS

AC125	20	BC171	11	BF179	30	MPSU08	56	ZTX302	20	2N3707	11
AC126	20	BC172	11	BF180	35	MPSU56	60	ZTX303	25	2N3708	11
AC127	20	BC177	18	BF195	12	OC26	170	ZTX304	24	2N3709	11
AC128	20	BC178	16	BF196	12	OC28	150	ZTX314	24	2N3710	16
AC141	24	BC179	18	BF197	14	OC35	130	ZTX326	40	2N3711	12
AC142K	38	BC182	9	BF198	18	OC36	130	ZTX341	20	2N3713	215
AC176	24	BC182L	11	BF200	30	OC41	48	ZTX500	15	2N3771	233
AC188	24	BC183	8	BF224A	18	OC42	48	ZTX501	15	2N3772	195
ACY17	35	BC183L	11	BF244	30	OC43	55	ZTX502	16	2N3773	283
ACY18	40	BC184	9	BF256	60	OC44	31	ZTX503	15	2N3819	22
ACY19	40	BC184L	11	BF257	30	OC45	28	ZTX504	25	2N3820	45
ACY20	40	BC187	28	BF258	30	OC46	28	ZTX531	25	2N3822	130
ACY21	35	BC212	10	BF259	30	OC70	28	ZTX550	25	2N3823	85
ACY22	40	BC212L	11	BF594	40	OC71	28	2N526	58	2N3866	90
ACY28	40	BC213	10	BF595	38	OC72	42	2N696	36	2N3903	20
ACY39	78	BC213L	12	BFR39	25	OC76	38	2N697	25	2N3904	18
AD140	70	BC214	10	BFR40	28	OC81	50	2N698	54	2N3905	18
AD149	70	BC214L	13	BFR41	28	OC82	50	2N706	18	2N3906	17
AD161	42	BC307B	20	BFR79	28	OC83	48	2N708	16	2N4037	52
AD162	42	BC328	15	BFR80	28	OC84	44	2N918	40	2N4058	17
AF114	50	BC338	12	BFR81	28	OC140	110	2N930	18	2N4061	17
AF115	50	BC441	36	BFX29	28	OC170	85	2N961	61	2N4859	65
AF116	50	BC461	38	BFX81	45	OC171	75	2N1131	22	2N5135	42
AF117	70	BC447	25	BFX84	26	OC202	95	2N1132	22	2N5136	42
AF139	35	BC547	12	BFX85	28	TIP29	43	2N1302	35	2N5138	20
AF178	70	BC548	12	BFX86	28	TIP29C	60	2N1303	50	2N5179	60
AF180	70	BC549	13	BFX87	28	TIP30	47	2N1304	50	2N5180	80
AF186	50	BC557	15	BFX88	28	TIP30C	65	2N1305	28	2N5191	70
AF239	42	BC558	20	BFY50	20	TIP31	50	2N1671B	215	2N5305	40
BC107	11	BC559	20	BFY51	20	TIP31A	52	2N2160	350	2N5457	32
BC107B	11	BCY70	18	BFY52	20	TIP31B	58	2N2219A	22	2N5458	32
BC108	11	BCY71	20	BFY71	20	TIP31C	66	2N2220A	25	2N5485	35
BC108B	11	BCY72	20	BRY39	39	TIP32A	58	2N2222	20	2N5777	45
BC108C	12	BD131	45	BSX20	18	TIP32C	75	2N2369	15	2N6027	40
BC109	11	BD132	45	BSY65	30	TIP33A	85	2N2476	125	3N128	112
BC109B	12	BD133	43	BSY95A	18	TIP33C	105	2N2484	25	3N140	112
BC109C	12	BD135	38	BU105	140	TIP34A	85	2N2646	48	40311	60
BC117	20	BD136	37	BU205	190	TIP34C	110	2N2894	30	40313	125
BC119	23	BD137	36	BU208	225	TIP35A	185	2N2904	22	40316	86
BC137	20	BD138	50	MJ491	160	TIP35C	220	2N2905A	22	40317	52
BC140	35	BD139	40	MJ2955	120	TIP36C	255	2N2906	22	40324	85
BC142	30	BD140	36	MJE340	54	TIP41A	63	2N2926G	10	40326	52
BC143	30	BD145	198	MJE370	58	TIP41B	73	2N3053	20	40327	62
BC147	8	BD222	75	MJE371	60	TIP42A	72	2N3054	55	40348	105
BC148	8	BD859A	65	MJE2955	99	TIP42B	82	2N3055	48	40360	43
BC149	8	BD696A	65	MJE3055	70	TIP2955	65	2N3121	40	40361	45
BC153	27	BDY17	195	MPF102	66	TIP3053	65	2N3133	43	40407	52
BC154	27	BDY60	110	MPF103	38	TIS43	34	2N3135	33	40411	295
BC157	10	BDY61	165	MPF104	36	TIS44	45	2N3250	30	40412	65
BC158	11	BF115	34	MPF105	40	TIS90	20	2N3442	140	40487	85
BC159	11	BF154	25	MPF106	40	TIS91	24	2N3663	26	40576	190
BC160	42	BF156	29	MPSA05	25	ZTX107	12	2N3702	11	40594	70
BC167A	11	BF167	30	MPSA06	25	ZTX108	12	2N3703	14	40673	68
BC168C	12	BF173	25	MPSA12	42	ZTX109	14	2N3704	11	Matched pair add 25p per pair	
BC169C	12	BF177	24	MPSA55	25	ZTX300	13	2N3705	11		
BC170	18	BF178	25	MPSA56	25	ZTX301	15	2N3706	11		

