EVERYDAY ELECTRONICS

858

OCTOBER 1992

INCORPORATING ELECTRONICS MONTHLY

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32-PAGE CATALOGUE

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WHISTLE SWITCH

Plus ALTERNATIVE ENERGY-3; CIRCUIT SURGERY; ACTUALLY DOING IT; AMATEUR RADIO AND MORE

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THE No. 1 INDEPENDENT MAGAZINE for ELECTRONICS, TECHNOLOGY and COMPUTER PROJECTS

AMSTRAD PORTABLE PC'S FROM £149 (PPC1512SD). £179 (PPC1512DD). £179 (PPC1640SD). £209 (PPC1640DD). MODEMS £30 EXTRA.NO MANUALS OR PSU.

HIGH POWER CAR SPEAKERS. Stereo pair output 100w each. 4ohm impedance and consisting of 6 1/2" woofer 2" mid range and 1" tweeter. Ideal to work with the amplifier described above. Price per pair £30.00 Order ref 30P7R.

MICROWAVE CONTROL PANEL. Mains operated, with touch switches. Complete with 4 digit display, digital clock, and 2 relay outputs one for power and one for pulsed power (programmable). Ideal for all sorts of precision timer applications etc. Now only £4.00 ref 4P151.

FIBRE OPTIC CABLE. Stranded optical fibres sheathed in black PVC. Five metre length £7.00 ref 7P29R

12V SOLAR CELL. 200mA output ideal for trickle charging etc. 300 mm square. Our price £15.00 ref 15P42R

PASSIVE INFRA-RED MOTION SENSOR. Complete with daylight sensor, adjustable lights on timer (8 secs -15 mins), 50' range with a 90 deg coverage. Manual overide facility. Complete with wall brackets, bulb holders etc. Brand new and guaranteed. Now only £19.00 ref 19P29

Pack of two PAR38 bulbs for above unit £12.00 ref 12P43R

VIDEO SENDER UNIT Transmit both audio and video signals from either a video camera, video recorder or computer to any standard TV set within a 100' range! (tune TV to a spare channel). 12v DC op. £15.00 ref 15P39R Suitable mains adaptor £5.00 ref 5P191R

FM TRANSMITTER housed in a standard working 13A adapter (bug is mains driven). £26.00 ref 26P2R

MINATURE RADIO TRANSCEIVERS A pair of walkie talkies with a range of up to 2 kilometres. Units measure 22x52x155mm. Complete with cases. £30.00 ref 30P12R

FM CORDLESS MICROPHONE. Small hand held unit with a 500' range! 2 transmit power levels reqs PP3 battery. Tuneable to any FM receiver. Our price £15 ref 15P42AR

12 BAND COMMUNICATIONS RECEIVER. 9 short bands, FM, AM and LW DX/local switch, tuning 'eye' mains or battery. Complete with shoulder strap and mains lead **NOW ONLY £19.00!! REF 19P14R.**

CAR STEREO AND FM RADIO. Low cost stereo system giving 5 watts per channel. Signal to noise ratio better than 45db, wow and flutter less than .35%. Neg earth. £19.00 ref 19P30

LOW COST WALIKIE TALKIES. Pair of battery operated units with a range of about 200'. Our price £8.00 a pair ref 8P50R

7 CHANNEL GRAPHIC EQUALIZER plus a 60 watt power amp! 20-21KHZ 4-8R 12-14v DC negative earth. Cased. £25 ref 25P14R.

NICAD BATTERIES. Brand new top quality. 4 x AA's £4.00 ref 4P44R. 2 x C's £4.00 ref 4P73R, 4 x D's £9.00 ref 9P12R, 1 x PP3 £6.00 ref 6P35R

TOWERS INTERNATIONAL TRANSISTOR SELECTOR GUIDE. The ultimate equivalents book. Latest edition £20.00 ref 20P32R.

CABLE TIES. 142mm x 3.2mm white nylon pack of 100 £3.00 ref 3P104R. Bumper pack of 1,000 ties £14.00 ref 14P6R

GOT A CARAVAN OR BOAT?

NEW 80 PAGE FULL COLOUR LEISURE CATALOGUE

2,500 NEW LINES FREE WITH ORDER ON REQUEST

OR SEND £1.00

GEIGER COUNTER KIT. Complete with tube, PCB and all components to build a battery operated geiger counter. £39.00 ref 39P1R

FM BUG KIT. New design with PCB embedded coil. Transmits to any FM radio. 9v battery req'd £5.00 ref 5P158R

FM BUG Built and tested superior 9v operation £14.00 ref 14P3R

COMPOSITE VIDEO KITS. These convert composite video into separate H sync, V sync and video. 12v DC. £8.00 ref 8P39R.

SINCLAIR C5 MOTORS 12v 29A (full load) 3300 rpm 6"x4" 1/4" O/P shaft. New. £20.00 ref 20P22R.

As above but with fitted 4 to 1 inline reduction box (800rpm) and toothed nylon belt drive cog £40.00 ref 40P8R.

ELECTRONIC SPEED CONTROL KIT for c5 motor. PCB and all components to build a speed controller (0-95% of speed). Uses pulse width modulation. £17.00 ref 17P3R.

SOLAR POWERED NICAD CHARGER. Charges 4 AA nicads in 8 hours. Brand new and cased £6.00 ref 6P3R.

ACORN DATA RECORDER ALF503 Made for BBC computer but suitable for others. Includes mains adapter, leads and book. £15.00 ref 15P43R

VIDEO TAPES. Three hour superior quality tapes made under licence from the famous JVC company. Pack of 5 tapes New low price £8.00 ref 8P161

PHILIPS LASER. 2MW HELIUM NEON LASER TUBE. BRAND NEW FULL SPEC £40.00 REF 40P10R. MAINS POWER SUPPLY KIT £20.00 REF 20P33R READY BUILT AND TESTED LASER IN ONE CASE £75.00 REF 75P4R.

12 TO 220V INVERTER KIT As supplied it will handle up to about 15w at 220v but with a larger transformer it will handle 80 watts. Basic kit £12.00 ref 12P17R. Larger transformer £12.00 ref 12P41R.

VERO EASI WIRE PROTOTYPING SYSTEM Ideal for designing projects on etc. Complete with tools, wire and reusable board. New low bargain price only £2.00 ref B2P1

HIGH RESOLUTION 12" AMBER MONITOR 12v 1.5A Hercules compatible (TTL input) new and cased £22.00 ref 22P2R

VGA PAPER WHITE MONO monitors new and cased 240v AC. £59.00 ref 59P4R

25 WATT STEREO AMPLIFIER c. STK043. With the addition of a handful of components you can build a 25 watt amplifier. £4.00 ref 4P69R (Circuit dia included).

BARGAIN NICADS AAA SIZE 200MAH 1.2V PACK OF 10 £4.00 REF 4P92R, PACK OF 100 £30.00 REF 30P16R

FRESNEL MAGNIFYING LENS 83 x 52mm £1.00 ref BD827R.

12V 19A TRANSFORMER. Ex equipment but otherwise ok. Our price £20.00

ULTRASONIC ALARM SYSTEM. Once again in stock these units consist of a detector that plugs into a 13A socket in the area to protect. The receiver plugs into a 13A socket anywhere else on the same supply. Ideal for protecting garages, sheds etc. Complete system £25.00 ref B25P1 additional detectors £11.00 ref B11P1

IBM AT KEYBOARDS Brand new 86 key keyboards £15.00 ref 15P612

AMSTRAD MP3

UHF/VHF TV RECEIVER/CONVERTER

CONVERTS COLOUR MONITOR INTO A TV!

£9.00

286 MOTHER BOARDS. Brand new and tested complete with technical manual. £49.00 ref A49P1

UNIVERSAL BATTERY CHARGER. Takes AA's, C's, D's and PP3 nicads. Holds up to 5 batteries at once. New and cased, mains operated. £6.00 ref 6P36R.

IN CAR POWER SUPPLY. Plugs into cigar socket and gives 3,4,5,6,7.5,9, and 12v outputs at 800mA. Complete with universal spider plug. £5.00 ref 5P167R.

RESISTOR PACK. 10 x 50 values (500 resistors) all 1/4 watt 2% metal film. £5.00 ref 5P170R.

CAPACITOR PACK 1. 100 assorted non electrolytic capacitors £2.00 ref 2P286R.

CAPACITOR PACK 2. 40 assorted electrolytic capacitors £2.00 ref 2P287R.

QUICK CUPPA? 12v immersion heater with lead and cigar lighter plug £3.00 ref 3P92R.

LED PACK ,50 red leds, 50 green leds and 50 yellow leds all 5mm £8.00 ref 8P52R

AMSTRAD 1640DD BASE UNITS

BRAND NEW AND CASED

TWO BUILT IN 5 1/4" DRIVES

MOTHER BOARD WITH 640K MEMORY

KEYBOARD AND MOUSE

MANUAL

OUR PRICE JUST

£79!!!!

IBM PRINTER LEAD. (D25 to centronics plug) 2 metre parallel. £5.00 ref 5P186R.

COPPER CLAD STRIP BOARD 17" x 4" of .1" pitch "vero" board. £4.00 a sheet ref 4P62R or 2 sheets for £7.00 ref 7P22R.

STRIP BOARD CUTTING TOOL. £2.00 ref 2P352R.

50 METRES OF MAINS CABLE £3.00 2 core black precut in convenient 2 m lengths. Ideal for repairs and projects. ref 3P91R

4 CORE SCREENED AUDIO CABLE 24 METRES £2.00 Precut into convenient 1.2 m lengths. Ref 2P365R

6 1/2" 20 WATT SPEAKER Built in tweeter 4 ohm £5.00 ref 5P205R

WINDUP SOLAR POWERED RADIO! FM/AM radio takes rechargeable batteries complete with hand charger and solar panel 14P200R

PC STYLE POWER SUPPLY Made by AZTEC 110v or 240v input. +5 @ 15A,+12 @ 5A,-12 @ .5A,-5 @ .3A. Fully cased with fan, on/off switch, IEC inlet and standard PC fly leads. £15.00 ref F15P4

ALARM PIR SENSORS Standard 12v alarm type sensor will interface to most alarm panels. £16.00 ref 16P200

MODEMS FOR THREE POUNDS!!

Fully cased UK modems designed for dial up system (PSTN) no data or info but only £3.00 ref 3P145R

TELEPHONE HANDSETS

Bargain pack of 10 brand new handsets with mic and speaker only £3.00 ref 3P146R

DATA RECORDERS

Customer returned mains battery units built in mic ideal for Computer or general purpose audio use. Price is £4.00 ref 4P100R

SPECTRUM JOYSTICK INTERFACE

Plugs into 48K Spectrum to provide a standard Atan type joystick port. Our price £4.00 ref 4P101R

ATARI JOYSTICKS

Ok for use with the above interface, our price £4.00 ref 4P102R

BENCH POWER SUPPLIES

Superbly made fully cased (metal) giving 12v at 2A plus a 6V supply. Fused and short circuit protected. For sale at less than the cost of the case! Our price is £4.00 ref 4P103R

BULL ELECTRICAL

250 PORTLAND ROAD HOVE SUSSEX
BN3 5QT TELEPHONE 0273 203500
MAIL ORDER TERMS: CASH PO OR CHEQUE WITH ORDER PLUS £3.00 POST PLUS VAT.

PLEASE ALLOW 7 - 10 DAYS FOR DELIVERY

FAX 0273 23077

SPEAKER WIRE

Brown twin core insulated cable 100 feet for £2.00 REF 2P79R

DISC DRIVES

Customer returned units mixed capacities (up to 1.44M) We have not sorted these so you just get the next one on the shelf. Price is only £7.00 ref 7P1R (worth it even as a stripper)

MICROSCOPE 1200X MAGNIFICATION

Brand new complete with shrimp hatchery, shrimps, prepared slides, light etc. £29.00 ref J29P4.

LIGHT ALARM SYSTEM

Small cased alarms that monitor a narrow beam area for sudden changes in light level. Complete with siren that sounds for a preset time when unit is triggered. £7.00 ref J7P1

JOYBALLS

Back in stock popular Commodore/Atari equiv (replace standard joystick) £5.00 ref J5P8

720K 3 1/2" DISC DRIVE

Brand new units made by JVC complete with tech info just £19.00!! ref J19P2

CAR BATTERY CHARGER

Brand new units complete with panel meter and leads. 6 or 12v output £7.00 ref J7P2.

CUSTOMER RETURNED SPECTRUM +2

Complete but sold as seen so may need attention £25.00 ref J25P1 or 2 for £40.00 ref J40P4

CUSTOMER RETURNED SPECTRUM +3

Complete but sold as seen so may need attention £25.00 ref J25P2 or 2 for £40.00 ref J40P5

HEX KEYBOARDS

Brand new units approx 5" x 3" only £1.00 each ref CD42R

PROJECT BOX

51/2" x 31/2" x 1" black ABS with screw on lid. £1.00 ref CD43R

SCART TO SCART LEADS

Bargain price leads at 2 for £3.00 ref 3P147R

SCART TO D TYPE LEADS

Standard Scart on one end, Hi density D type on the other. Pack of ten leads only £7.00 ref 7P2R

OZONE FRIENDLY LATEX

250ml bottle of liquid rubber sets in 2 hours. Ideal for mounting PCB's fixing wires etc. £2.00 each ref 2P379R

QUICK SHOTS

Standard Atari compatible hand controller (same as joysticks) our price is 2 for £2.00 ref 2P380R

VIEWDATA SYSTEMS

Brand new units made by TANDATA complete with 1200/75 built in modem infra red remote controlled qwerty keyboard BT appproved Prestel compatible, Centronics printer port RGB colour and composite output (works with ordinary television) complete with power supply and fully cased. Our price is only £20.00 ref 20P1R

AC STEPDOWN CONVERTOR

Cased units that convert 240v to 110v 3" x 2" with mains input lead and 2 pin American output socket (suitable for resistive loads only) our price £2.00 ref 2P381R

CURLY CABLE

Extends from 8" to 6 feet! D connector on one end, spade connectors on the other Ideal for joysticks etc (6 core) £1.00 each ref CD44R

COMPUTER JOYSTICK BARGAIN

Pack of 2 joysticks only £2.00 ref 2P382R

BUGGING TAPE RECORDER

Small hand held cassette recorders that only operate when there is sound then turn off 6 seconds after so you could leave it in a room all day and just record any thing that was said. Price is £20.00 ref 20P3R

NEW SOLAR ENERGY KIT

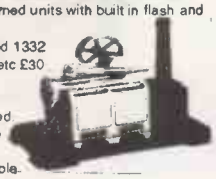
Contains 8 solar cells, motor, tools, fan etc plus educational booklet. Ideal for the budding enthusiast! Price is £12.00 ref 12P2R

286 AT PC

286 MOTHER BOARD WITH 640K RAM FULL SIZE METAL CASE, TECHNICAL MANUAL, KEYBOARD AND POWER SUPPLY £139 REF 139P1 (no i/o cards or drives included) Some metal work req'd phone for details.

35MM CAMERAS Customer returned units with built in flash and 28mm lens 2 for £8.00 ref 8P200

STEAM ENGINE Standard Mamod 1332 engine complete with boiler piston etc £30 ref 30P200



TALKING CLOCK

LCD display, alarm, battery operated Clock will announce the time at the push of a button and when the alarm is due. The alarm is switchable from voice to a cock crowing!£14.00 ref 14P200.R

HANDHELD TONE DIALLERS

Small units that are designed to hold over the mouth piece of a telephone to send MF dialling tones. Ideal for the remote control of answer machines. £5.00 ref 5P209R

AMAZING TALKING COINBOX!

Fully programmable talking, lockable coinbox BT approved, retail price is £79 ours is just £29! ref J29P2.

ANSWER PHONES £15

Customer returned units with 2 faults one we tell you how to fix the other you do your self! £18 ref J18P2 or 4 for £60 ref J60P3 BT approved (retail price £79.95!! each)

COMMODORE 64 MICRODRIVE SYSTEM

Complete cased brand new drives with cartridge and software 10 times faster than tape machines works with any Commodore 64 setup. The orginal price for these was £49.00 but we can offer them to you at only £25.00! Ref 25P1R

90 WATT MAINS MOTORS Ex equipment but ok Good general pupose unit £9.00 ref F9P1

HI FI SPEAKER BARGAIN Originally made for TV sets they consist of a 4" 10 watt 4R speaker and a 2" 140R tweeter If you want two of each plus 2 of our crossovers you can have the lot for £5.00 ref F5P2.

VIDEO TAPES E180 FIFTY TAPES FOR £70.00 REF F70P1

360K 5 1/4" Brand new drives white front. £20.00 Ref F20P1

EMERGENCY LIGHTING SYSTEM

Fully cased complete with 2 adjustable flood lights. All you need is a standard 6v lead acid battery. Our price is just £10 ref J10P29

AMSTRAD 464 COMPUTERS

Customer returned units complete with a monitor for just £35! These units are sold as faulty and are not returnable.

IN SUSSEX? CALL IN AND SEE US!

SOME OF OUR PRODUCTS MAY BE UNLICENSABLE IN THE UK

VOL. 21 No. 10 OCTOBER 1992

EVERYDAY ELECTRONICS

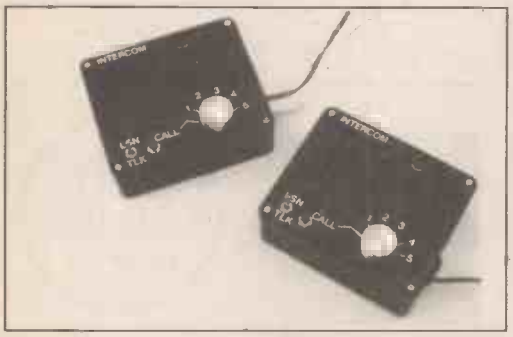
INCORPORATING ELECTRONICS MONTHLY

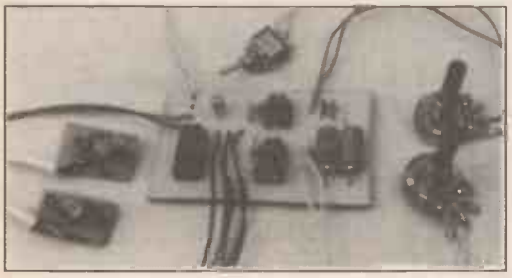
ABC CONSUMER PRESS

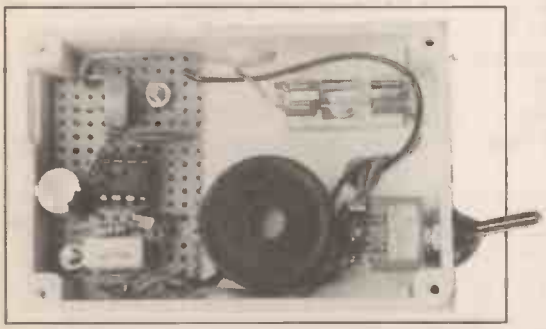
The No. 1 Independent Magazine for Electronics, Technology and Computer Projects

ISSN 0262 3617

PROJECTS . . . THEORY . . . NEWS . . .
COMMENT . . . POPULAR FEATURES . . .







Projects

Series

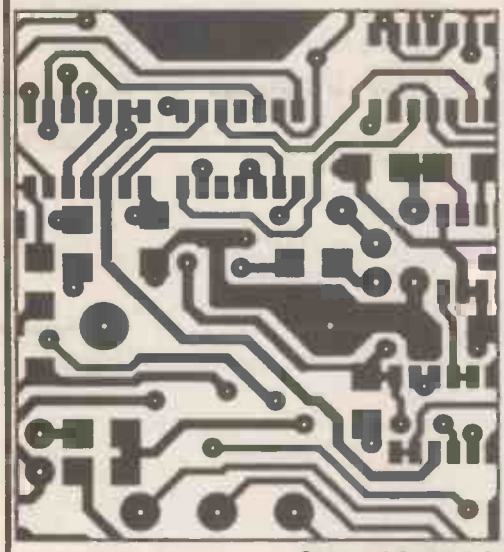
Features

Our November '92 Issue will be published on Friday, 2 October 1992. See page 611 for details.

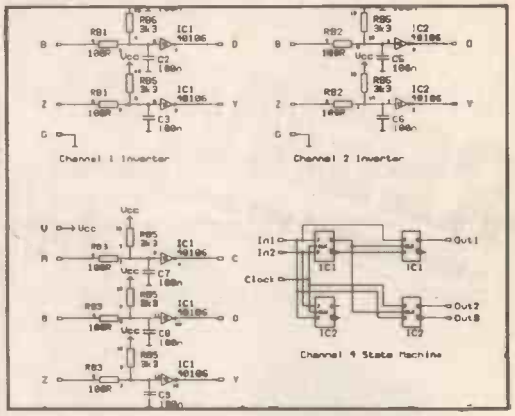
Readers Services • Editorial and Advertisement Departments 619

EASY-PC PCB and Circuit Diagram CAD

Forget using tapes and lightbox! Create your Circuit Boards using CAD - like the professionals.



- Runs on PC/XT/AT etc. with Hercules, CGA, EGA or VGA display and many DOS emulations.
- Design Schematics Single and Double sided and Multilayer boards including Surface Mount.
- Standard output includes Dot Matrix / Laser / Inkjet Printer, Pen Plotter, Photo-plotter and N.C. Drill.
- Extremely powerful.
- Very easy to use.



EASY-PC

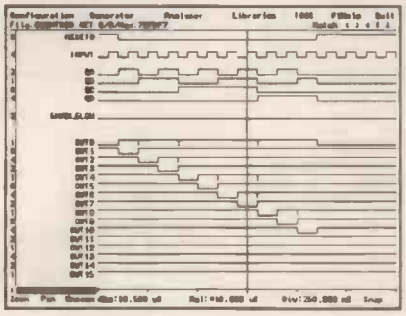
Technical support is free, for life!

Only £98.00! Plus P&P+VAT

Over 13,000 Installations in 70 Countries Worldwide!

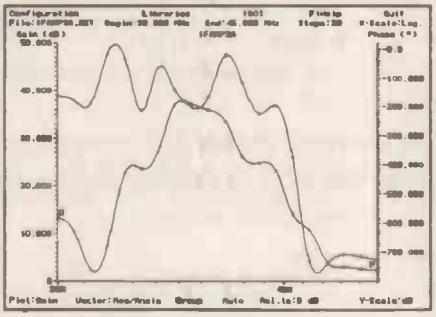
Options:-500 piece Surface Mount Symbol Library £48, 1000 piece Symbol Library £38, Gerber Import facility £98.

DIGITAL SIMULATION £195



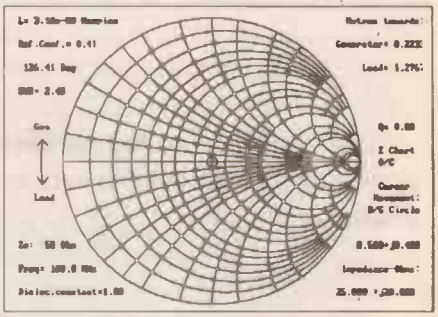
- At last! A full featured Digital Circuit Simulator for less than £1000!
- PULSAR allows you to test your designs without the need for expensive test equipment.
- Catch glitches down to a pico second per week!
- Includes 4000 Series CMOS and 74LS Libraries. 74HC/HCT libraries only £48.00 each.
- Runs on PC/XT/AT/286/386/486 with EGA or VGA.

ANALOGUE SIMULATION £195



- NEW powerful ANALYSER III has full graphical output.
- Handles R's,L's,C's, Bipolar Transistors, FET's, OP-amp's, Tapped and Untapped Transformers, and Microstrip and Co-axial Transmission Lines.
- Plots Input / Output Impedance, Gain, Phase & Group Delay.
- Covers 0.001 Hz to >10GHz
- For PC/XT/AT/286/386/486 with EGA or VGA.
- Very fast computation.

SMITH CHART CAD £195



- Z-MATCH II simplifies RF matching and includes many more features than the standard Smith Chart.
- Handles transmission line transformers, stubs, discrete components, S Parameters etc.
- Supplied with many worked examples.
- Superbly easy to learn and use.
- Runs on IBM PC/XT/AT/386/486, CGA,EGA,VGA.
- Ideal for Education and Industry.

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International: +44 -480-61778, Fax: +44-480-494042 ACCESS, AMEX, MASTERCARD, VISA Welcome.

FREE 196 Page GREENWELD CATALOGUE

– the biggest yet and packed with components, kits, tools etc.

21st Anniversary Issue

In addition to the merged titles next month is significant because it represents 21 years of EE. We have some special features looking at future technology – the next 21 years!

TEACH-IN '93

It is a tradition; roughly every two years since issue No. 1 we publish a new and completely different Teach-In series. The last one was **Design Your Own Circuits**, *this one is aimed at GCSE and 'A' level students.*

If you are taking electronics or technology at school or college, this series is for you.

If you just want to learn the basics of electronics then this series is for you.

If you are teaching electronics or technology you must make sure you see it.

The series will be invaluable if you are considering a career in electronics or even if you are already training in one. Or if you just want to brush up on your knowledge.

Don't miss the start of **Teach-In '93** *next month.*

To go with the series there is a very comprehensive and exciting **Mini Lab**. *This enables the construction and testing of both demonstration and development circuits. This learning aid brings electronics to life in an enjoyable and interesting way: you will both see and hear the electron in action!*

Later there is an additional **Micro Lab** *microprocessor add-on system that will appeal to higher level students and those that wish to develop microprocessor projects.*

In addition to all the above there will be the usual varied range of news, features and regulars including the following projects:

Altimeter, Personal Stereo Amp and a Reaction Timer.

DON'T MISS YOUR COPY!

Fill in the Shop Save card in this issue or take out a subscription now (see page 667). The demand for copies will be very high!

Please notice our new logo. From next month we will be joined by the present readers of **Practical Electronics**. *We have purchased that title and will merge it with EE.*

EVERYDAY WITH PRACTICAL ELECTRONICS

NOVEMBER ISSUE PUBLISHED FRIDAY, 2nd OCTOBER 1992

NEXT MONTH

SURVEILLANCE
PROFESSIONAL QUALITY KITS

No. 1 for Kits

Whether your requirement for surveillance equipment is amateur, professional or you are just fascinated by this unique area of electronics SUMA DESIGNS has a kit to fit the bill. We have been designing electronic surveillance equipment for over 12 years and you can be sure that all of our kits are very well tried, tested and proven and come complete with full instructions, circuit diagrams, assembly details and all high quality components including fibreglass PCB. Unless otherwise stated all transmitters are tuneable and can be received on an ordinary VHF FM radio.

UTX Ultra-miniature Room Transmitter
Smallest room transmitter kit in the word! Incredible 10mm x 20mm including mic. 3-12V operation. 500m range.....£16.45

MTX Micro-miniature Room Transmitter
Best-selling micro-miniature Room Transmitter
Just 17mm x 17mm including mic. 3-12V operation. 1000m range.....£13.45

STX High-performance Room Transmitter
Hi performance transmitter with a buffered output stage for greater stablity and range. Measures 22mm x 22mm including mic. 6-12V operation, 1500m range.....£15.45

VT500 High-power Room Transmitter
Powerful 250mW output providing excellent range and performance. Size 20mm x 40mm. 9-12V operation. 3000m range.....£16.45

VXT Voice Activated Transmitter
Triggers only when sounds are detected. Very low standby current. Variable sensitivity and delay with LED indicator. Size 20mm x 67mm. 9V operation. 1000m range...£19.45

HVX400 Mains Powered Room Transmitter
Connects directly to 240V AC supply for long-term monitoring. Size 30mm x 35mm. 500m range.....£19.45

SCRX Subcarrier Scrambled Room Transmitter
Scrambled output from this transmitter cannot be monitored without the SCDM decoder connected to the receiver. Size 20mm x 67mm. 9V operation. 1000m range.....£22.95

SCLX Subcarrier Telephone Transmitter
Connects to telephone line anywhere, requires no batteries. Output scrambled so requires SCDM connected to receiver. Size 32mm x 37mm. 1000m range.....£23.95

SCDM Subcarrier Decoder Unit for SCRX
Connects to receiver earphone socket and provides decoded audio output to headphones. Size 32mm x 70mm. 9-12V operation.....£22.95

ATR2 Micro Size Telephone Recording Interface
Connects between telephone line (anywhere) and cassette recorder. Switches tape automatically as phone is used. All conversations recorded. Size 16mm x 32mm. Powered from line.....£13.45

★★★ Specials ★★★

DLTX/DLRX Radio Control Switch
Remote control anything around your home or garden, outside lights, alarms, paging system etc. System consists of a small VHF transmitter with digital encoder and receiver unit with decoder and relay output, momentary or alternate, 8-way dil switches on both boards set your own unique security code. TX size 45mm x 45mm. RX size 35mm x 90mm. Both 9V operation. Range up to 200m.
Complete System (2 kits).....£50.95
Individual Transmitter DLTX.....£19.95
Individual Receiver DLRX.....£37.95

MBX-1 Hi-Fi Micro Broadcaster
Not technically a surveillance device but a great idea! Connects to the headphone output of your Hi-Fi, tape or CD and transmits Hi-Fi quality to a nearby radio. Listen to your favourite music anywhere around the house, garden, in the bath or in the garage and you don't have to put up with the DJ's choice and boring waffle. Size 27mm x 60mm. 9V operation. 250m range.....£20.95

UTLX Ultra-miniature Telephone Transmitter
Smallest telephone transmitter kit available. Incredible size of 10mm x 20mm! Connects to line (anywhere) and switches on and off with phone use. All conversation transmitted. Powered from line. 500m range.....£15.95

TLX700 Micro-miniature Telephone Transmitter
Best-selling telephone transmitter. Being 20mm x 20mm it is easier to assemble than UTLX. Connects to line (anywhere) and switches on and off with phone use. All conversations transmitted. Powered from line. 1000m range.....£13.45

STLX High-performance Telephone Transmitter
High performance transmitter with buffered output stage providing excellent stability and performance. Connects to line (anywhere) and switches on and off with phone use. All conversations transmitted. Powered from line. Size 22mm x 22mm. 1500m range.....£16.45

TKX900 Signalling/Tracking Transmitter
Transmits a continous stream of audio pulses with variable tone and rate. Ideal for signalling or tracking purposes. High power output giving range up to 3000m. Size 25mm x 63mm. 9V operation.....£22.95

CD400 Pocket Bug Detector/Locator
LED and piezo bleeper pulse slowly, rate of pulse and pitch of tome increase as you approach signal. Gain control allows pinpointing of source. Size 45mm x 54mm. 9V operation.....£30.95

CD600 Professional Bug Detector/Locator
Multicolour readout of signal strength with variable rate bleeper and variable sensitivity used to detect and locate hidden transmitters. Switch to AUDIO CONFORM mode to distinguish between localised bug transmission and normal legitimate signals such as pagers, cellular, taxis etc. Size 70mm x 100mm. 9V operation.....£50.95

QTX180 Crystal Controlled Room Transmitter
Narrow band FM transmitter for the ultimate in privacy. Operates on 180 MHz and requires the use of a scanner receiver or our QRX180 kit (see catlogue). Size 20mm x 67mm. 9V operation. 1000m range.....£40.95

QLX180 Crystal Cointrolled Telephone Transmitter
As per QTX180 but connects to telephone line to monitor both sides of conversations. 20mm x 67mm. 9V operation. 1000m range.....£40.95

QSX180 Line Powered Crystal Controlled Phone Transmitter
As per QLX180 but draws power requirements from line. No batteries required. Size 32mm x 37mm. Range 500m.....£35.95

QRX180 Crystal Controlled FM Receiver
For monitoring any of the 'Q' range transmitters. High sensitivity unit. All RF section supplied as a pre-built and aligned module ready to connect on board so no difficulty setting up. Outpt to headphones. 60mm x 75mm. 9V operation.....£60.95

A build-up service is available on all our kits if required.

UK customers please send cheques, POs or registered cash. Please add £1.50 per order for P&P. Goods despatched ASAP allowing for cheque clearance. Overseas customers send sterling bank draft and add £5.00 per order for shipment. Credit card orders welcomed on 0827 714476.

OUR LATEST CATALOGUE CONTAINING MANY MORE NEW SURVEILLANCE KITS NOW AVAILABLE. SEND TWO FIRST CLASS STAMPS OR OVERSEAS SEND TWO IRCS.

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LAST CHANCE TO SEND FOR OUR 32 PAGE SUMMER SALE LIST!!

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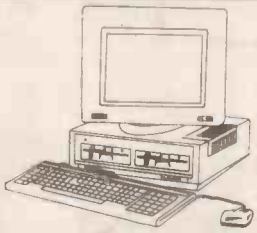
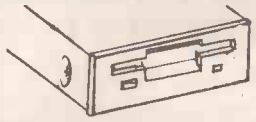
AMSTRAD PC1640 COMPUTER OFFER



Brand new base unit, keyboard, mouse and manual. Completely standard machine fitted with 2 x 5.25" disk drives, only being sold so cheaply as we have no monitor to go with them!

Amazing Price! - **£99.95**

3.5" DISK DRIVE

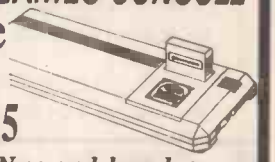


Model FD9. Brand new and boxed, this cased 3.5" 720k unit comes complete with cables and instructions. Plugs into printer port.

Superdeal Price **£24.95**

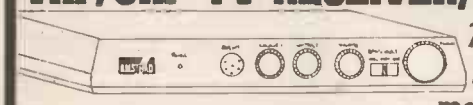
C64 GAMES CONSOLE

Value Pack **£49.95**



Z9109 New and boxed games machine based on the popular C64 computer - you get the console, power supply, TV lead, Cheetah joystick and 4 game cartridge - Flimbo's quest, Fiendish Freddy, Klax and International Soccer.

VHF/UHF TV RECEIVER/CONVERTER



Z8991 Amstrad MP3 computer modulator/converter.

A complete, fully tuneable VHF/UHF TV receiver with RGB and composite video out, and sound on the internal speaker. For use with the Amstrad CTM644-2 monitor specifically, or can be used with any colour/mono home computer monitors that have a 15.625kHz line frequency. Grey case 330x250x50mm Controls: contrast, colour, tuning, volume and band select (VHF-L, VHF-H, UHF) RGB output on 8 pin DIN skt, and composite video. Intended for European market - needs 2 ceramic filters changing. Parts and instructions supplied. Needs stabilised 12V DC, either from monitor or seperate power supply (our AL12, £8.14 is ideal)

ONLY £14.95

AMSTRAD CLOCK TIMER

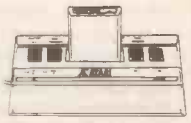
Z8999 Model CT1 - in plastic case that sits under monitor. MW/LW/FM receiver with 3" speaker, + digital clock with alarm and snooze facilities.

Great Value **£7.95**

ATARI 2600 GAMES CONSOLE

Complete and boxed with joystick, power supply, TV lead and games cartridge (centipede). Not new, but fully checked and working

Special Price **£29.95**



AMSTRAD GX4000 HOME ENTERTAINMENT SYSTEM

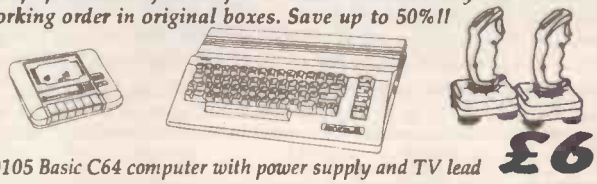
- *Games Console
- *2 Control Paddles
- *TV lead
- *Burnin' Rubber Cartridge
- *Power Supply
- *Instruction Books

Inputs for 2 paddles, analogue joysticks, light gun/pen etc. Outputs: UHF, RGB on 8 pin DIN skt, SCART skt, stereo sound 3.5mm skt. Uses 168 pin dedicated chip, Z80A CPU, AY-3-8912 sound chip, UM1234 UHF modulator

ONLY **£29.95**

commodore

Scoop purchase of a major store's returns. Fully checked in good working order in original boxes. Save up to 50%!!



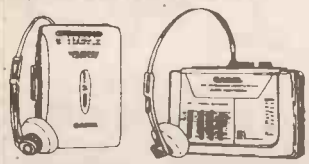
Z9105 Basic C64 computer with power supply and TV lead **£60**

Z9106 NightMoves/Mindbenders Pack. This contains the C64 Computer, C2N datacorder, 2 joysticks and 9 cassettes inc Trivial Pursuit, Confuzion etc **£75**

THE 'Greenweld Guardian' IS OUR MONTHLY NEWSLETTER FREE TO ALL BARGAIN LIST SUBSCRIBERS - ONLY £6 A YEAR FOR THE NEXT 12 ISSUES OF ALL OUR LISTS!!

CASIO

Casio have just introduced a range of personal stereos and portable audio equipment at very competitive prices:



W880 Bass boost, auto stop, belt clip **£8.99**
AS51R As above but with AM/FM radio **£15.99**
AS500R As AS51R, but with auto reverse **£23.50**
W120 As AS500R but with graphic equalizer **£27.99**

CP80 Bass boost, AM/FM/LW radio, single cassette, 6W PMPO **£32.95**
CP200 Bass boost, AM/FM/LW radio, twin cassette, hi-speed dubbing, graphic equalizer, 8WPMPO **£42.95**
CD510 CD player, twin cassette, AM/FM/LW radio + lots of other features, 45W PMPO **£159.95**

FOREGROUND MUSIC SPEAKERS

High quality for pubs, clubs etc. Bass unit, mid and 2 tweeters. Moulded cabinet with adjustable bracket. Max power 80W. Size 275x170x125mm. 4R imp.

Less than half price!
£39.95 per pr!

INSULATION TEST UNIT

Y136C 500V tester that can be used with most digital meters. 2 ranges covering 100k-1999M. Supplied with leads, batts, instructions and carry case. Original trade price £34

£12.95

CAMERA CLEARANCE

110 & 35mm - all are returns, some have small parts missing, but great value for lenses, electronics etc (most have built in flash units)

5 for £10

STEREO AUTO-REVERSE CASSETTE MECHS

Z5405 High quality heavy duty all metal construction stereo cassette player mechanism, probably intended for continuous background music. This is a lovely bit of kit - starts playing as soon as a cassette is inserted. Has fast forward, rewind and eject keys. It's bi-directional, and the sensing circuit automatically reverses the tape at the end. Has a Canon motor and works off 12V DC. Great value at **£4.95**.