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WARBLING TIMER (ZB 5)	Aug 79	£5·80
POWER SUPPLY 9V (ZB 6)	Aug 79	£8·25
ELECTRONIC TUNING FORK (ZB 7)	Aug 79	£8·90
SWANEE WHISTLER (ZB 8)	Aug 79	£3·50
TRAILER FLASHER UNIT (ZB 9)	Aug 79	£3·00
TOUCH-ON PILOT LIGHT LESS CASE (ZB 10) SEE LIST (ZB 34)	Aug 79	£1·70
QUIZ REFERENCE (ZB 12)	Aug 79	£4·50
SOLDERING IRON BIT SAVER (ZB 13)	July 79	£7·00
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CHOKE WARNING DEVICE (ZB 28) SEE LIST (ZB 36)	April 79	£7·50
POWER SUPPLY (ZB 30) SEE LIST (ZB 37)	Feb 79	£27·80
LIGHTS REMINDER FOR CAR (ZB 32)	Jan 79	£4·50

All above kits include parts as described in article, i.e. vero/board or p.c. board, i.e. sockets, connecting wire etc.

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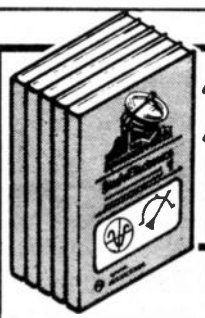

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IT'S FREE

This newsletter brings advance information of new lines, special snips and "too few to advertise" items. We call it "Advance Advertising News". Whenever you want a copy just send a S.A.E. or the subscription rate of £1·50 for 12 issues, which is just about what it costs us to address the envelope and post them second class.

SPECIAL NOTES: The "+" sign after the amount shows the amount of V.A.T. The postage is based upon the amount the article costs to send if the same article forms part of a larger parcel. Would your order be less than £6·00 however, you must send an additional 50p to offset packing and other expenses.

IMPORTANT NOTES:

1. In our July/Aug newsletter we announced a standby heater kit. The heading for this should have read: 5000 watts not 500 watts, and don't forget you can save yourself over £4 by ordering this during September.
2. In some advertisements the Delta siren/bleeper was specified as suitable for A.C. only, it will however work from 6-12 volts D.C. or 12-24 volts A.C.