NEW POWER SUPPLIES

Z5406D High efficiency step down power regulator module by SGS. This is a GSR400 type, as listed by Farnell at £41.11 each. Output is 7V @ 4A from a DC input of 10-46V. Possible uses include battery charger, or put two together and use 24V lorry battery to power car equipment. Our **special price - just £5.75 each.**

Z5409 Eurocard size - 160x100mm by Protek. 115/230V input. Outputs: +5V @ 3A; +12V @ 2A; -12V @ 0.25A Price **£8.95**

UHF TUNER

Z2648 UHF TV tuner - at least, the front end. Fagor SUF743 has a co-ax socket inlet into the screened case 65x50x20mm. Inside the PCB has some surface mount bits + BF966S, BF970 and BF199 transistors and a few coils. Giveaway Price 2 for **£1.00**

GREENWELD ELECTRONIC COMPONENTS

All 1 off and pack prices include VAT, qty prices do not. P&P **£2.50** per order (£9 next day) Min Credit Card £12. Official orders from Education welcome; min invoice charge £15. Payment is accepted by cheque, PO, cash (inc foreign currency banknotes), book tokens, Access, Visa, Connect. Our stores have enormous stocks - we are open from 9-5.30 Mon-Sat. Come and see us!

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27D PARK ROAD, SOUTHAMPTON, SO1 3TB

BARGAINS – 14 New Ones This Month

PROJECT BOX a first-class, Japanese two-part moulding size 95mm x 66mm x 23mm. Held together by 2 screws, this will hold a PP3 battery and a PCB and is ideal for many projects. To name just a few, the washer bottle monitor, the Quicktest and the model railway auto signal, described in last month's issue of E.E. This is nicely finished and very substantial. You get 2 for **£1**, Order Ref. 876.

HOLD IT MAGNETIC BASE embedded in a circular metal shallow disc, diameter approximtely 65mm (2½"), is the most powerful magnet. We have yet to find anyone who can remove this with his fingers. Ideal for adding extra shelves inside a metal case or to glass without drilling. Its uses, in fact, are innumerable. Price **£2** each, Order Ref. 2P296.

AMSTRAD EXPANSION BUS BOARD – their part no. Z70901. Just one IC is missing from its socket so it is quite likely that these boards have never been used. They contain a terrific quantity of very useful parts. There are 4 x 32 way edge connector sockets with gold-plated contacts, 7 crystals, over 40 ICs many of which are plug-in types. There are 5 micro processors Japanese-made, 8 socket connectors with gold-plated pins and hundreds of other small parts. Yours for **£10**, Order Ref. 10P94.

LIMITED SUPPLY ITEMS are only described in our newsletter. Over 50 appear in our current issue. If you order something this month you will receive this and the next three issues posted to you free of charge.

ANOTHER AMSTRAD BOARD. Reference number 112C 2001-3501. This has 6 plug-in ICs, 2 of which are 3500 DI types but the really important one is the Japanese-made D78310CW. In addition to the ICs there are 2 microprocessors, 1 SCR, 10 various transistors, over 10 diodes, 4 electrolytics, 1 Piezo sounder, 2 power transistors and a miscellaneous collection of other bits and pieces. Obviously cost a small fortune to make, our price to you is **£5**, Order Ref. 5P192.

WANT A SPARE 3" DISC DRIVE FOR YOUR AMSTRAD? We have, unused and believed O.K., Amstrad 3" disc drives that are all complete but need the front bezel. It shouldn't be too difficult a job to take the bezel off your old one and fit it to this and you should then have a new and perfect 3" disc drive which, as you probably know, are virtually unobtainable now. Price **£15** each, Order Ref. 15P45. Or, if you haven't got a drive from which you can remove the bezel, we can supply one, with good bezel but with some other fault for only **£5**, Order Ref. 5P193. This may seem a lot to pay for the bezel but, remember, you will have a complete set of spare parts for your 3" drive so it really is a bargain.

OPD DUAL MICRO DRIVE UNIT. This is a twin unit, each unit having its own motor, record/playback head and PCB with all electronics. In addition to being a direct replacement in the OPD, this can also be used with the Spectrum or the QL. We have a copy of the procedure necessary and will gladly supply a photostat of this if you require it when you purchase the unit. The price is **£5**, Order Ref. 5P194.

THIS MONTH'S SNIP is a first-class, battery operated, fan. Japanese-made (Nippon), this is approximately 93mm square, its optimum voltage is 12 but it operates very well with only 6V when the current is only 100mA. Brushless, so there are no parts to wear out, nor will this interfere with your computer. Price only **£4**, Order Ref. 4P65. Mains power supply unit to operate this at variable speeds, **£2**, Order Ref. 2P3.

12V 2A MAINS TRANSFORMER upright mounting with mounting clamp. Price **£1.50**, Order Ref. 1.5P8.

AM/FM RADIO CHASSIS with separate LCD module to display date and time. This is complete with loudspeaker and is mains powered but is not cased and, as yet, we have no information on how to wire it up. So, if you want a challenge, here it is! By way of recompense we will give the first customer to send us the connection details a **£25** credit voucher. The price of the AM/FM radio chassis with LCD module is **£3.50**, Order Ref. 3.5P5. All purchasers will receive connection details directly we have them.

2, 3 AND 4 WAY TERMINAL BLOCKS the usual grub screw types. Parcel containing a mixture of the 3 types, giving you 100 ways for **£1**, Order Ref. 875.

12/24V DC SOLENOID. The construction of this is such that it will push or pull as the plunger is a combined rod and piston. With 24V this is terrifically powerful but is still quite good at 12V and, of course, it can be operated by any intermediate voltage with increasing or decreasing power. It has all the normal uses of a solenoid and an extra one, if wired in series with a make and break, this could be a scribing tool for marking plastics and soft metals. We welcome other ideas and will give a **£25** credit voucher for any used. Price **£1**, Order Ref. 877.

2M 3-CORE LEAD terminating with flat pin instrument socket, **£1**, Order Ref. 879. Ditto but with plug on the other end so that you could use this to extend an instrument lead. **£1.50**, Order Ref. 1.5P10.

MULTI-CORE CABLES all with 8A 230V cores so suitable for disco and other special lighting effects. With earthable woven screen and thick pvc outer. 3 core, 30p per metre, 16 core, 50p per metre, 18 core, 80p per metre, 25 core, **£1** metre and 36 core, **£1.50** per metre.

VARIAC an infinitely variable unit gives any voltage from 0-230 a.c. at ½A. Obviously an invaluable piece of equipment which should be in every workshop and probably would be except that the usual price for this is **£35** plus VAT. Now is your chance to buy one, brand new, at **£15** including VAT, Order Ref. 15P42B.

JUST ARRIVED a 5" 20W 4ohm, mid-range speaker, **£3**, Order Ref. 3P145 and a matching 4ohm 20W tweeter, **£1.50**, Order Ref. 1.5P9.

ULTRA THIN DRILLS Actually 0.3mm. To buy these regular costs a fortune. However, these are packed in half dozens and the price to you is **£1** per pack, Order Ref. 797B.

YOU CAN STAND ON IT! Made to house GPO telephone equipment, this box is extremely tough and would be ideal for keeping your small tools. Internal size approx. 10½" x 4½" x 6" high. These are complete with snap closure lip and shoulder-length carrying strap. Taken from used equipment but in good condition, price **£2**, Order Ref. 2P283B.

BUILD YOUR OWN NIGHT LIGHT, battery charger or any other gadget that you want to enclose in a plastic case and be able to plug into a 13A socket. We have two cases, one 3½" x 2¼" x 1¾" deep, **£1** each, Order Ref. 845. The other one is 2½" x 2¼" x 1¾" deep, 2 for **£1**, Order Ref. 565.

SAFETY LEADS curly coil so they contract but don't hang down. Could easily save a child from being scalded. 2 core, 5A, extends to 3m, **£1**, Order Ref. 846, 3 core, 13A, extends to 1m, **£1** each, Order Ref. 847, 3 core, 13A, extends to 3m, **£2** each, Order Ref. 2P290.

POWER SUPPLY WITH EXTRAS mains input is fused and filtered and the 12V dc output is voltage regulated. Intended for high class equipment, this is mounted on a PCB and, also mounted on the board but easily removed, are 2 12V relays and a Piezo sounder. **£3**, Order Ref. 3P80B.

5V 2.5A POWER SUPPLY UNIT £5, Order Ref. 5P186.

ULTRA SONIC TRANSDUCERS 2 metal cased units, one transmits, one receives. Built to operate around 40kHz. Price **£1.50** the pair, Order Ref. 1.5P/4.

100W MAINS TRANSFORMERS normal primaries 20-0-20 at 2.5A. or 30V at 3.5A, **£4**, Order Ref. 4P24. 40V at 2.5A, **£4**, Order Ref. 4P59. 50 V at 2A, **£4**, Order Ref. 4P60.

PHILIPS 9" HIGH RESOLUTION MONITOR black & white in metal frame for easy mounting, brand new still in maker's packing, offered at less than price of tube alone, only **£15**, Order Ref. 15P1.

16 CHARACTER 2-LINE DISPLAY screen size 85mm x 36mm, Alpha-numeric LCD dot matrix module with integral micro processor made by Epson, their Ref. 16027AR, **£8**, Order Ref. 8P48.

INSULATION TESTER WITH MULTIMETER internally generates voltages which enable you to read insulation directly in megohms. The multimeter has four ranges. AC/DC volts, 3 ranges DC milliamps, 3 ranges resistance and 5 amp range. These instruments are ex British Telecom but in very good condition, tested and guaranteed OK, probably cost at least £50 each, yours for only **£7.50**, with leads, carrying case £2 extra, Order Ref. 7.5P/4.

MAINS 230V FAN best make "PAPST" 4½" square, metal blades, **£8**, Order Ref. 8P8.

2MW LASER Helium neon by Philips, full spec. **£30**, Order Ref. 30P1. Power supply for this in kit form with case is **£15**, Order Ref. 15P16, or in larger case to house tube as well **£18**, Order Ref. 18P2. The larger unit, made up, tested and ready to use, complete with laser tube **£69**, Order Ref. 69P1.

1/3 HP 12V MOTOR – THE FAMOUS SINCLAIR C5 brand new, **£15**, Order Ref. 15P8.

SOLAR CHARGER holds 4 AA nicads and recharges these in 8 hours, in very neat plastic case, **£6**, Order Ref. 6P3.

FERRITE AERIAL ROD 8" Long x ⅜" diameter, made by Mullard. Complete with 2 coil formers. 2 for **£1**, Order Ref. 832B.

AIR SPACED TRIMMER CAPS 2-20 pf ideal for precision tuning UHF circuits, 4 for **£1**, Order Ref. 818B.

FIELD TELEPHONES just right for building sites, rallies, horse shows, etc., just join two by twin wire and you have two way calling and talking and you can join into regular phone lines if you want to. Ex British Telecom in very good condition, powered by batteries (not included) complete with shoulder slung carrying case, **£9.50**, Order Ref. 9.5P/2.

MAINS ISOLATION TRANSFORMER stops you getting "to earth" shocks. 230V in and 230V out. 150watt upright mounting, **£7.50**, Order Ref. 7.5P/5 and a 250W version is **£10**, Order Ref. 10P79.

MINI MONO AMP on PCB. Size 4" x 2" with front panel holding volume control and with spare hole for switch or tone control. Output is 4 watt into 4 ohm speaker using 12V or 1 watt into 8 ohm using 9V. Brand new and perfect, only **£1** each, Order Ref. 495.

AMSTRAD POWER UNIT 13.5V at 1.9A encased and with leads and output plug, normal mains input **£6**, Order Ref. 6P23.

ATARI 65XE at 65K this is quite powerful, so suitable for home or business, unused and in perfect order but less PSU, only **£19.50**, Order Ref. 19.5P/5B.

80W MAINS TRANSFORMERS two available, good quality, both with normal primaries and upright mounting, one is 20V 4A, Order Ref. 3P106 the other 40V 2A, Order Ref. 3P107, only **£3** each.

PROJECT BOX size approx 8" x 4" x 4½" metal, sprayed grey, louvred ends for ventilation otherwise undrilled. Made for GPO so best quality, only **£3** each, Order Ref. 3P74.

12V SOLENOID has good ½" pull or could push if modified, size approximately 1½" long x 1" square, **£1**, Order Ref. 232.

WATER VALVE 230V operated with hose connections, ideal for auto plant spray or would control air or gas into tanks etc., **£1** each, Order Ref. 370.

BUILDING YOUR OWN PSU, battery charger, night light, or any other gadget that you want to enclose in a plastic case and be able to plug into a 13A socket? We have two cases, one 3½ x 2¼ x 1¾" deep, **£1** each, Order Ref. 845. The other one is 2½ x 2¼ x 1¾" deep, 2 for **£1**, Order Ref. 565.

EXPERIMENTING WITH VALVES don't spend a fortune on a mains transformer, we can supply one with standard mains input and secs. of 250-0-250V at 75mA and 6.3V at 3A. **£5**, Order Ref. 5P167.

15W 8 OHM 8" SPEAKER & 3" TWEETER made for a discontinued high quality music centre, gives real hi-fi, and only **£4** per pair, Order Ref. 4P57.

3V SOLAR PANEL price **£3**, Order Ref. 3P99B.

3 GANG .0005 MFD TUNING CONDENSER with slow motion drive. Beautifully made by Jackson Brothers and current list price is probably around £20. Yours for **£5**, Order Ref. 5P189.

STEREO HEADPHONES extra lightweight with plug, **£2** each, Order Ref. 2P261.

BT TELEPHONE LEAD 3m long and with B.T. flat plug ideal to make extension for phone, fax, etc. 2 for **£1**, Order Ref. 552.

WATER PUMP very powerful with twin outlets, an ideal shower controller, mains operated, **£10**, Order Ref. 10P74. Ditto but with a single outlet. Same price & order ref. Please specify which one you require.

0-1MA FULL VISION PANEL METER 2¾" square, scaled 0-100 but scale easily removed for re-writing, **£1** each, Order Ref. 756.

PCB DRILLS 12 assorted sizes between .75 and 1.5mm, **£1** the lot, Order Ref. 128.

Prices include V.A.T. Send cheque/postal order or ring and quote credit card number. Add £3 post and packing. Orders over £25 post free.

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HART KITS give you the opportunity to build the very best engineered hifi equipment there is, designed by the leaders in their field, using the best components that are available.
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In short HART is your 'friend in the trade' giving you, as a knowledgeable constructor, access to better equipment at lower prices than the man in the street.
You can buy the reprints and construction manual for any kit to see how easy it is to build your own equipment the HART way. The FULL cost can be credited against your subsequent kit purchase.
Our list will give you fuller details of all our Audio Kits, components and special offers.

AUDIO DESIGN 80 WATT POWER AMPLIFIER.

This fantastic John Linsley Hood designed amplifier is the flagship of our range, and the ideal powerhouse for your ultimate hifi system. This kit is your way to get £K performance for a few tenths of the cost!. Featured on the front cover of 'Electronics Today International' this complete stereo power amplifier offers World Class performance allied to the famous HART quality and ease of construction. John Linsley Hood's comments on seeing a complete unit were enthusiastic:- "The external view is that of a thoroughly professional piece of audio gear, neat elegant and functional. This impression is greatly reinforced by the internal appearance, which is redolent of quality, both in components and in layout." Options include a stereo LED power meter and a versatile passive front end giving switched inputs using ALPS precision, low-noise volume and balance controls. A new relay switched front end option also gives a tape input and output facility so that for use with tuners, tape and CD players, or indeed any other 'flat' inputs the power amplifier may be used on its own, without the need for any external signal handling stages. 'Slave' and 'monobloc' versions without the passive input stage and power meter are also available. All versions fit within our standard 420 x 260 x 75mm case to match our 400 Series Tuner range. ALL six power supply rails are fully stabilised, and the complete power supply, using a toroidal transformer, is contained within a heavy gauge aluminium chassis/heatsink fitted with IEC mains input and output sockets. All the circuitry is on professional grade printed circuit boards with roller tinned finish and green solder resist on the component ident side, the power amplifiers feature an advanced double sided layout for maximum performance. All wiring in this kit is pre-terminated, ready for instant use!
RLH11 Reprints of latest articles.....£1.80
K1100CM HART Construction Manual.....£5.50

LINSLEY HOOD 1400 SERIES ULTRA HIGH-QUALITY PREAMP

Joining our magnificent 80 Watt power amplifier now is the most advanced preamplifier ever offered on the kit, or indeed made-up marketplace. Facilities include separate tape signal selection to enable you to listen to one programme while recording another, up to 7 inputs, cross recording facilities, class A headphone amplifier, cancellable 3-level tone controls and many other useful functions, all selected by high quality relays. For full details see our list.

LINSLEY HOOD 'SHUNT FEEDBACK' R.I.A.A. MOVING COIL & MOVING MAGNET PICKUP PREAMPLIFIERS

Modern, ultimate sound systems are evolving towards built-in preamplifiers within or near the turntable unit. This keeps noise pickup and treble loss to a minimum. We now offer two units, both having the sonically preferred shunt feedback configuration to give an accurate and musical sound, and both having the ability to use both moving magnet and moving coil cartridges.
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VOL. 21 No. 10 OCTOBER '92

JOINING IN OUR 21ST

From next month you will notice an addition to the title of your magazine. This is because we are being joined by the readers of *Practical Electronics*. We have purchased that title from its present publishers and it will be merged with *Everyday Electronics*.

Some of the titles of our present regular pages will be changed to make PE readers feel at home and *Everyday with Practical Electronics* will continue to develop in the way EE has over the past 21 years.

Significantly the November issue is also our 21st anniversary issue – it will be 21 years to the month since EE was launched out of *Practical Electronics* and now the titles will recombine to form the best possible electronics magazine. Let me assure you that you will not be losing any of your favourite articles or range of projects, in fact we intend to add to the variety as we have always tried to do.

SIGNIFICANT

As indicated above the November issue cover will use a new logo and is based around a symbolic piece of artwork that fits in well with our 21st anniversary and with the merged titles. Both of these designs are shown in our advertisement for next month's issue on page 611.

TEACH-IN

It has been our practice, ever since EE started, to publish a Teach-In series every two years and *Teach-In '93* starts next month. This time it has been very carefully planned to cover the GCSE and "A" level electronics syllabus and our contributors have enlisted the assistance of an experienced GCSE moderator to overlook the work. We will also, with the help of the various examination boards, be publishing past questions and model answers.

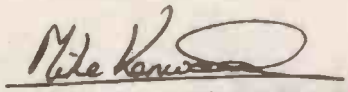
To go with the new series a *Mini Lab* has been designed and this incredibly versatile test and development board will also be featured next month. We anticipate that it will become a standard for those learning about, and working with, electronics. If your interest in electronics does not encompass the General Certificate examinations you will still find the whole series very valuable as a complete tutorial in our subject.

DEMAND

Due to the likely high demand for the November issue – it also has a free 196 page catalogue banded to it – it is essential that you make sure your copy is reserved for you **You really won't want to miss it!**

If you do not already have a standing order or a subscription you can make sure of seeing a copy by filling in the "shop save" card inserted in this issue and handing it to your newsagent, he will then keep a copy for you. If you don't like what you see when he hands you the magazine you are under no obligation to buy it – your newsagent simply returns it and is not charged anything as all copies are on sale-or-return.