12v SUBMERSIBLE PUMP
Just join it to your car battery, drop it into the liquid to be moved and up it comes, no messing about, no priming, etc. Suitable for water, paraffin and any non-explosive, non-corrosive liquid. One use if you are a camper, make yourself a shower. Price £6 + 90p. A free gift, first 100 purchasers will get tap with built-in switch and length of plastic tubing.

PRECISION RESISTORS
A fortunate purchase enables us to offer almost a complete range of Mullard metal film precision resistors, 1% tolerance. Values start at 5 r and go right through to 976 k. Most values are available in ¼ watt and ½ watt rating. Price 25p + 3½p each in small quantities, or 20p + 3p each where supplied not less than 10 of a value, 15p + 2½p each not less than 100 of a value.

THIS MONTH'S ELECTRICAL SNIP
Parcel of M.E.M. White flush 13 amp sockets, switches, etc. Total retail value over £56 + vat for only £28 + £4·20. You get 10 double 13 amp sockets and 6 single 13 amp S sockets with neons, 14 power (20 amp dpt switches and spurs some with neons), 20 single ganged one-way, two-way and intermediate switches, and super free gift (worth £3). If not collecting please add £2.

M.E.M. WHITE FLUSH SOCKETS, ETC.
We have picked out the popular items for the snip parcel described above but a list of the other parts available is as follows (makers list Nos.): 220, 224, 240, 242, 244, 711, 712, 813, 1000, 1005, 1010, 1011, 1020, 1021, 1022, 1024, 1025, 1033, 1400, 1400 WH, 1401 WH, 1402, 1402 WH, 1403, 1403 WH, 1404, 1404 WH, 1405, 1405 WH, 1407, 2025, 7092. Electricians and Contractors using these accessories should send for our M.E.M. Electrical List where prices and quantity discounts will be quoted.

VARI-CAP T.V. PUSH BUTTON TUNER
W. German make but fitted to several popular colour T.V.'s, makers Ref. No. 2357 0076. This has 6 push buttons, each of which is in effect a multi turn pot, total resistance is 15k. The buttons are black with chrome metal tops. Price £1 + 15p, post 25p. Good quantity available at usual discount rates.

MULTI TURN POT WITH KNOB
100k lin, 20 turn used in many T.V. receivers, makers ref. 7802 412-00051. Suitable for fine control of resistence in general circuitry. Price 40p + 6p.

T.V. DIPLEXER
On plastic moulding size 2½" × 1¾". We are able to offer these at such a low price that they can be used as T.V. aerial sockets only. Price 10 for £1 + 15p.

TRANSDUCERS
As used remote control T.V. receivers. **Price £1·50 + 22p.**

BURGLAR ALARM
Mains operated new circuit available, this is simple to install and trouble free. Price list and diagram free on request.

ARMY 48 SETS
As made for and used in the Second World War, we have a few of these in mint condition, complete with carrying satchels, headphones, throat mikes and instruction cards. In unopened boxes. Price £30 + £4·50. Post £2.

MUSIC CENTRE COVER
Size 20" × 13½" × 4". Clear plastic £3·50 + 52p, carriage and special packing £2.

25 AMP D.C. METERS
Flush panel mounting, wide angle, extra long, 320° scale made for G.P.O. Really beautiful instrument, brand new in original cartons. Limited quantity only so no discounts. Price £8 + £1·20. (Less than half maker's price.)

BIG BLOWER
Driven by 1/10 H.P. mains motor but compact and quiet running. This is ideal for air conditioning, fume extraction, pressurizing and many other applications. Overall size 10½" × 10½" dia. Outlet size 10½" × 4½". Price £15 + £2·25, carriage £3. Note this is the largest of our 'Snail' shaped blowers, we have smaller ones right down to 10 watt motors with outlets as small as 2" × 2", in fact we can cover almost any application and welcome your enquiries. Prices are from £3 complete with motor.

DOLLS HOUSE SWITCH
Time is fast approaching when you may be thinking of making toys. Small surface mounting switches are often a problem and this is why we are now offering this plastic bodied rotary switch suitable for low voltage applications. Price 10 for £1·50 + 22p.

CASSETTE STORAGE CASE
With dust cover, holds 5 cassettes and comes complete with clip for joining to another, so you can make up in lengths to suit yourself. Price 50p + 7½p + 50p post or ten for £4 + 90p, post £1·50.

TELEPHONE ANSWERING MACHINES
Grade 2 machines are in stock ready for immediate despatch or collection (if coming specially to collect please telephone first). For the benefit of new readers we supply these machines on the understanding they are broken up or at least not used for their original purpose. The machines are secondhand but so far as we can see they are complete and quite possibly in good working order. We do not test them but guarantee to replace any part of the machine should it be missing or faulty, providing we are notified within 7 days of receipt. Prices for the machines are as follows: Grade 2 that is in very good condition £15·50 + £2·25, and Grade 1 which are top grade machines and are our very best almost perfect £20· + £3 each, but there is likely to be one month's wait. To these prices must be added £2·50 to cover carriage.
Mains Power Pack in Plastic Case for Telephone Answering Machine. Price £4·50 + 63p. Post 50p.

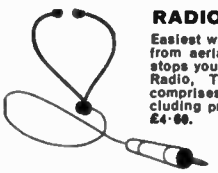
POT CORES
We now have good stocks of Ferrite pot cores. These are ex unused equipment and contain the bobbin and have been opened ready to use.

	Diameter	Thickness	Price	
FX 2243	4·5 cm	3·0 cm	75p + 12p	per pair
FX 2242	3·5 cm	2·3 cm	60p + 9p	
FX 2240	2·5 cm	1·6 cm	50p + 7p	

COMPONENT BOARD 421
Again from unused equipment, major items on these are two power silicon transistors, Motor Rola Ref. SJ 5433, mounted on a heat sink with mica insulators, also behind the panel are two power rectifiers ST NS 1008. Price 90p + 9p.

MULLARD UNILEX
A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost anyone in easy - to - assemble modular form and complete with a pair of speakers this should sell at about £30—but due to a special bulk-buy and as an incentive for you to buy this month we offer the system complete at only £15 including VAT and postage.

SHORTWAVE CRYSTAL SET
Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 10, 25, 29, 31 metre bands. Kit contains chassis front panel and all the parts £2·30—crystal earphone 65p including VAT and postage.



RADIO STETHOSCOPE
Easiest way to fault find, traces, signal from aerial to a speaker, when signal stops you've found the fault. Use it on, Radio, TV, amplifier, anything. Kit comprises transistors and parts including probe tube and twin stetho-set £4·60.

WINDSCREEN WIPER CONTROL
Vary speed of your wiper to suit conditions. All parts and instructions to make £4·25.

DRILL CONTROLLER
Electronically changes speed from approximately 10 revs to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £3·75.

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Will proved circuit flashes up to 750 watts of lamps. Complete kit includes S.C.P. mains input leads, all parts and very neat plastic case £4·95.

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Complete mechanisms with record/playback and erase heads—all electronics and speaker £9·75 post and VAT paid. *Note* these are all cased up ready to use but case may be slightly uncomplete, cracked or broken.

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To quickly receive parts for these and other E.E. projects, send the approximate cost as shown. Any cash adjustment can be made later.

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TIL 302. l.e.d. com. anode—character size 4" approx. Price £1·15 + 16p.