What have you got to lose? There is even a free prize draw so you might wind up with a very useful prize – read the shop save card to see what it is.



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We advise readers to check that all parts are still available before commencing any project in a back-dated issue.

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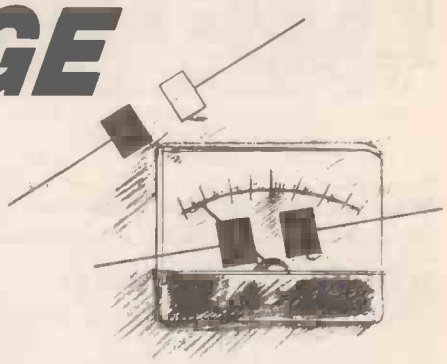
Constructional Project

EXTENDED RANGE CAPACITANCE METER



STEVE KNIGHT

Designed to cover a spread from 2pF to 1μF and 0·5μF to 5000μF, in two switched ranges. A third switched position indicates "leakage current" – useful for checking electrolytics.

IN THE design of analogue type capacitance meters, where the instrument works on the popular principle that the output pulse duration of a monostable or one-shot multivibrator depends upon the time constant used in the feedback path, the main problem involves the measurement of capacities above a few microfarads and the elimination of stray capacitance on ranges below some 100pF. With large values of *C*, the time constant element in the design requires very small values of *R* and this leads to unreliable operation of the monostable or calls for changes in the operating frequency.

As for the strays, these are usually indeterminate and can often be as high as 25pF or so. Any attempt to get accurate readings below a few hundred picofarads is, therefore, a hit-and-miss procedure.

This present design gives a range of capacitance values from about 2pF up to 5000μF in two distinct sections: From 2pF to 1μF on a low range and from 0·5μF to 5000μF on a high range. Further more, the stray capacitances are "tuned out" within the system so that there is no theoretical lower limit to the measurement range.

An additional feature, particularly, useful when checking electrolytics, is a qualitative measure of leakage current with an applied potential of about 9V. The full circuit diagram for the Extended Range Capacitance Meter is shown in Fig. 1 so from that let us see how the instrument does its stuff.

CIRCUIT DESCRIPTION

We assume for the general circuit explanation that the ganged Mode-Selector switches S1a through to S1g are set on Position 1, the lower capacitance range.

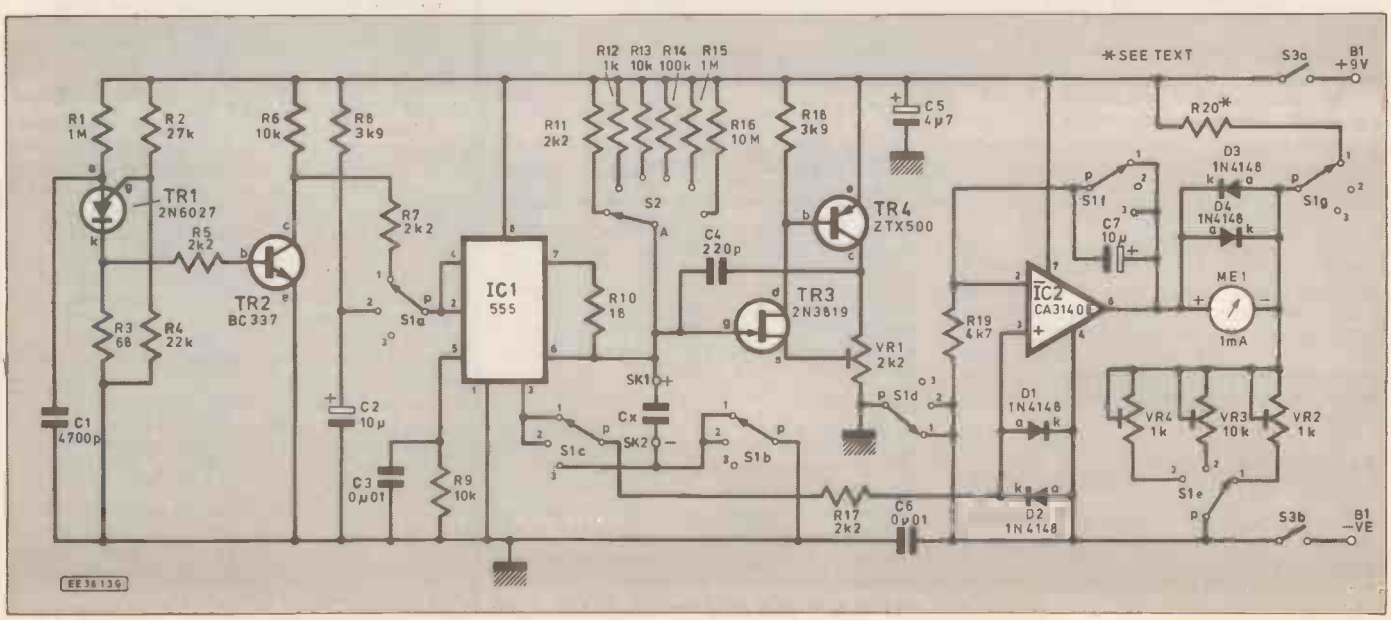
Transistor TR1 is a programmable unijunction type 2N6027 connected up in a self-oscillating mode with a stand-off ratio determined by resistors R2 and R4. Capacitor C1 charges through the anode (a) resistor R1 and when the anode voltage reaches a point about 0·7V above the potential on the gate (g) the transistor switches on, discharging the capacitor through the cathode (k) resistance R3. The cycle then repeats.

Although the charging characteristic of capacitor C1 is the usual exponential sawtooth, our wanted output across resistor R3 is a short positive-going pulse at a repetition frequency of about 350Hz. The precise value is not important.

These pulses are inverted by transistor TR2 and applied to the trigger and reset inputs (pin 2 and pin 4) of the NE555 timer IC1. In the monostable mode, IC1 output at pin 3 is low until the trigger pulse is applied to pin 2. At that time, the output is driven high for a period determined by the value of the capacitor under test (C_X) and the selection of resistors R12 to R16 inclusive, made by Range switch S2.

The capacitor under test C_X charges through the selected resistor until it reaches half the supply voltage, that is, about 4·5V. This point comes about by resistor R9 being effectively in parallel with the internal divider chain of the 555 and prevents the capacitor voltage from reaching its usual design level of two-thirds the supply potential.

Fig. 1. Complete circuit diagram for the Extended Range Capacitance Meter. Note that TR1 is a programmable unijunction transistor which is made up from a pnp *transistor combined with an* npn *transistor in a single package*



As soon as the "high" point is reached, the timer resets and C_X is discharged through pin 7. The duration of the high state on pin 3 is consequently proportional to the value of C_X, as Fig. 2 illustrates.

ZEROING

All this is quite conventional and in a simple form of this instrument, this waveform, operating at the frequency of the clock, TR1, can be used directly to deflect the pointer of a milliammeter (which will take up a position representing the average value of the waveform) and so indicate on a suitably calibrated linear scale the value of the test capacitor. However, with this elementary arrangement there is a problem with zero setting the meter, particularly on the low capacitance ranges, and the effect of strays is not positively eliminated by a "backing-off" meter current system.

The rectangular output waveform from pin 3 of IC1 is therefore fed to the non-inverting (+) input pin of IC2, a CA3140 MOSFET input op.amp connected (in this mode) as a unity gain voltage-follower. The input waveform is reduced to about 0·7V amplitude by diode D1 and d.c. restored to the earth line by diode D2. This introduction of an op.amp enables high capacitance to be measured by using it as an integrator over the appropriate ranges.

The indicating meter ME1 is connected to the output (pin 6) of IC2 by way of preset potentiometer VR2 and gives a reading which is the average value of the waveform and hence proportional to the test capacitance.

ELIMINATING STRAYS

So far, so good. But this circuit does not perform too well on the lowest capacitance range (0 – 100pF) because of the presence of strays which, in both the wiring and the effect of the 555, amounted in the original design to something like 35pF.

As mentioned above, the non-zero output which appears with no test capacitor connected can be effectually backed off by putting a reverse d.c. bias on the meter; this then operates as a Set Zero control. However, this leads to an additional panel control which needs adjustment each time the instrument is used.

In this present design, the strays acting across the test terminals (SK1/SK2) are eliminated by making use of the Miller effect in a f.e.t. amplifier and introducing a phase shift around the loop made up of transistors TR3 and TR4 so that an effectual capacitive reactance is introduced which cancels out the effect of the strays at source. The theory of such circuits, for anyone who is interested, can be found in a number of textbooks under reactance simulation systems. Setting the method up will be explained later.

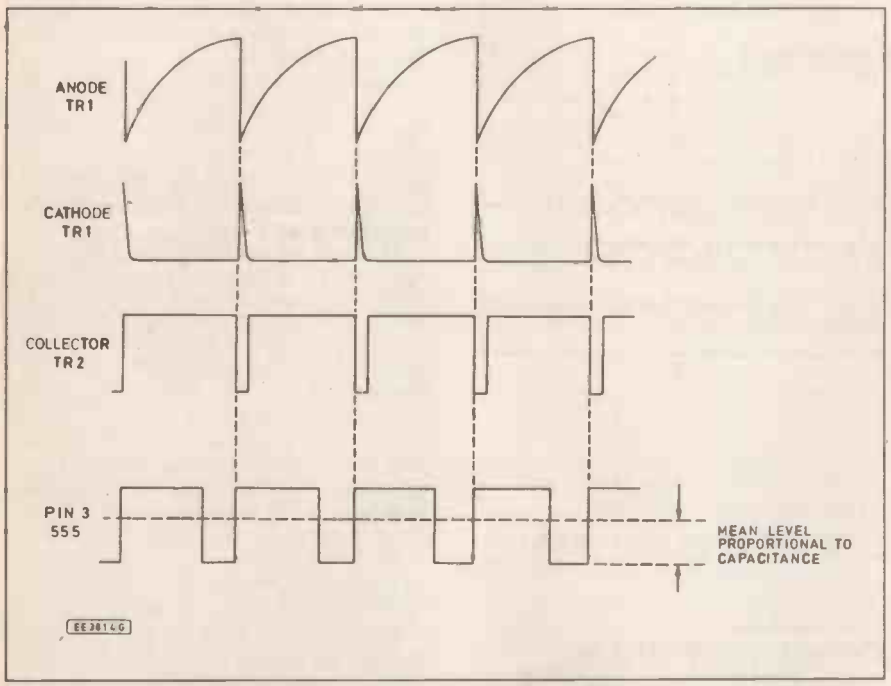


Fig. 2. Waveforms seen at the unijunction TR1, inverting transistor TR2 and the output (pin 3) of the 555 timer IC1.

EXTENDING THE RANGE

To measure capacitances above a few microfarads with this type of circuit normally calls for a much lower clock frequency and an extension of the monostable timing period. By converting the 3140 op.amp (IC2) into an integrator, however, by introducing a capacitor (C7) into the feedback loop and by using a single-shot trigger pulse at the input of the 555 timer (IC1), a simplified arrangement emerges which enables capacitances up to 5000µF to be measured with good accuracy.

What the integrator effectively does is to "hold" the meter indication of the mean pulse amplitude while the reading of capacitance is taken. Going back to Fig. 1, when switch S1 is operated to Position 2 (the High Capacitance mode) the normal clock output from the collector of TR2 is disconnected and the input to IC1 is simply derived from the junction point between resistor R8 and capacitor C2.

This may not appear as an input source at first glance but with no supply voltage applied, C2 is uncharged and hence the potential at the input of IC1 is zero. When the supply is switched on, the 555 sees this zero potential as a momentary low, hence the monostable is triggered.

As in the case of the Low Capacitance mode, a high of about 0·7V amplitude is applied to the non-inverting (+) pin of IC2 for the period over which the "test capacitor" is charging to half the supply potential. The effect of the integration which now takes place is that the i.c. output fed to the meter ramps up until at the end of the input pulse the meter reading is proportional to the duration of the pulse and hence proportional, as before, to the value of the test capacitor.

LEAKAGE

Only one other thing need concern us at this point before we move on to the constructional details of this instrument, and that is capacitor leakage. This is of more importance when checking electrolytics or perhaps some of the older

COMPONENTS

Approx cost guidance only **£25** *plus case*

See SHOP TALK Page

Resistors

R1	1M	
R2	27k	
R3	68	
R4	22k	
R6	10k (2 off)	
R5, R7, R11, R17	2k2 (4 off)	
R8, R18	3k9 (2 off)	
R9	10k	
R10	18	
R12	1k	1%
R13	10k	1%
R14	100k	1%
R15	1M	1%
R16	10M	1%
R19	4k7	
R20	See text	

All 0·25W 5% carbon film, except where stated

Capacitors

C1	4700p polycarbonate 5%
C2, C7	10µ tantalum, 16V (2 off)
C3, C6	0µ01 polycarbonate (2 off)
C4	220p polystyrene
C5	4µ7 tantalum, 16V

Switches

S1	7-pole, break-before-make, wafer switch; made up from two 4-pole 3-way wafers
S2	2-pole 6-way rotary switch, Lorlin
S3	Min. d.p.d.t. toggle switch

Potentiometers

VR1	2k2 min. preset, vertical
VR2, VR4	1k ¾in. multiturn cermet preset (2 off)
VR3	10k ¾in. multiturn cermet preset

Semiconductors

D1-D4	1N4148 signal diode (4 off)
TR1	2N6027 Programmable Unijunction Transistor (PUT)
TR2	BC337 *npn* med. power low freq. transistor
TR3	2N3819 *n*-channel field effect transistor (f.e.t.)
TR4	ZTX500 *pnp* small sig. low freq. transistor
IC1	NE555 timer i.c.
IC2	CA3140E MOSFET I/P, Bipolar O/P op.amp

Miscellaneous

ME1	1mA moving coil meter (60mm x 46mm, cutout 38mm)

Metal case, size approx. 205mm x 152mm x 92mm; 8-pin d.i.l. socket (2 off); screw terminal post – one red, one blue; 4mm socket, yellow; plastic 28mm diameter, collet fixing, knob (with red cap) – 2 off; PP3 battery and connector; stranded connecting wire; fixing nuts and bolts; stand-off spacer; solder tag; solder, etc.

Printed circuit board available from *EE PCB Service*, code EE804.

paper types which may have been stored for some years.

For this test, switch S1 is now moved to Position 3; in this mode all the active components except IC2 are rendered inoperative by switch section S1d. IC2 reverts to its voltage-follower configuration by way of S1f, while the capacitor leakage current (if there is one) is forced to flow to the negative rail by way of limiting resistors R11, R17 and diode D1.

The voltage developed across diode D1 is applied to IC2 input, pin 3, and a deflection indicative of the level of leakage appears on the meter ME1. Because of the diode characteristic, the indication is approximately square law and a separate calibration graph can be drawn up to rationalize the current readings in microamps leakage. It is often only sufficient to know whether a leakage is excessive or otherwise.

CONSTRUCTION

The prototype model was built (after half a dozen bread-board assemblies!) on to a small single-sided printed circuit board. (This board is available from the *EE PCB Service*, code EE804). All components except the meter, R20, D3 and D4 and the two-wafer ganged switch (S1a-S1g) are mounted on the board and the whole assembly fits into a suitable case.

Probably the best approach is to wire up the ganged switch S1 assembly first, the various outgoing and interconnecting wires being shown in Fig. 3. Twelve leads from the actual switch tags go to the printed board and these are numbered as are the corresponding points on the board to which they are later attached.

Terminal pins are best used at the board points as it is then easier to remove a wire if a mistake is made. The specified switch is a two-wafer job, each wafer being 4-pole, 3-way, though only seven of the available eight poles are used.

It is not particularly important which banks are used for the required seven switches; what *is* important is that the wiring is carefully checked and that different coloured leads are used to avoid any later confusion. Use thin flexible, multi-coloured, stranded wire rather than solid; 7/0.2mm is adequate.

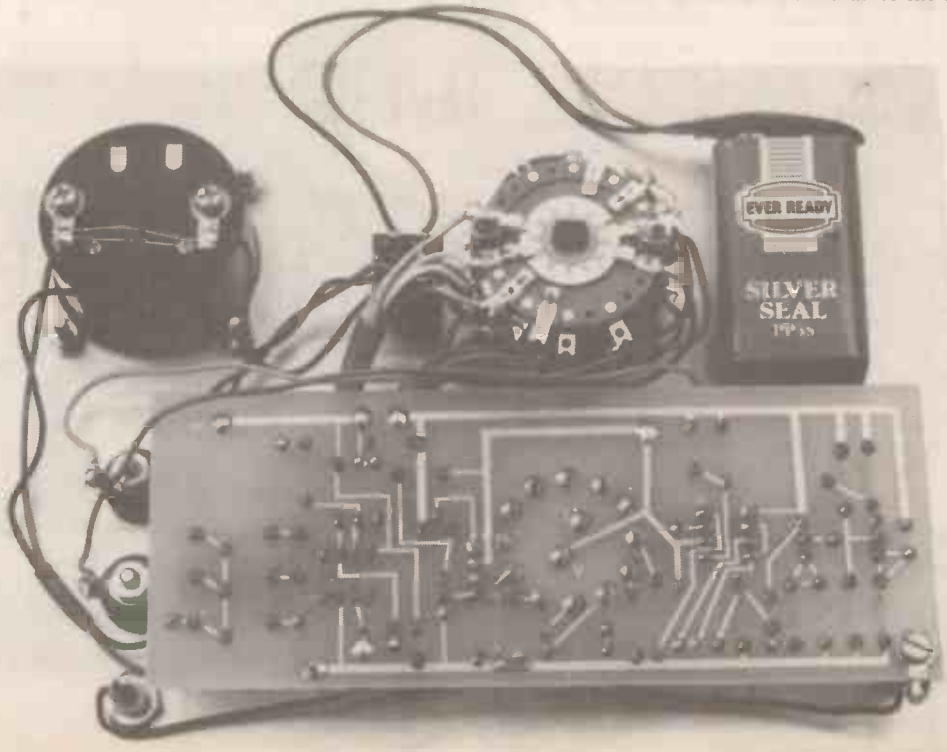
Note that resistor R20 is mounted directly on the switch itself, not on the board. The end of this resistor which is shown going to +V conveniently connects to the On-Off/One Shot switch S3 which is next to S1 on the suggested front panel layout.

CIRCUIT BOARD

The details of the printed board component layout and full size underside copper foil master pattern is shown in Fig. 4. There should be no problems in wiring the board up, but the usual care must be exercised with the transistors, diodes and tantalum capacitors with regard to polarity. The markings on tantalums are often notoriously difficult to interpret.

Although the prototype had solder pins mounted on the component side of the board to make the necessary connections to the Mode switch S1, this did tend to pack the wires between board and rear of the front panel when assembled. So it is possibly better to have the pins available on the copper side of the board as this makes for much easier soldering.

It seems best if all components are mounted on the rear of the front panel of



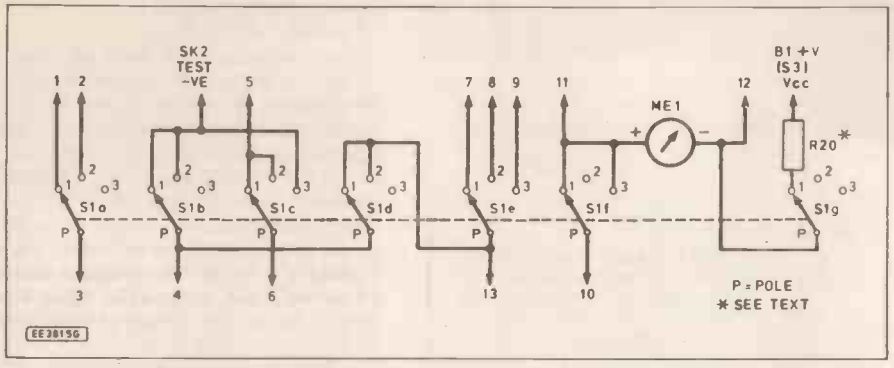


Fig. 3. Wiring to the ganged mode switch wafers. It is best to wire up the switch first, using multicoloured stranded leads for interconnecting to the circuit board. The numbers on the lead-off wires should be taken to identical ones on the p.c.b. The wiring to the On/Off switch S1 is shown above right.

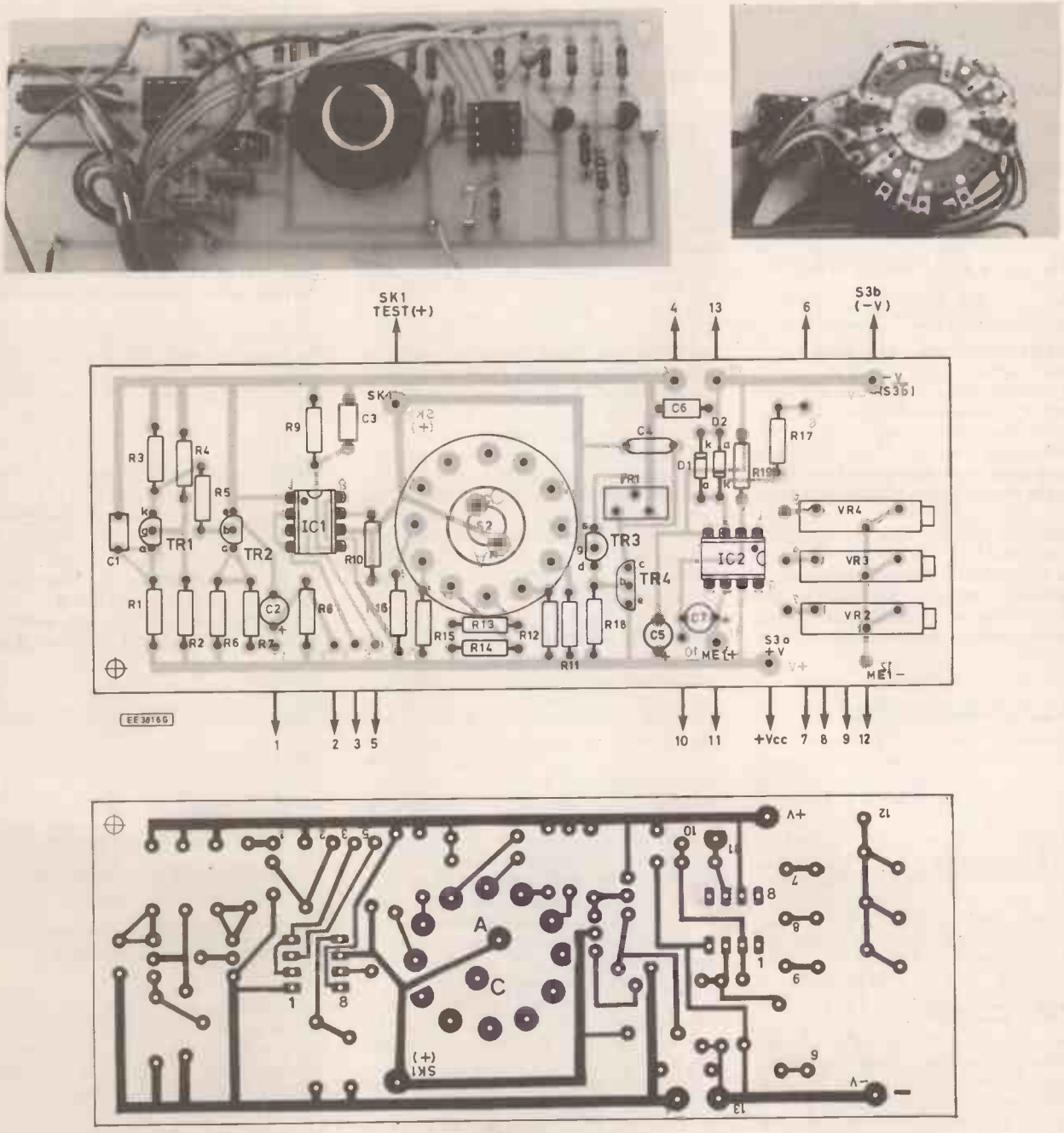


Fig. 4. Printed circuit board component layout and full size copper foil master pattern. The small numbers on the track-side are included for those who wish to wire switch S7 directly to the copper pads/pins side. The "leads" around the component side are to assist topside wiring, if preferred.

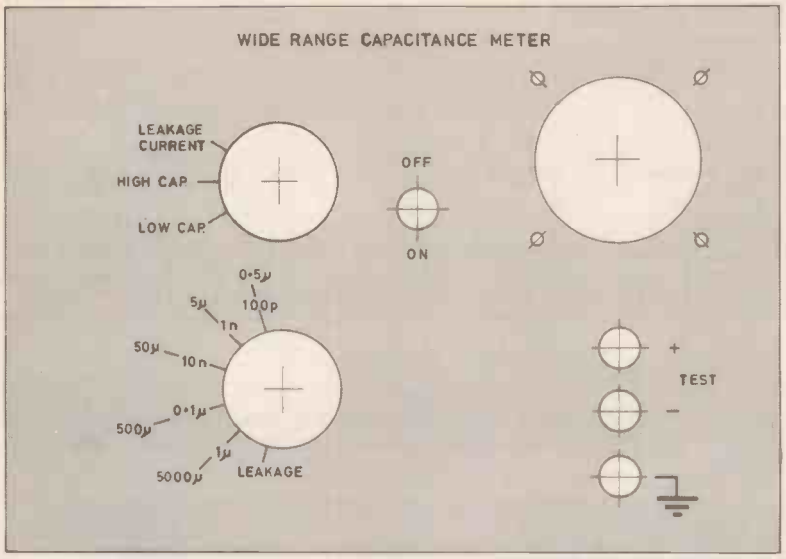


Fig. 5. Suggested front panel (half full size) layout and lettering. The drilling sizes will depend on the components used.

the box which will house the instrument. No specific case was chosen, but the one used has a 205mm x 152mm (8in. x 6in.) panel and a box depth of 92mm (3⅝in.).

The assembly can be comfortably housed on a panel size down to about 165mm x 127mm (6½in. x 5in.) and a suggested front panel layout is shown in Fig. 5 and the photo. This gives quite an attractive appearance when carefully labelled with rub-down lettering, but if you fancy any other arrangement by all means do your own thing.

There is nothing critical about the layout, but try to keep all the interconnecting wires as short as practicable (*not* tight!) especially the two to the Test terminals, whatever layout you plump for. *Don't* twist these last two wires together or the total strays might exceed the capabilities of the correcting circuitry.

The circuit board is fixed to the front panel by the bush and nut mounting of Range switch S2. To prevent the possibility of the board rotating if the fixing of the switch works loose, an additional support should be provided by means of a 16mm (⅝in.) spacer securing the board to the panel at some other convenient point.

CALIBRATION

Provided that the assembly is correct and there are no faulty components, this instrument is very easy to set up. We start with the Low Capacitance range in conjunction with the setting of the stray compensating preset control VR1 and the selection of resistor R20 if needed.

You will need as a minimum requirement a 100pF capacitor, one per cent or better, though it is useful if you can get hold of one per cent types of values 1nF, 10nF and 0·1µF. The first two of these are readily available from a number of advertisers.

LOW CAP

First of all, set *all* the preset potentiometers to about their mid-travel positions. Set the Mode switch to Low Capacitance and the Range switch to 100pF. Connect the accurate 100pF "test" capacitor across the test terminals SK1/SK2, then switch on.

Adjust preset VR2 to give a full scale reading (f.s.d.) on the meter. Remove the capacitor and adjust preset VR2 very carefully to obtain a *minimum* reading on the meter.

Now replace the test capacitor, readjust VR2 for full scale deflection; remove the capacitor and readjust VR2 for a minimum. This procedure may be repeated if necessary until no further changes can be produced.

It may happen that despite the elimination of the stray capacitance a very small residual reading may be evident with no test capacitor connected. This comes about from the still finite pulse width from the 555 timer.

If this is no worse than, say, a part of a scale division, ignore it; otherwise add resistor R20 at this stage to bring the reading to zero. A 100k resistor in the prototype did this, but some slight variation is possible; if you choose a value too *low* the meter will show a small negative reading.

This completes the calibration of the Low Cap range; if you have other accurate capacitors within the range 1nF to 1µF use them to verify that the other ranges are o.k. In *all* cases, it is preferable to *switch off* when a capacitor is changed as your body capacity can send the meter over to full scale, particularly on the two lowest ranges.

HIGH CAP

The problem of calibrating the High Cap range is getting hold of accurate high value capacitors. Electrolytics are out of the question, of course, but fortunately for this project with its lowest "high" range of 0·5µF, any capacitor from 0·1µF to 0·5µF (or suitable parallel combinations to make up a value within this range) will do for the calibration.

With the instrument *switched off*, connect the known capacitor to the Test terminals, set the Mode switch to High Cap and the Range switch to the 0·5µF position. Now switch on; the meter reading will rise rapidly as the integrator IC2 output ramps upwards, and after a second or two will come to rest at some definite point.

Now adjust preset VR3 to set the meter reading to coincide with the value of the known capacitor. This then completes the "high" calibration.

Notice the procedure for measurement on the High range: the instrument *MUST* be switched off when the capacitor is connected and the range selected, and *then* switched on. This switching operates the "single-shot" triggering of the 555 timer IC1 and initiates the integration process.

If there is any drift of the reading on this range, suspect a possible leakage in C7, the integrating capacitor.

LEAKAGE TESTING

The following check gives an indication of the leakage current with about 7·5V applied across the test capacitor. To set the system up, switch both Mode and Range switches to Leakage, put a shorting link across the test terminals SK1, SK2, switch on and adjust preset VR4 to give a full scale reading.

As already mentioned, the meter reading (apart from the 1mA f.s.d. obtained in this setting-up procedure) is not directly indicative of the *actual* leakage current because of the effect of the non-linearity of diode D1. Fig. 6 shows the graph connecting the meter reading with the true leakage current. For example, if with a particular electrolytic as the test capacitor the meter read 0·8mA (remember, it is a 1mA meter) the true leakage current would be about 150µA.

Below a reading of 0·4mA the leakage is less than a few microamps. Mica, silver-mica, polythene, polycarbonate and similar types of capacitor will normally give a zero reading, but some older paper types may show small leakages if they have been stored for some time.

Electrolytic capacitors on the other hand will display small leakages in nearly every instance, but these should not normally exceed a few micro-amps; the leakage goes up with the capacity in

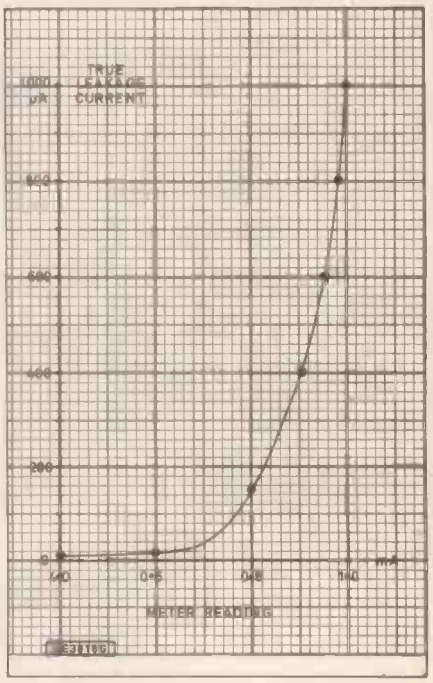


Fig. 6. Typical calibration curve determining the "true leakage current".

general terms. If an electrolytic has been on the shelf for some time it will show a high leakage for a short while, but reforming will take place in the leakage mode and the meter reading should fall back accordingly.

Always make sure that capacitors, particularly large electrolytics, are completely discharged before attaching them to the Test terminals.

You can plot your own graph by observing the meter readings obtained from a range of known resistors connected across the Test terminals, deducing the true current from Ohm's law. □

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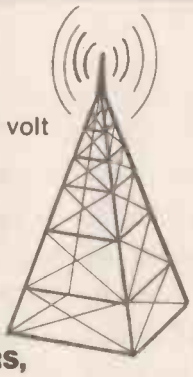

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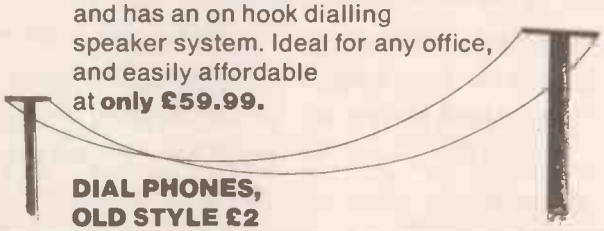

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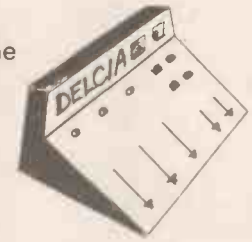

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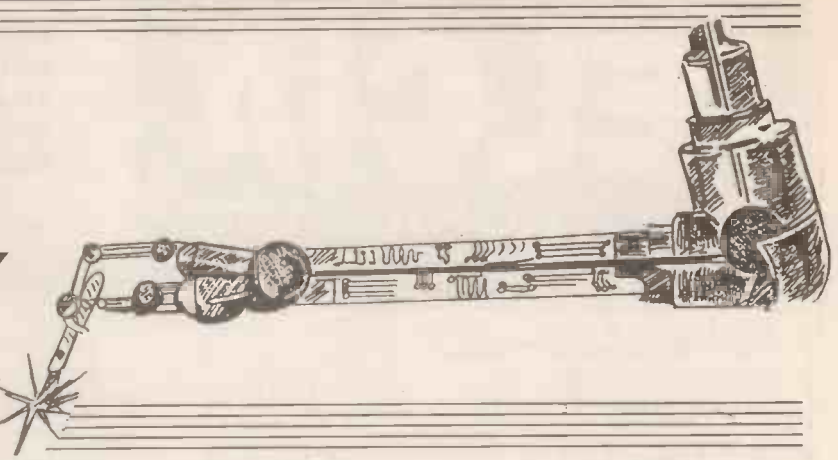


MIKE TOOLEY B.A.

Welcome once again to* Circuit Surgery, *our regular clinic for readers' problems. This month we have some useful points relating to the selection of fuses for use with low voltage high current d.c. power supplies. We also revisit the timer software described in August's installment of* Circuit Surgery *and help to sort out some of the confusion which surrounds the pin connecting conventions used with some of the more popular silicon transistors. There is also a circuit which can be used to increase the video signal gain provided by a monitor or colour TV receiver.

Fuses – Their Uses and Abuses

Malcolm Taylor writes from Kent to ask me whether I could give some advice on suitable types and ratings for fuses used in a low-voltage power supply. Malcolm's letter includes a number of interesting observations together with some useful suggestions and so I make no apologies for quoting it in its entirety:

"I am building a high-current d.c. power supply which produces an output of 13·5V at 10A. The supply uses a 2N3055 silicon power transistor as I have a plentiful supply of these and they seem to be extremely rugged.

I am feeding the base terminals of the series pass transistors from the output of a "jacked-up" 7812 regulator. Initial experiments with a transformer rated at 12V and 10A proved to be unsuccessful. Instead I had to use a component rated at 15V 12A together with a hefty bridge rectifier and two parallel connected 6800µF electrolytic capacitors.

Other measures taken to prevent the output voltage dropping when on-load include the use of some very hefty wiring. This runs from the transformer to the bridge rectifier and the two reservoir capacitors and also from the output terminals to the series pass transistors and a single earth/common point. Wire stripped from off-cuts of domestic mains wiring was found to be ideal for this purpose!

I calculated the required current rating (and allowing for a reasonable margin) before fitting a pair of 1A mains fuses in series with the mains supply to each pole of the on/off switch. However, one or other of the fuses seemed to blow as soon as the unit was switched on. A pair of 5A fuses tend to remain intact but have also blown on one or two occasions when the unit is first switched on. Can you tell me what causes this problem and what the fuse rating should be?

The circuit of Mr Taylor's simple yet effective power supply is shown in Fig. 1. The output voltage of the regulator (normally 12V) is increased by raising the voltage at the common terminal with respect to ground. This is quite a useful technique particularly when the desired output voltage does not coincide with the voltage provided by a fixed voltage regulator.

Mr Taylor's problem arises from the very high "in-rush" current which occurs at the instant of switching on as C1 and C2 take charge for the first time. Furthermore, if the mains switch closes at, or near, the positive or negative peak of the mains voltage, a very appreciable current will be drawn from the mains, albeit momentarily. Once the capacitors have become charged, the mains current will settle to a relatively small value (about 1A when the supply is fully loaded).

The two mains fuses should be 20mm "high breaking capacity" (HBC) anti-surge components rated at 2A and fitted in suitable panel-mounted fuseholders. The anti-surge characteristic of the mains fuses will ensure that they do not rupture when the unit is first switched on and the reservoir capacitors charge for the first time.

It is important to note that the anti-surge fuses may not protect the power supply under all eventualities as they still exhibit a finite rupturing time. A sudden short-circuit across the output will produce a very large current within the series pass transistors TR1/TR2. Under these circumstances, the fuses will rupture in a few milliseconds but this may just not be fast enough to protect the power transistors!

Pin connections

Mr Walton writes from Northampton with a timely warning to readers:

"I recently purchased some plastic transistors for use in a constructional project. After a lot of detective work I discovered to my amazement that these transistors seem to have totally different connections from those specified in the article. Why should this be?"

Well Mr Walton, it is an unfortunate fact of life that transistor pin connections are not standardised for a given encapsulation and "plastic" transistors are a particularly good example of this!