USEFUL BREAKDOWN UNIT
We do not normally offer second hand equipment for breaking down but this particular item contains so many useful pieces that we have decided to break our rule. The unit is in fact a pocket "bleeper" in a most useful case, size about 2½" wide by ½" thick by 5½" deep, ideal size to fit into the top jacket pocket. Case comes apart by undoing two screws, inside is printed circuit board upon which are mounted a miniature loud speaker, three rechargeable nicads diac type 150—4 ferrite potted coils, three of which are tunable, 4" ferrite rod. Mercury tilt switch on when case is upright, 4 electrolytic condensors, one micro switch, 8 transistors all with usable length leads, 4 polystyrene capacitors, 2 pin plug for charging batteries without uncasing and approximately 4 diodes and approximately 30 various capacitors and resistors, most of the resistors being ¼ watt type, truly a very useful unit although secondhand, still in reasonable condition. Price £1·50 + 22p.

25 WATT SPEAKERS
Comprising 8" woofer and 3" tweeter with crossover and terminal connection panel, all mounted in good quality non-resonant cabinet. These are extremely good quality units comparable with those selling at twice the price. Cabinet size approx. 20" high, 10½" wide and 8¼" deep, heavy cabinet made of thick blockboard. Price £25 + £3·75 the pair, well worth your coming to collect, but if you cannot collect they are still worth this £5 extra for carriage.

TWIN PADDED FLEX
5 amp ideal for some electric irons and appliances that require very flexible lead, 10 metre lengths. Price £1 + 15p. Post 45p.

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In aerosol can for easy application and for putting lubricant into places where the normal oil-can cannot reach. Offered at about half the original list price. 30p + 7p per can (8 oz) or 12 cans for £4 + 60p, post £1·50. The lubricant is I.C.I. Fluon L169.

V3 MICROSWITCH
Popular switch with 10 amp 250 volt changeover contacts. Price £15 per 100, or £140 per 1000 + VAT. Ditto with 15 amp changeover contacts £20 per 100 or £180 per 1000.

ASSORTED MICROSWITCHES
10 different small, medium and large sizes to suit most projects and repair jobs. Price £1·50 + 22p. If this pack does not contain the one you want, give us a ring, we may have it.

PUSH SWITCHES
That really stand out, its large dished knob also makes this extra easy to operate, sprung to return to normal when pressure is removed. 10 amp 250 volt changeover contacts. Type 1, 1 c/o 40p + 6p. Type 2, 2 c/o 60p + 9p. Type 3, 3 c/o 90p + 12p.

HFW KIT
Light Tracer and Strobe for disco's or parties. 2 running light patterns and a strobe. Was described with full constructional details in September Everyday Electronics. Our price for complete kit including case £14 + £2·10.

SPRING LOADED ROCKER SWITCH
Made originally for car dash. This is a simple on/off for up to 10 amps. Price 25p + 4p.

DP PANEL SWITCH
Arco made. This is a handsome switch, it has a long flat-ended toggle, black and chrome finish. Rated 2 amps at 250 volts and double-pole on/off. Price 40p + 6p.

PUSH BUTTON SWITCH
Suitable mains, audio or RF. Each switch rated at 250 volts 15 amps. 1st (black push button) closes 2 circuits; 2nd (white push button) operates one changeover; 3rd (white push button) operates one changeover; 4th (white push button) opens one circuit. Note: All depressed buttons remain down until cleared by the 5th (red button). Further note: It is a relatively easy job to alter the position of the tags, thus making the switches suit your circuit. Fitted with 3 white, 1 red and 1 black button. Price 75p + 11p.

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This comprises 12 miniature changeover micro switches joined in banks of 3 and mounted on frame with four digital numbered thumb wheels and a removable lever for locking the thumb wheel, the thumb wheel operates 3 banks. Over 4,000 combinations are possible, by re-wiring the switch connections underneath thousands more variations are possible. If you are making equipment which should not be switched on accidentally or without authority, then this is a switch to consider. It can be used as a coding switch for many other operations. Very neat and compact, measuring approx. 4" × 1¼" and 1¼" deep. Price £1·75 + 26p.