At a guess, I suspect that the transistors which you mention have been supplied in TO92 packages (see Table). Unfortunately there are at least four different pinout

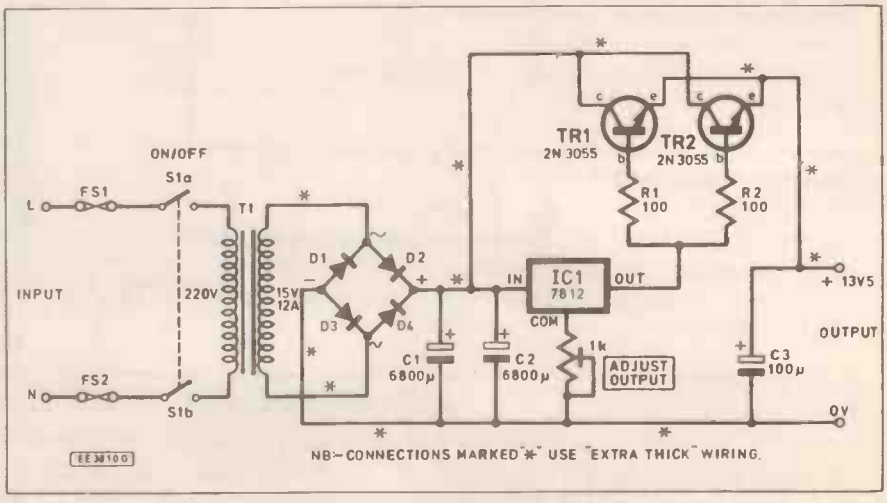


Fig. 1. Mr Taylor's high current power supply.

connecting conventions in common use for this type of encapsulation:

Package	Pins 1	2	3	Examples NPN	PNP
TO92a	b	c	e	BC182L, BC183L, BC184L	2N3702, 2N3703, BC213L, BC214L
TO92b	b	e	c	BF594, BF595, BF694	
TO92c	e	b	c	BC547, BC548, BC549	BC327, BC557, BC558
TO92d	c	b	e	2N3903, 2N3904, 2N4400, 2N4401	2N4402, 2N4403

Many component suppliers include transistor pin connecting information within their catalogues and others can supply this information if requested. Finally, a copy of the latest *Towers International Transistor Selector* can be a very worthwhile investment. This book contains tabulated data on over 29,000 transistors and it includes encapsulation and connecting information.

Video signal booster

Video enthusiast, ***David Thomas*** writes from Swansea with an interesting request:

"I have made a number of modifications to a 14in. portable colour TV receiver, including external composite and RGB video inputs. This seems to work well on a variety of signal sources but one snag is that there appears to be insufficient gain in the video amplifier stages as I need to keep the contrast control fully advanced. Can you suggest how I can add some extra gain to the circuit? (PS: I have tried a single-stage common-emitter amplifier but this simply inverts the signal!)"

From the information which you supply David, I have ascertained that the d.c. level at the base of the video output stage is at about 7·2V. This is important since it will be necessary to preserve this d.c. level in our added circuitry (the stage must be d.c. coupled as it has to cope with a video signal). The circuit of the variable gain video booster is shown in Fig. 2.

In order to produce an overall phase shift of 360 degrees, I have used a direct coupled two-stage amplifier in which both transistors operate in common emitter mode. The first transistor is an *npn* device whilst the second is *pnp*.

The first stage operates with a collector current of nominally 2mA whilst the second operates at 4mA. The values of collector and emitter resistors can be calculated quite easily and the nearest preferred values used in the circuit. The BC184 and BC212 transistors are readily available, the former having a minimum h_{FE} of 240 (at $I_C = 2mA$) whilst the latter provides a minimum h_{FE} of 50 (at $I_C = 4mA$). As is conventional, the higher gain device is used in the first stage.

It is important to note that I have incorporated a large amount of negative feedback in both stages in order to increase the bandwidth and reduce the stage gain to a manageable amount. The gain of the first stage is adjustable from about 1 to 50 whilst the second has a gain of about 5·5.

Timer software revisited

In August's *Surgery* we described a computer program for designing 555 timer circuits. Several of you have asked for a GWBASIC version so here it is:

```
100 '
110 '555 timer circuit designer
120 '
130 'Initialise
140 '
150 KEY OFF
160 ON ERROR GOTO 1060
170 SCREEN 0
180 COLOR 1, 2, 3
190 UL$ + STRING$(31, CHR$(205))
200 '
210 WHILE 1
220 '
230 'Display main menu
240 '
250 :
260 CLS
270 PRINT UL$
280 PRINT "555 TIMER I.C. CIRCUIT
    DESIGNER"
290 PRINT UL$; " "
300 PRINT " Select timer configuration..."
310 PRINT " [M] = monostable"
320 PRINT " [A] = astable"
330 PRINT " [Q] = quit"
340 R$ = " "
350 WHILE INSTR(" MAQmaq",R$) < 2
360  R$ = INKEY$
370 WEND
380 IF R$ = "Q" OR R$ = "q" THEN LS:
END
390 '
400 PRINT UL$
410 IF R$ = "M" OR R$ = "m" THEN
    GOSUB 450
420 IF R$ = "A" OR R$ = "a" THEN
    GOSUB 690
430 WEND
440 '
450 :
460 PRINT " Monostable timer
    configuration..."
470 INPUT " Timing period (in ms)"; T
480 'Recommend a value for c
490 CREC = T / 100
500 CREC = INT(1000 * CREC) / 1000
510 PRINT UL$
520 PRINT " Recommended value for the"
530 PRINT " timing capacitor is";
540 PRINT USING "###.###"; CREC;
550 PRINT " uF"
560 PRINT UL$
570 R = 0
580 WHILE R > 1 * 10 ^ 3 OR R < 1
590 INPUT " Capacitor value (uF)"; C
600 R = T / (1.1 * C)
610 PRINT UL$
620 PRINT " Timing resistor = ";
630 PRINT USING "######.#"; R;
640 PRINT " kohm"
650 WEND
660 GOSUB 970
670 RETURN
680 '
690 :
700 PRINT " Astable timer
    configuration..."
710 INPUT " Capacitor value (uF)"; C
720 PRINT UL$
730 PRINT " NB: High time must be
    greater"
740 PRINT " than low time..."
750 PRINT UL$
760 T1 = 0
770 T2 = 1
780 WHILE T1 < 1.05 * T2
790 INPUT " High output time (ms)"; T1
800 INPUT " Low output time (ms)"; T2
810 WEND
820 R2 = T2 / (.693 * C)
830 R1 = T1 / (.693 * C) - R2
840 F = 1.44 / ((R1 + (2 * R2)) * C)
850 PRINT " R1 = ";
860 PRINT USING "######.#"; R1;
870 PRINT " kohm"
880 PRINT " R2 = ";
890 PRINT USING "######.#"; R2;
900 PRINT " kohm"
910 PRINT " P.r.f. = ";
920 PRINT USING "###.###"; F;
930 PRINT " kHz"
940 GOSUB 970
950 RETURN
960 '
970 :
980 PRINT UL$
990 PRINT " Press any key to continue..."
1000 R$ = ""
1010 WHILE R$ = ""
1020 R$ = INKEY$
1030 WEND
1040 RETURN
1050 '
1060 :
1070 PRINT UL$
1080 PRINT " An error has occured!"
1090 GOSUB 970
1100 RESUME 250
```

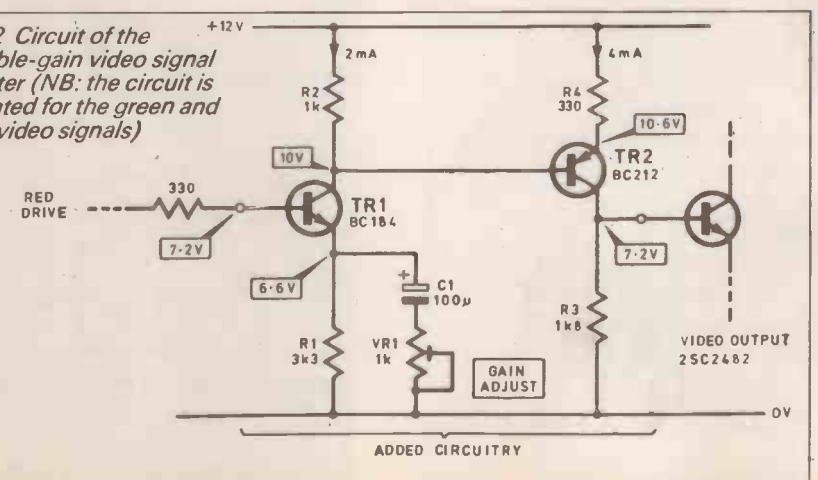


Fig. 2 Circuit of the variable-gain video signal booster (NB: the circuit is repeated for the green and blue video signals)

Next month: Next month's *Surgery* will be dedicated to the "audio enthusiast"; we shall be describing some simple analogue circuitry for compressing audio signals. We also provide details of a 30V power supply for use with a valve preamplifier.

In the meantime, if you have any comments or suggestions for inclusion in *Circuit Surgery*, please drop me a line at: Faculty of Technology, Brooklands College, Heath Road, Weybridge, Surrey, KT13 8TT. Please note that I cannot undertake to reply to individual queries from readers however I will do my best to answer all questions from readers through the medium of this column.

Special Feature

ALTERNATIVE ENERGY

T. R. de VAUX BALBIRNIE — PART 3

If you ever go across the sea to Denmark . . .

IN the previous parts of this series we have looked at the need to seek alternative energy supplies. In the next two parts we shall examine several of these. However, this month will be devoted to *wind power* because this method shows great promise and has reached the stage of large-scale commercial development. Some countries, such as Denmark, already generate a significant fraction of their total electricity requirement using wind power.

North-West Denmark, parts of the U.K. (especially in Scotland) and the west coast of Ireland share some of the most favourable climate in Europe for wind energy abstraction. Fig. 1 shows a Wind Map of Europe with the darker areas indicating the best places for large-scale exploitation.

GROWING UP

If anyone thinks that wind energy technology resembles an episode of *Last of the Summer Wine* or is best suited to eccentric boffins with equipment collapsing all around, they had better think again. Over the past 15 years, wind power has grown up. It has become serious, technologically advanced – and is here to stay. There are now about 30 wind turbine manufacturers operating – mostly in the European Community.

The purpose of a wind turbine is to extract as much movement energy (kinetic energy) as possible from the wind and turn it into kinetic energy in the blades. The slowly-moving blades are attached to a *rotor* which will then have its shaft speed increased using a gearbox and hence operate a generator to produce electricity. All the mechanical parts will be situated at the top of a tall tower in a housing called the *nacelle*.

A large modern wind turbine will have *variable pitch* blades – that is, the angle which the blades make along the longitudinal axis may be varied (compare with feathering of an oar in rowing). This angle should be capable of being varied during operation to present the greatest area to the wind at low wind speeds and to gradually reduce it as the wind speed increases.

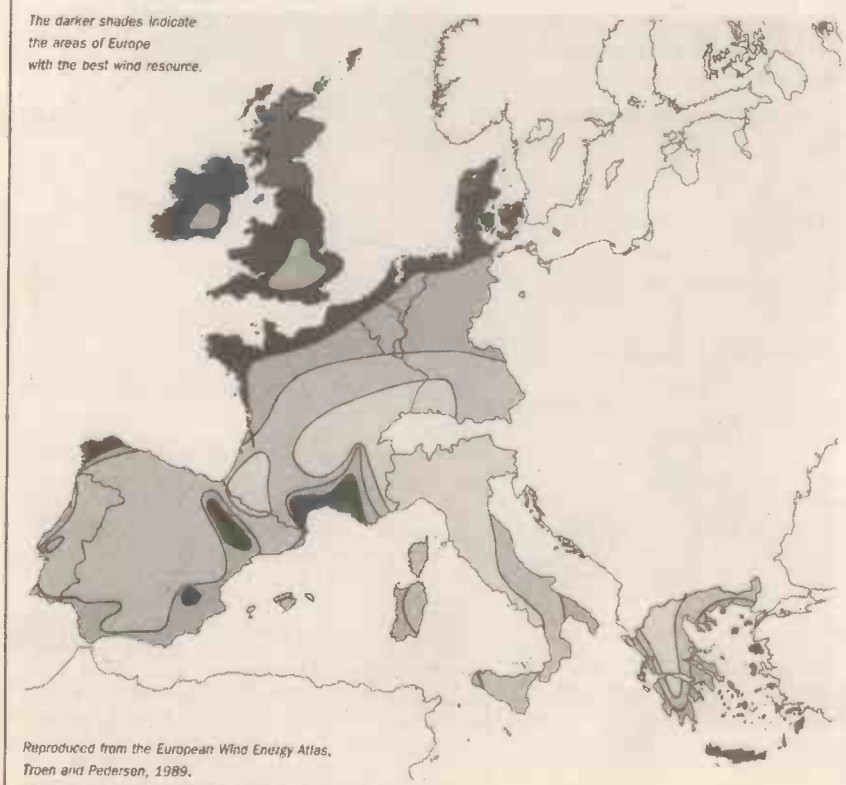
It is usually necessary to provide a means of steering the blades to face the wind – i.e. controlling the *yaw* – since the wind direction varies from day to day. This involves turning the nacelle on a *yaw ring*. A practical wind turbine must also be capable of being stopped in a reasonably short time for maintenance work to be carried out and also more rapidly in an emergency.

MICROPROCESSOR CONTROL

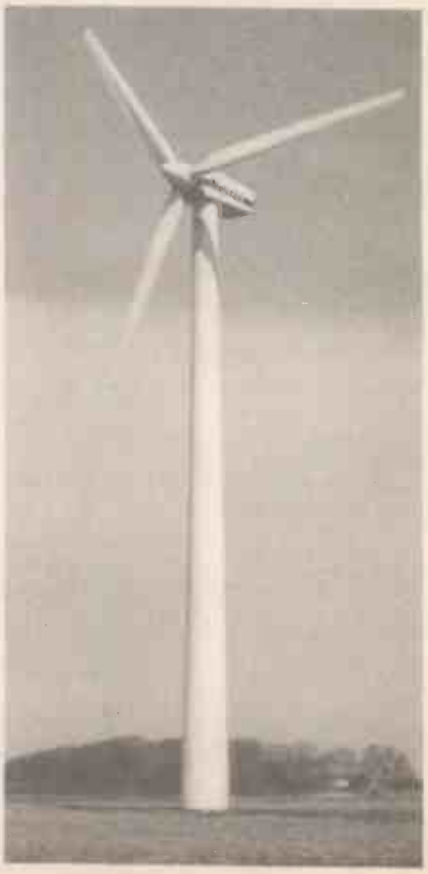
Although the wind provides a free source of power, it is also a very variable resource. It turns out that although the basic principle of the wind turbine is simple, its design is

Fig. 1. The European wind atlas

The darker shades indicate the areas of Europe with the best wind resource.



Reproduced from the European Wind Energy Atlas, Troen and Pederson, 1989. The atlas was prepared before the unification of Germany



The Vestas factory showing the test turbine and, in the foreground, turbine blades ready for transporting.

fairly complex. In practice, the control systems for yaw and pitch mentioned above are placed under microprocessor control.

Traditionally, the Danes, Dutch and Germans have relied in the past on the wind as a source of power more than the British. It is then hardly surprising that they have been quick to exploit the new market in modern wind turbines.

Denmark leads the way in wind technology and is practising what she preaches by making a commitment to generate 10 per cent of her electricity requirement this way by the end of the century. In fact, she is already well on the way to achieving this. A referendum of the Danish people indicated a wish to steer clear of atomic energy so this country remains free of nuclear power stations.

Denmark began a major wind turbine installation programme some 15 years ago and since then has accelerated her wind power contribution to meet the 10 per cent target. With the total average Danish demand standing at some 18,000MW, 1800MW is needed from wind turbines or the equivalent output of one very large conventional power station.

A trip to Denmark seemed a good idea to see at first hand what we can learn from a well-organised programme of research and development coupled with a serious view of alternative energy methods in general. We chose the Vestas factory as our chief point of call together with a visit to a large collection of turbines on a wind farm.

OFF TO DENMARK

At the Vestas factory, wind turbines are developed, manufactured, marketed and serviced for the home market and for export to all parts of the world. Vestas is a wholly Danish-owned company employing about 500 people with the present structure having come about through the amalgamation of Vestas Wind Systems and Danish Wind Technology at Viborg. Vestas have had many years of experience in the manufacture and maintenance of almost 4000 wind turbines installed worldwide.

The Vestas wind turbine manufacturing plant is situated on the west coast of mainland Denmark (Jutland) in the small village of Lem near Ringkobing. The fibreglass section and mechanical construction plant are separate but close to one another.

We were welcomed and shown around by Tom Pederson. His enthusiasm for wind technology in particular and alternative energy in general showed in all he said. He explained that the company in Lem had been well established in the engineering field for many years, manufacturing a variety of machines such as pumps. With the need for wind turbine development and manufacturing work, it was simply coincidence that the geographical situation of the area was ideal for testing purposes.

MANUFACTURING

Vestas make as much as they can themselves, Tom Pedersen told us. However, some of the specialized components such as the generators and gearboxes are bought-in under contract from various suppliers – Vestas have no wish to enter this type of specialized manufacturing field. The blades are the subject of continuous research carried out by Vestas themselves.

The blades are manufactured in the glass fibre section where over the years more than 7000 have been produced. Blades are currently made from glass-fibre re-inforced with epoxy resin and polyester.

Vestas products are under constant development. Currently they manufacture a range of four wind turbines all having the familiar three-blade form and looking similar apart from size. The latest and largest in the range is the V39-500kW model. The others are the Windane 34-400kW, the V27-225kW, shown on the previous page (developed from the previous V25-200kW unit) and the smallest in the range – the V20-100kW developed from the old V17-75kW unit. The smaller turbines still in widespread use all over the world are no longer made.

The rating figure is, of course, the *maximum* output and is obtained above a specified wind speed. The approximate height of the tower for the largest model is 40m, 30m for the 400kW and 225kW models and 23m for the "baby" of the range. The diameters swept by the blades vary from 39m to 20m.

Tom Pedersen told us that improved efficiency combined with economic forces dictate gradual but ever-increasing power outputs. In this way, the customer is provided with the cheapest generation of one kilowatt-hour. This is at present achieved with the 500kW model. As our host told us – "As we get better, it may be that the norm approaches 1MW."

SALES

We walked outside to see rows of completed wind turbines (without the blades since these are fitted when the unit is on site) and also some erected ones used for testing purposes. "That one over there is the 500kW turbine – it looks the same as the 225kW one, doesn't it? Go up to it, though, and you will see that it is a lot bigger".

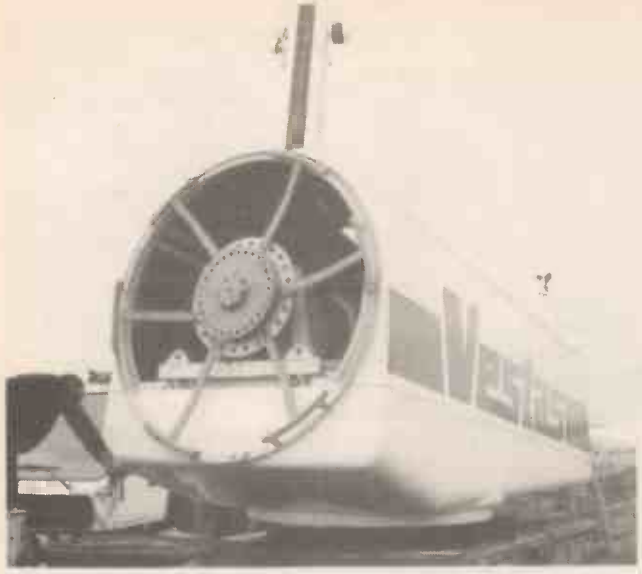
The plant keeps up a continuous output of completed wind turbines whether sold or not. In this way, Vestas can cope with sudden demand as sometimes happens when one customer recommends another and so sets off a chain reaction. Although the company's products are sold all over the world, a large proportion are exported to the USA – as of 1st December, 1991 a total of 2607 units were installed there, chiefly on various wind farms in California.