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First class maker, will respond to light or infra-red. 5 for £1 + 15p. 100 for £15 + £2·20. 1000 for £125 + £18·75.

CONTACT STAT
This is a skeleton thermostat with control knob calibrated 90°F-190°F. Put it into a box and you have calibrated wall stat or fix its flat base in close contact with the item to be controlled, for instance, bolt it to the casing of an electric motor, heat sink of semi conductor or other device which must not be allowed to overheat or strap it to a water tank, etc., etc. The switch will make and break 15 amps at normal mains voltage. Price £1·90 + 22p.

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188K	37p
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161	48p
162	48p
AF 116	35p
117	35p
124	63p
139	40p
172	37p
239	48p
BC 107	10p
108	10p
109	10p
147	8p
148	8p
149	9p
157	12p
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169C	12p
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Standard D.P.D.T.	17p
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Miniature	22p

DIN

Pins	Plug	Socket
2	15	10
3	15	10
4	15	10
5 (180°)	15	10
5 (240°)	15	10

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COMPONENTS 1N4148 0·9p. 1N4002 3·1p. 741. 16p. bc182, bc184, bc212, bc214, bc548 5p. Resistors ¼W 5% E12 10R to 10M 1p, 0·8p for 50+ of one value. 16V electrolytics 5,1,2,5,10,22mf 5p, 100mf 6p, 1000mf 10p. 1 lb FeCl £1·30. Dalo pen 84p. 40 sq ins pcb 66p. Polystyrene capacitors E12 63V 10 to 1000pf 3p, 1n2 to 10n 4p. Ceramic capacitors 50V E6 22pf to 47n 2p. Zenors 400mW E24 2v7 to 33v 7p. Preset pots submin 0·1W 100 to 4M7 6p.
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T-DEC AND CSC BREADBOARDS s-dec £3·79, t-dec £4·59, u-deca £4·69, u-decb £7·16, 16 dil adaptor £2·31, exp4b £2·64, exp300 £6·61, exp350 £3·62, exp325 £1·84.
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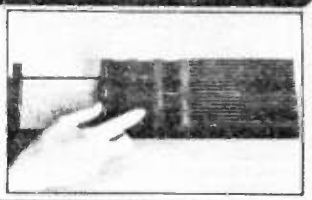

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PROGRAMMABLE £29·50 + VAT.
COLOUR CARTRIDGE T.V. GAME.
The TV game can be compared to an audio cassette deck and is programmed to play a multitude of different games in COLOUR, using various plug-in cartridges. At long last a TV game is available which will keep pace with improving technology by allowing you to extend your library of games with the purchase of additional cartridges as new games are developed. Each cartridge contains up to ten different action games and the first cartridge containing ten sports games is included free with the console. Other cartridges are currently available to enable you to play such games as Grand Prix Motor Racing, Super Wipeout and Stunt Rider. Further cartridges are to be released later this year, including Tank Battle, Hunt the Sub and Target. The console comes complete with two removable joystick player controls to enable you to move in all four directions (up/down/right/left) and built into these joystick controls are ball serve and target fire buttons. Other features include several difficulty option switches, automatic on screen digital scoring and colour coding on scores and balls. Lifelike sounds are transmitted through the TV's speaker, simulating the actual game being played.
Manufactured by Waddington's Videomaster and guaranteed for one year.

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PLAY CHESS AGAINST YOUR PARTNER.
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PLAY CHESS AGAINST THE COMPUTER.
The stylish, compact, portable console can be set to play at seven different levels of ability from beginner to expert including "Mate in two" and "Chess by mail". The computer will only make responses which obey international chess rules. Castling, on passant, and promoting a pawn are all included as part of the computer's programme. It is possible to enter any given problem from magazines or newspapers or alternatively establish your own board position and watch the computer react. The positions of all pieces can be verified by using the computer memory recall button.
Price includes unit with wood grained housing, and Staunton design chess pieces. Computer plays black or white and against itself and comes complete with a mains adaptor and 12 months guarantee.