The largest group of similar units is the set of 98 V27-225kW turbines at Tehachapi with a total generating capacity of over 22MW. Most turbines are supplied on an enclosed tubular tower with internal access ladder. This form of construction provides a very elegant appearance. The towers are painted white to blend in with the sky-line. Galvanized lattice towers may be supplied as an alternative but, although cheaper, do not look so good.

COMPUTER CONTROL

Since the aim is to extract as much energy as possible from the wind, certain measurements need to be made continuously and some form of control/monitoring applied.

A Danish Wind farm sited close to the Vestas factory.



The nacelle which houses the generator.

A generator for the V27-225kW turbine.

Wind direction is monitored using a wind vane and wind speed using an anemometer both mounted on the top of the unit at operational height. These devices contain optoelectronic transducers which feed information to the microprocessor-based control unit at the base of the tower.

Information from the wind vane instructs the nacelle carrying the rotor to turn (yaw) to face the wind while information from the anemometer shuts down the turbine if the wind speed becomes too low or too high. At all times, the microprocessor regulates the pitch of the blades on the three larger models. Thus, at low wind speeds the area presented to the wind is high and gradually reduces as the wind speed increases. The power output is then substantially constant between certain limits.

The smallest of the range – the V20-100kW – does not have variable pitch – it is said to be *stall regulated.* We asked about the software. "We write it ourselves – this means that we can fine-tune it as we make minor changes to the design."

NATIONAL GRID

In practice, when on-site the wind turbines will be connected to a National Grid system. In this way, electricity may be sold at a premium rate (as non-fossil fuel energy) and electricity bought from the grid when the wind is insufficient.

A common misconception is to think that the speed of rotation of the rotor depends on the wind speed as in a traditional windmill. This cannot be so since the speed of rotation must synchronize with the existing supply on the grid and therefore turn at a specific speed. In Europe, the grid supply provides 50Hz a.c. (that is, 50 complete waves per second). The a.c. generator in the wind turbine must therefore do likewise.

Providing there is sufficient wind, the speed of the rotor will increase until synchronization is reached whereupon the unit "locks" and an electronic control unit switches the output through to the grid. The rotor will then continue to run at synchronisation speed (in the case of the 500kW turbine this is 30r.p.m.) as it "pushes" energy into the system.

As the wind speed increases, the rotor continues to turn at the same speed but the force on the rotor eventually reaches the point where damage could be caused. At a certain wind speed, therefore, the control system disconnects the output and the blades are fully feathered so that minimum blade area faces the wind. No power is then delivered and the blades come to rest.

If the wind speed becomes too low to allow synchronization, the output is once again disconnected. In the USA the mains frequency is 60Hz and modifications for this market are needed to take account of the higher frequency. Fig. 2 shows the output of a 500kW turbine as a function of wind velocity. It will be seen that full rated power

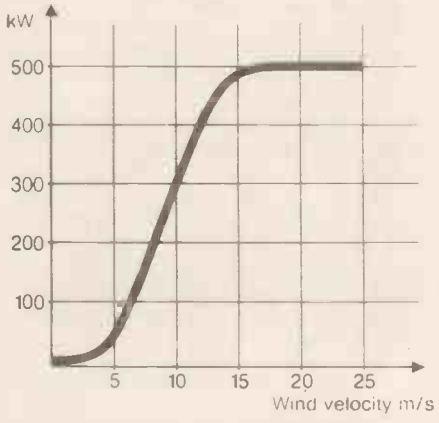


Fig. 2. Power output curve for the 500kW turbine.

is obtained at speeds above 16m/s – 36 m.p.h. (Force 7) with automatic shut-down at 25m/s – 56 m.p.h. (Force 10).

CONTROL SYSTEM

We went through the door into the tower of the V27-225kW test unit to see the control system in operation. A display on the panel gives information concerning output power and other operating parameters such as temperatures at various parts of the turbine. Remote monitoring of these functions is possible over a telephone line if required.

There is also a meter which looks very much like a household electricity consumption meter but here it is used for the reverse process – to provide data on the amount of energy supplied to the grid and hence the payment to be made to the operator for the electricity generated.

As mentioned previously, a wind turbine needs brakes. For normal stopping of the machine for maintenance, full feathering of the blades is sufficient. This brings the turbine to rest in a gentle and controlled way which causes least strain on the mechanical components. In an emergency, there is a more violent means of arresting it using hydraulic brakes combined with full feathering of the blades.

Braking is applied to the high-speed gearbox shaft and uses disc brake calipers fitted with non-asbestos linings. Although applying these brakes stops the turbine very quickly, this method was not demonstrated to us since it puts a great deal of strain on the mechanical parts – rather similar to the brakes on a car being applied as hard as possible.

If overspeed of the rotor should be combined with a fault in the controller, an independent monitor will activate the emergency stopping procedure automatically.

Inside the plant again, we walked past a large concrete-lined hole in the floor. "Not a swimming pool for the staff", Tom Pederson told us. "It's being prepared for tests on the 500kW turbine – this has some very heavy components and present facilities are inadequate". This reference to a swimming pool led me on to talk about staff relations. "Everyone works together like one happy family, really" was the reply.

WIND FARM

Leaving the factory and following directions given by our host, we drove the short distance to the wind farm. Here, in one ambitious project, 100 units of various types and power outputs operate side by side and row by row: 35 units of 75kW, 34 units of 90kW, 2 units of 200kW and 29 units of 225kW combine to provide a total rated output of 12·6MW.

Some of these units now appear small by todays standards – if they were all 500kW units, the output power would be 50MW. Listening carefully – there was no traffic or other noise – we confirmed that the noise of the turbines on a wind farm is negligible – some rushing sound and a very little mechanical noise. We also noted that most of the land is still capable of being farmed in the traditional way.

The wind farm is unmanned apart from times when a fault develops or when servicing is required. Wind turbines like other

mechanical devices need to be serviced and this involves a short period of non-production once a year.

EUROPEAN INSTALLATIONS

By December, 1991 Vestas had installed 1001 wind turbines on her own soil, 721 of these standing alone with the rest grouped together in wind farms. The smallest installed turbine has a capacity of 55kW and the largest one 400kW. The following table shows the number and type of Vestas wind turbines installed in various other European countries together with the nominal total capacity (in MW).

TABLE 1

Country	No of turbines	Capacity (MW)
Germany	74	13·63
Sweden	28	5·22
Norway	8	2·53
U.K.	8	1·33
Spain	8	1·06
Turkey	1	0·55
Italy	1	0·40
Greece	4	0·24
France	1	0·20

We left Denmark very impressed. By the way, if any readers wish to take a motoring holiday in Denmark they will be pleasantly surprised by the uniformly excellent road system, the lack of traffic in rural areas and the courtesy and good command of the English language by the Danes. Low national speed limits and well-disciplined driving makes motoring a pleasure.

You will not have to drive far before seeing a wind turbine. One point – there is a rule whereby all cars must used dipped headlights even during the day. British drivers tend to forget.

VESTAS AT HOME

Vestas supplied the turbines – ten WD 34-400kW units – for the UK's own Delabole Wind Farm in Cornwall. This is situated two miles from the North Cornwall coast approximately 240m (787ft) above sea level and this turns out to be an ideal location for wind energy exploitation. The wind farm covers some 140 acres with units placed 250m apart – a total installed output of 4MW.

A £26M hospital – the Wansbeck General Hospital – is under construction in Ashington, Northumberland. This is designed to open in 1993 with a view to serving a population of 190,000. The innovative design shows clearly what savings can be made and could be a model for similar schemes in the 21st century. The idea is to cut the projected energy costs by £135,000 – that is, by 60 per cent.

The hospital is sited in an area of high wind and a Vesta wind turbine has been chosen to generate a substantial amount of the total electricity requirement – around 20 per cent. The use of a wind turbine in this situation is thought to be a world "first". A computer will monitor energy demand of the complex and call on various types of generator – oil, gas, wind – or the national Grid to provide the most economic energy at any given time.

Use of high-efficiency insulation and double-glazing maximize energy savings as does the use of natural light wherever possible. Plans for an on-site incinerator/generating plant are also in hand – more about this type of scheme will be discussed in Part 5 of this series (December, 1992 issue).

WIND SHELTER

The Wood Green Animal Shelter in Cambridgeshire has also taken innovative measures to save energy and to protect the environment. This organisation is a charity which relies on the generosity of supporters so the more cash saved in terms of energy bills, the more work it is able to do. Preliminary studies into the feasibility of using wind energy were begun in 1988.

Since the site is not ideally placed, there was some scepticism at the time as to whether sufficient wind was available for the successful operation of a wind turbine. The Shelter planned their research well, calling on the help of the Cavendish Laboratory in nearby Cambridge and local air force stations to provide data concerning wind speed and direction for the previous ten years.

The University of East Anglia Climatic Research Unit was also called in to collate the information and run a computer program aimed at predicting the likely wind strength and direction over the next ten years. All this amassed data confirmed that the scheme was not only possible but made economic sense too. The wind turbine chosen was a Vestas V27-225kW unit.

The Wood Green shelter needs electricity to run a restaurant, an education department for the College of Animal Welfare and various veterinary facilities as well as the power needed for the welfare of the animals placed in its care. A *non-fossil fuel contract* was set-up and signed in 1990 whereby the Shelter agreed to sell total production from the wind turbine to the electricity company until 1998.

The electricity needed for the shelter is then purchased from the grid in the usual way. This has the advantage that the electricity generated sells at a special premium rate – some 50 per cent more than it is purchased for. Also, a suitable supply is always available irrespective of the amount of wind from day to day or hour to hour. It turns out that, in cash terms, the payback period of the turbine will be approximately three years with present rates of interest.

Apart from one very early malfunction, the turbine has continued to operate up to expectations. It has even become a landmark and a local tourist attraction.

U.K. CONTRIBUTION

All the foregoing may suggest that we in Britain are sitting twiddling our thumbs. However, this is not the case for here there is a great deal of important development and manufacturing work going on. As well as the popular type of medium-power turbine, we have specialist companies producing both the very large and small power devices. Britain also makes a contribution in the field of *vertical axis* wind turbine technology of which more will be said presently.

Marlec Engineering in Northampton manufacture the *Rutland Windcharger* range of small wind turbines. These have been in production for over ten years now and are exported worldwide. Marlec Engineering were, in fact, awarded the Queen's Award for Export Achievement in 1989.

A WEG MS-3 wind turbine sited at Carmarthen Bay.

WINDCHARGERS

The Windchargers are not intended to be used as stand-alone generators but are designed specifically to maintain the charge in 12V or 24V (there are two separate versions) lead-acid ("leisure-type") batteries which may then be used to supply power for lights, television, water pumps, refrigerator, etc. They are thus ideal for use in remote buildings, holiday homes, caravans, boats etc.

The design of the actual generator is innovative with much use being made of glass reinforced polyester resin. In the smaller – 910 series – the blades trace a circle approximately 90cm (3ft) in diameter and are made from thermosplastic.

A useful feature is the low wind speed needed for cut-in (i.e. for charging to commence) – only 4 m.p.h. (1·8 m/s) corresponding to Force 2. The full rated output of 50W is available at 10 m/s (Force 5). In a good situation it can be seen that a 60Ah leisure-type battery could be fully charged from scratch in 15 hours approximately.

The manufacturers therefore provide control gear to prevent damage to the battery in the event of long periods of high wind. There are special-purpose versions of the 910 series with the same specification but with particular applications in mind – one is specially designed for marine use, for example.

The Furlmatic 1800 is the big brother of the 910 with a rated output of 250W. The blades on this sweep a diameter of 180cm (6ft) approximately. Charging with this model begins with a wind speed of 5 m.p.h. (2·3m/s corresponding to Force 2 approximately) with full output achieved at 22 m.p.h. (10 m/s or Force 5).

It is interesting to note that the same company supply solar cell panels with a rated power output of between 5 and 60W in bright sunshine depending on size. An interesting idea is to use a *hybrid* charging system – that is, battery charging being provided part by wind generator, part by solar panel. This will provide more balanced charging throughout the year compared with one method used alone. Thus, in the winter there is likely to be less sun but more wind and in the summer the reverse.

POWERFUL STUFF

At the high-output end of the market, the Wind Energy Group, Ltd (WEG) produce the MS-3, 33m diameter wind turbine. The Wind Energy Group is a joint company formed between British Aerospace, p.l.c. and Taylor Woodrow Construction, Ltd. This company has been the Department of Energy's main contractor in the field of wind energy since the late 70's. Research and development work has included site selection, wind measurement, grid connection studies, windfarm development and performance monitoring.

WEG, Ltd. has some 40 professional engineers working on the wind energy programme with the capability of drawing on the huge resources of the parent companies. The MS-3 is a 2-blade design, the blades themselves being made of wood epoxy composite. Full pitching and yaw adjustment are featured using electromechanical control and all placed under microprocessor management.

Emergency braking is provided by disc brakes applied to the gearbox high speed output shaft. The tower is of galvanized steel, 25m high. The full rated power of the MS-3 – 300kW – is obtained with a wind speed of 11·5m/s (25·5 m.p.h. or Force 6). This output is then maintained up to 25m/s (56 m.p.h.) when the automatic cut-off system operates.

Remote control or monitoring of functions may be carried out using a modem link with a telephone line if required. The MS-3 may be seen operating in Wales, Scotland, Northern Ireland, Italy and in California where a single well-sited turbine can generate the electrical requirements of 300 homes. This corresponds to an annual output of more than 1MWh at a mean wind speed of 7.5m/s and at a cost of 5p per kWh.

The MS-3 is an ideal turbine for grouping with others in wind farms and will be used extensively for this purpose in 1992. In 1984, WEG supplied a 5MW wind farm in the California desert with 20 250kW 3-bladed 25m turbines. This was through a joint venture between WEG and US Windpower Inc. the largest windfarming company in the world.

A 20m diameter 250kW WEG wind turbine was erected on Orkney and this has been producing power since July, 1983. Later, the mighty 60 metre LS-1 (Large-Size 1) was constructed by the Department of Energy and the North of Scotland Hydroelectric Board – a joint venture by Taylor Woodrow, British Aerospace and GEC. This was inaugerated in November, 1987 and with a rated output of 3MW is sufficient to supply the total electricity needs of 2000 homes. The LS-1 (shown in Part 2) is the most powerful wind turbine ever constructed in the UK and is still one of the largest in the world.

VERTICAL AXIS TURBINES

Renewable Energy Systems, Ltd in Hemel Hempstead take a different approach to wind turbine technology. Here, the sails rotate *horizontally* – that is, turning on a vertical axis (see photograph) Vertical axis turbines have the advantage of being able to use the wind from whatever direction it blows without having to rotate the whole mechanism.

The design of the blades takes the form of an aerofoil which synchronizes with the 50Hz grid at 33 r.p.m. The prototype VAWT 260 was designed and constructed with financial assistance from the Department of Trade and Industry and the European Community. This demonstration unit was erected on St. Mary's, Isles of Scilly in 1988 where it was connected to the island's diesel-fired electricity network operated by the South Western Electricity Board.

The VAWT 260 has a rated output of 100kW with a 10·5m rotor diameter and blades measuring 13·3m tip to tip. Two generators are situated together with the gearbox and control circuitry at ground level. The use of two generators maximizes the output under all operational wind conditions with cut-in occurring at 5m/s. The maximum service wind speed is 23m/s.

The VAWT 260 is suitable for remote and island communities and may be grouped into windfarms.

Next month we shall continue with our study of Alternative Energy sources by taking a look at *water power* – use of the tides, waves and hydroelectric schemes. We shall also look at the use of hydrogen obtained from water to be used as a fuel to power a car.

The VAWT 260 vertical axis wind turbine. In this design the generators can be sited at ground level.

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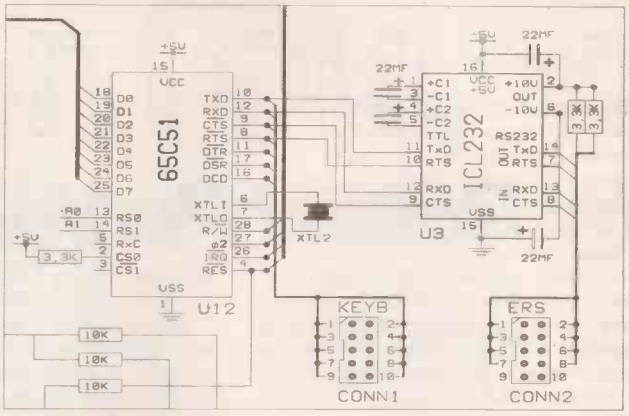

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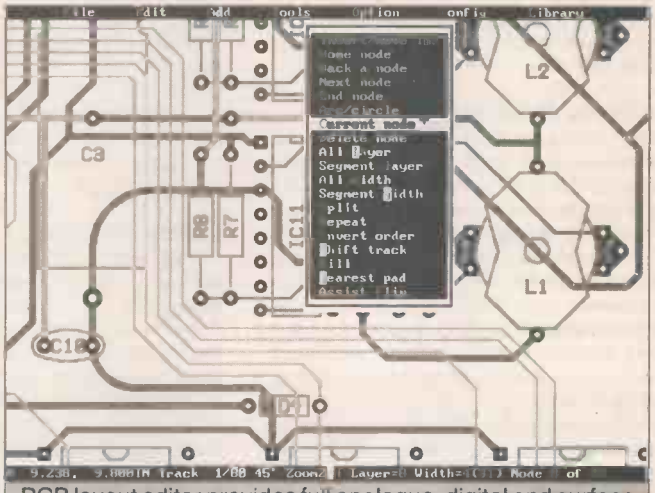

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ACTUALLY DOING IT!

by Robert Penfold

I READ with interest the recent correspondence in *Everyday Readout* (August and September 1992 issues) concerning what might be termed the "nuts and bolts" side of electronic project construction, and the usability of finished projects.

If you have some electronic projects published, very early in the proceedings you learn that you cannot please everyone. In fact it seems to be hard to please anyone much of the time. Whichever way you do something, there will always be constructors who have to do things differently!

DO YOUR OWN THING

I do not regard this as a bad thing, and I do not expect constructors to produce perfect clones of my designs. Part of the fun is doing things your own way, and customising designs. With modern circuits and circuit building methods it is often very difficult to make worthwhile modifications to the electronics. The mechanical side of things is a different matter though, and in the majority of cases there is plenty of scope for "doing your own thing".

The instructions for building most projects go into great detail about the electronics, but are rather sketchy about the mechanical side of things. This is a sensible approach, since there is little point in providing front panel drilling details if more than 90 per cent of constructors will use a different case and their own layout.

Precise drilling details are normally only given where it is important to get things just right, such as where a project has been miniaturised, and there is barely room for everything inside the case. With this type of project you would be well advised to follow the suggested layout as accurately as possible. Otherwise you might find that the proverbial quart does not fit into the pint pot.

PRACTICAL CONSIDERATIONS

Apart from a very few awkward projects, there is little risk in doing your own thing with the mechanical side of construction. If the layout is particularly critical for some reason, there should be a warning to this effect somewhere in the text. You have to be sensible in your approach though, and need to plan things out carefully.