OTHER CHESS COMPUTERS IN OUR RANGE INCLUDE
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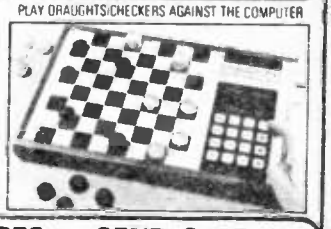
PLAY DRAUGHTS/CHECKERS AGAINST THE COMPUTER



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Whilst prices of goods shown in classified advertisements are correct at the time of closing for press, readers are advised to check with the advertiser both prices and availability of goods before ordering from non-current issues of the magazine.

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MULLARD LP1164 AM/FM I.F. Modules guaranteed unused £1·50. P.P. C.W.O. S.A.E. Lists. Tennex Limited, Stock Road Industrial Estate, Southend, Essex.

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OFFERS FOR "EVERYDAY ELECTRONICS". Issues Dec 71; Jan '72; All issues Mar '72 to Dec '75. Newport I.O.W. 527864.

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FREE. World-famous manufacturer's convenient, pocket-sized electronic construction guide (nearly 200 full-colour illustrations). Limited period offer. Send SAE now to TECHNOCENTRE, 54, Adcott Road, Middlesbrough.

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IN VIEW of current Government moves towards free enterprise in the sale of telephones and their installation we may be presented with the largest instant growth industry opportunity of the decade.

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DISCOVER ELECTRONICS. Build forty easy projects including: Metal Detector; Breathalyser; Radios; Stethoscope; Lie Detector; Touch time-switches; Burglar Alarms, etc. Circuits, plans all for £1·29 including FREE circuit board. Mail only. RIDLEY PHOTO/ELECTRONICS, Box 62, 111 Rockspark Road, Uckfield, Sussex.

200 COMPONENTS £4 10. Red L.E.D.s 0·125 90p. Lists 15p. Sole (E. E.), 37 Stanley Street, Ormskirk, Lancs L39 2DH.

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NORTHERN IRELAND. Build your own Computer. Nascom-1 Microcomputer kits. From P & O Computers (N.I), 81 Dublin Rd, Belfast BT2 7HF. Tel: 22010 evenings. Donaghmore 312. Belfast 621706.

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For next to the set fitting.
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35–40	3·40	1·95	1·15	·84
41–43	4·55	2·55	1·95	1·30
44–46	5·05	3·05	2·15	1·70
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48	15·00	9·00	6·00	3·30

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Prices include P & P and VAT.
SAE brings list of copper & resistance Wires.
Dealer enquiries invited.

RECHARGEABLE BATTERIES

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FULL RANGE AVAILABLE. SAE FOR LISTS. £1·25 for Booklet "Nickel Cadmium Power" plus catalogue. Write or call, Sandwell Plant Ltd., 2 Union Drive, Boldmere, Sutton Coldfield, West Midlands. 021-354 9764. Or see them at TLC, 32 Craven Street, Charing Cross, London WC2.

BUILD 25 PROJECTS with our multi-purpose kits, details supplied. Send £15·00 to Major Oak Services, 33 Lillian Avenue, London W3.

TUNBRIDGE WELLS COMPONENTS, BALLARD'S, 108 Camden Road, Tunbridge Wells, Phone 31803. No lists, enquiries S.A.E.

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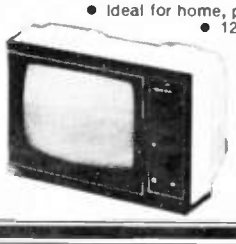

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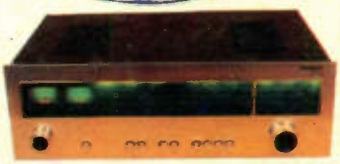

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