Probably the most common error is to choose a case that is too small. A case may accommodate all the loose components with masses of room to spare, but might still prove to be inadequate to take everything in made-up form. A reasonable amount of space is required between controls and sockets if the finished unit is to be usable.

Some layouts look quite plausible, but you find that when a plug is inserted into a socket it becomes virtually impossible to get at one or two of the controls. It is not just a matter of getting everything into the case. With everything installed, will you be able to wire the off-board components to the circuit board?

My usual approach to designing front panel layouts is to actually place all the control knobs on the front panel, and to then shuffle them around until I have found a layout that looks reasonably good and is usable. For something like a jack socket, use the fixing nut to reserve its front panel space, and bear in mind that in use there will be something plugged into it.

COMPROMISE

Although it would be nice to be able to put any control wherever you liked, remember that there are practical limitations, and compromise will often be necessary. The layout must avoid lots of long connecting wires and a "rats nest" of crossed-over wires inside the case. This is not just a matter of making the interior of the unit look pretty.

With messy wiring it is relatively easy to make a mistake when wiring-up the front panel components. It also makes fault finding more difficult if the project should ever need servicing. Of greater importance, with many projects long and crossed over wires could prevent the unit from working properly. With sensitive audio and radio equipment it is normally *essential* to have the wiring short and direct if instability is to be avoided.

Another consideration is that the component on the inside of the case can be much bigger than the control knob on the outside. Modern potentiometers are quite small, as are most other controls, but be careful to leave enough room for any large components. This mainly means switches, and rotary switches in particular.

Once you have arrived at a satisfactory layout, it is just a matter of carefully measuring the positions of all the components, and drawing-up a plan of the front panel. After double checking everything, and making sure that you have not overlooked anything that must be mounted on the front panel, you can transfer the design to the front panel and drill all the holes.

MAKING YOUR MARK

Marking the drilling positions onto aluminium panels is usually quite easy. Soft pencils and many types of fibre-tipped pen will mark these panels quite well, but the marks can be easily polished out once the drilling has been completed. As aluminium is a very soft metal it is essential not to mark the panel with a hard grade of pencil, or anything else that could leave deep scratches. The exception is where the panel will eventually be covered with some sort of veneer. Paint will not necessarily cover scratches properly.

Some aluminium cases are supplied with a protective covering of plastic. It is best to leave this covering in place until as late in the proceedings as possible. A fibre-tipped pen having a spirit based ink will mark the plastic very well, but little else will.

With a metal panel it is essential to use a centre-punch to provide a small indentation to guide the point of the drill. Centre-punches also work quite well with soft plastics, but should not be used on hard plastics (where they could easily result in the panel badly cracking). With hard plastics it is better to use a sharp bradawl, using as little pressure as possible. Hard plastics should be drilled very carefully, again using as little pressure as possible.

CLAMPING

If the front panel can be removed from the case it can be clamped onto the workbench and is then easily worked. Fit a scrap piece of wood or particle board under the panel to protect the workbench. A couple of wooden "pads" can be used to prevent the clamps from damaging the finish of the panel.

With non-removable panels you must improvise, and do the best you can. Working on a panel under these circumstances is much easier if you have three or four arms, or can get someone to help hold things in place. With an awkward case it is even more important than normal that you do not rush things. A "bull in a china shop" approach is never the right one for project construction. Proceed steadily and very carefully.

With so many cases made from either soft metal or plastic, or a hard but brittle plastic, I prefer to use a hand drill when producing the holes. A large heavy-duty type is well suited to this type of work, or an old "brace and bit" style drill is even better (but very difficult to obtain these days). With either type of drill you can proceed gently and slowly, with good control over what is happening.

The problem with power drills is that they tend to "snatch" their way through soft materials, rather like a corkscrew going into a cork. This tends to produce rough results, and is a bit dangerous since you are not in total control of the drill. With hard plastics a power drill can easily produce a badly cracked-up panel.

If you really must use a power drill I would recommend using some sort of variable or multi-speed type, with the drill set at a low speed. This ensures that everything happens at a slow enough speed for you stay in control of the situation. It is more than a little helpful if the drill is mounted in a drill stand. Sharp drill bits are less likely to "snatch", and will give neater results.

CONTROL MOUNTING

Virtually all controls are mounted via a threaded bush and a mounting nut. The main exceptions are the rocker and slider switches. These can be difficult to get

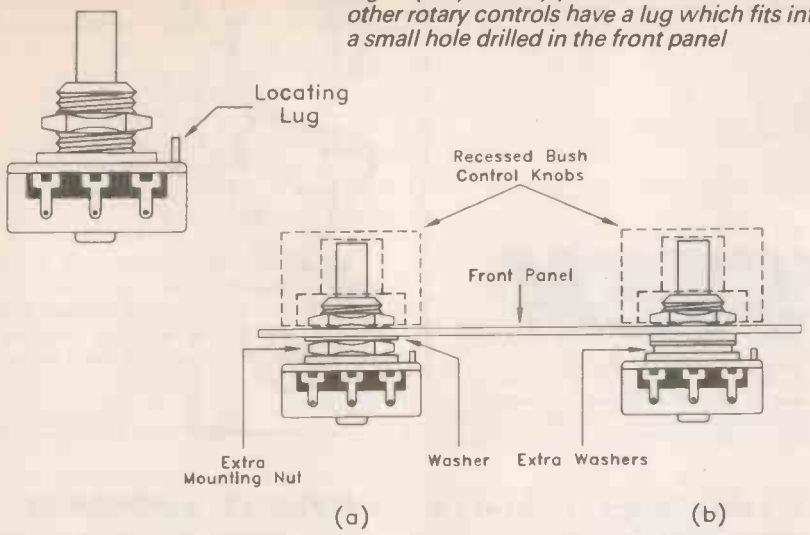


Fig. 1 (left). Rotary potentiometers and some other rotary controls have a lug which fits into a small hole drilled in the front panel

Fig. 2. In home constructor equipment the lugs on rotary controls are normally unused, as they do not reach the panel.

properly fixed in place, and are probably best avoided until you have gained a reasonable amount of experience at project building.

The normal size components require 10 millimetre diameter mounting holes. The miniature types usually require 5 or 6.35 millimetre diameter mounting holes. Component retailers' catalogues provide a lot of physical information about components, including mounting hole sizes, but you can easily measure the bush diameter using a ruler.

It is advisable to drill a small guide hole of around three millimetres in diameter first, and to then drill this out to the required final size. This helps to minimise any "wandering" of the holes.

LOCATING LUGS

If you look at some potentiometers you will find that each one has a small lug somewhere on the front (as in Fig.1). This is also present on some rotary switches and a few other types of rotary control. The general idea is to make a hole for this lug in the front panel, and it then ensures that the control does not rotate out of position if the mounting nut should become a little loose.

The home constructor normally ignores this lug. If a control should become loose, you can soon tighten it again. Commercial electronic equipment often has all the controls mounted on the real front panel, with a dummy panel in front of this for decorative purposes. Most home constructor equipment does not have the dummy panel. If holes for the lugs were drilled in the front panel, they would probably be clearly visible, giving a very rough appearance to the finished unit.

The lug does not normally reach the front panel anyway. Some extra washers or an additional fixing nut are used over the mounting bush so that it does not protrude through the front panel any further than is really necessary (Fig.2). This enables the control knob to fit close to the panel, which gives a neat appearance.

Most of the control knobs available to amateur users have the collar that fits onto the control's spindle well recessed into the knob. These knobs can be fitted virtually flush against the front panel.

DUMMY PANEL

If you would like to take the commercial approach and fit a dummy panel, it is not difficult to do this. The panel can be made from 18, 20, or even 22 s.w.g. aluminium, since it is under no strain. The simplest approach is to drill it with holes to fit over the bushes of the controls, to fit it in place, and then fit the control knobs. This leaves the dummy panel with no proper method of fixing, and just the control knobs to keep it in place.

This may not seem to be a very good way of tackling the problem, but in practice it works better than you might think. It is a system I have seen used on several pieces of ready-made audio equipment.

If you are not happy with a "floating" dummy panel, a few blobs of Blue-Tack will fix it to the main panel and ensure that the finished unit is rattle-free. Alternatively, the panel can be bolted in place, as shown in Fig.3. This provides a very secure method of fixing, but the screw heads will slightly spoil the appearance of the panel. Another option is to use some nuts over the control bushes to fix the dummy panel firmly in place. This is the neatest solution where it is possible, but in many cases you will find that there is not enough of the bush protruding through the panel.

When using a dummy panel you must include holes in the front panel to accommodate the lugs on the controls. Alternatively, the lugs can be filed down. You must use one method or the other, or the controls will not fit perpendicular to the panel.

Clearly the dummy panel method is only applicable to certain types of case, where the presence of the extra panel will not be obvious. It is usable with many instrument cases, and will give a very neat finish indeed if the panel is covered with a brushed aluminium effect veneer.

The neat and simple front panel arrangement used on this months Capacitance Meter.

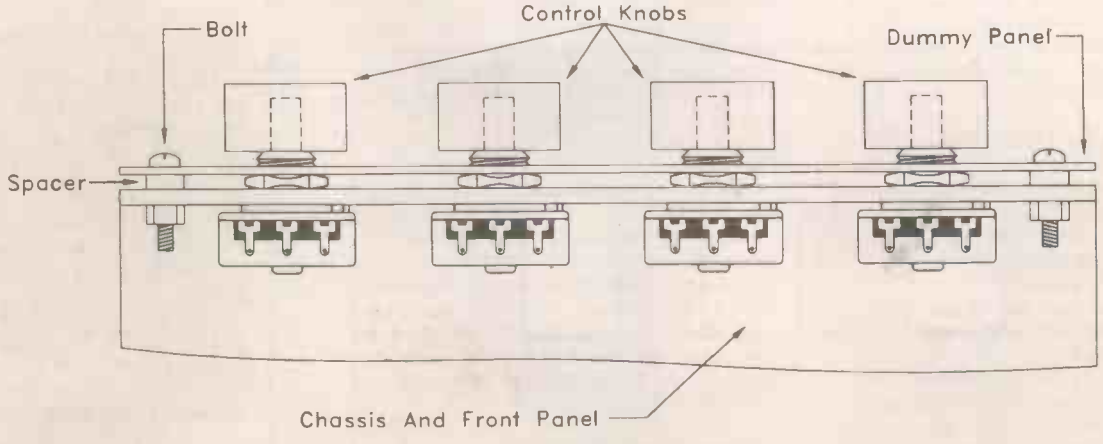
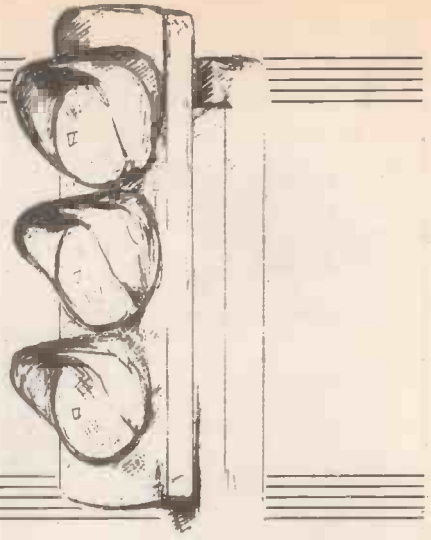


Fig. 3. Using a dummy panel. It does not have to be bolted in place, dummy panels are often left "floating".

Constructional Project

TRAFFIC LIGHT SYSTEM



J. HEWES

HIGHWAY CODE TRAINING • MODEL CARS • MODEL RAILWAYS • Can be used to operate up to four sets of l.e.d.s; two sets of low current (50mA to 100mA) lamps; or trigger relays to switch high current lamps – 12V 24W.

TRAFFIC light circuits are very popular with electronics constructors and modellers judging by the author's experience from a school electronics club. The circuit is a classic of electronics text books, but these circuits tend to be unsatisfactory for construction for a number of reasons: generating lights for just one road, equal amber and green times; 5V power supply required; no p.c.b. layout, etc.

The traffic light system described here was designed to meet the different requirements of several club members without modification to the control circuit. It can be used to operate up to four sets of l.e.d.s, or two sets of low current (50mA-100mA) lamps, or to operate relays to switch high current lamps such as 12V 24W types.

Applications can therefore range from miniature traffic lights on model railways, through small lights for model cars, to nearly full size lights to assist cyclists learning the Highway Code. The control circuit will operate from a wide range of power supply voltages, from 4·5V to 18V.

The design of a suitable traffic light post is left to the constructor since this depends greatly on the application and on the skills of the constructor.

HOW IT WORKS

The control circuit diagram of Traffic Light System is shown in Fig. 1. The circuit consists of an astable clock (IC1) driving a T-type flip-flop (IC2) which has a buffer (IC3) connected to its output.

The clock and flip-flop control the traffic light sequence as shown in Fig. 2. The amber and green times can be varied independently so that an appropriate combination can be selected for the chosen application. The amber time can be varied from 0·7s to 7·7s and the green time from 7s to 77s.

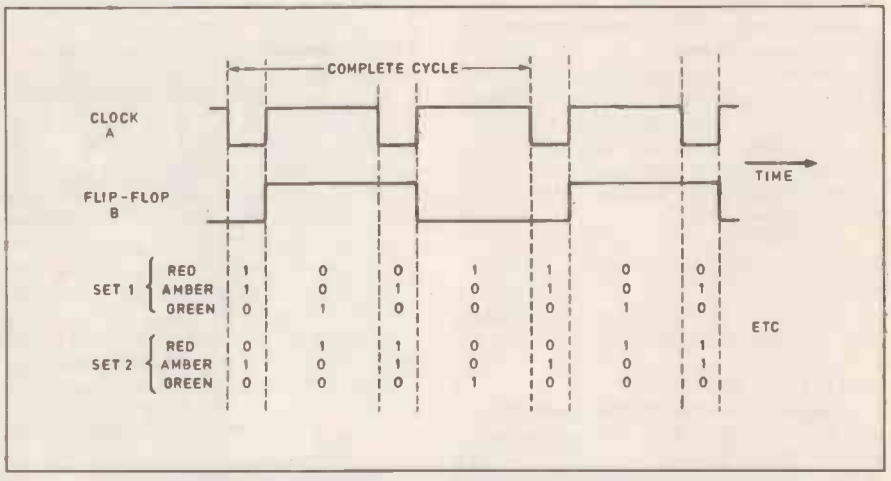
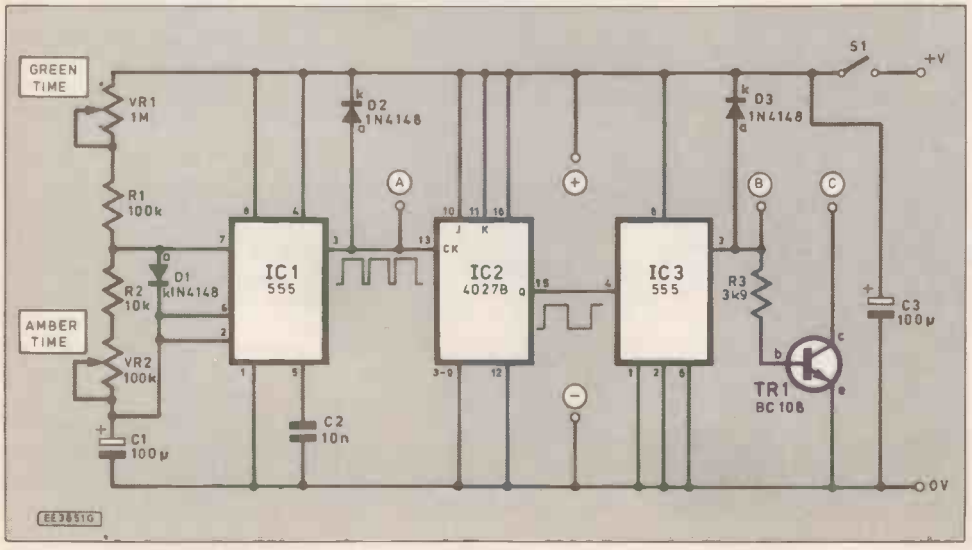


Fig. 2. Traffic light control sequence. 0 = lamp off; 1 = lamp on.

Fig. 1. Circuit diagram of Traffic Light System control circuit. The circled letters refer to locations on the "lights" interconnecting terminal block TB1.



The amber control adjusts the space (low) time of the clock signal from IC1 and the green control adjusts the mark (high) time. Normally the green time is much longer than the amber time so the clock signal has a large mark-to-space ratio.

The red and red-and-amber times are equal to the green and amber times respectively. The system is not quite like real traffic lights in that there is never a time when all lights are red, however the extra complexity this involves is not justified for model systems and the difference is unlikely to be noticed by most people.

Only one of the flip-flops in the 4027B dual JK flip-flop, IC2, is used in this circuit. This is connected to operate as a T-type flip-flop so that it changes state every time it receives a rising-edge clock input.

The flip-flop output from IC2 is incapable of supplying the necessary current to operate the traffic lights

COMPONENTS

CONTROL CIRCUIT

Resistors — See SHOP TALK

R1	100k	
R2	10k	
R3	3k9	

All 0·25W, 5% carbon film (or equivalent)

Potentiometers

VR1	1M rotary carbon, lin.
VR2	100k rotary carbon, lin.

Capacitors

C1, C3	100µ axial elect., 25V (2 off)
C2	10n metallised polyester

Semiconductors

D1-D3	1N4148 silicon diode (3 off)
TR1	BC108 *npn* transistor
IC1, IC3	NE555 timer (2 off)
IC2	4027B dual JK flip-flop

Miscellaneous

S1 Single pole on/off switch

Plastic case, size at least 100mm x 75mm x 40mm; 8-pin d.i.l. socket (2 off); 16-pin d.i.l. socket; battery clip; 9V battery (or alternative, see text); 5-way terminal block (2A); stranded connecting wire; solder etc.

The printed circuit board is available from the *EE PCB Service*, code EE806.

L.E.D. SETS

Red l.e.d. (2 off)
Yellow (or amber) l.e.d. (2 off)
Green l.e.d. (2 off)
470 ohm 0·25W resistor (6 off)

Stripboard, size 9 strips x 5 holes (2 off); 4-core signal cable, length to suit application (2 off).

These quantities are for two l.e.d. sets, all quantities should be doubled for four l.e.d. sets.

LOW CURRENT LAMP SETS

Either: Lamp and holder, e.g. m.e.s. 6V 60mA (6 off)
1N4001 silicon diode
4-core signal cable, length to suit application (2 off)
Colour filters (red, amber and green) if not in lampholders.

Or: Grain of wheat lamp, red (2 off)
Grain of wheat lamp, amber (2 off)
Grain of wheat lamp, green (2 off)
1N4001 silicon diode
4-core signal cable, length to suit application (2 off).

HIGH CURRENT LAMP SETS

Single pole 10A on/off switch
Fuse (e.g. 13A) and holder
6-way 10A terminal block
SPCO relay (e.g. 12V coil, 5A contacts)
DPCO relay (e.g. 12V coil, 5A contacts)
Lamp and holders (e.g. s.b.c. 12V 24W) (6 off)
Colour filters (red, amber and green) if not in lampholders
2-core 13A mains flex or alternative to suit application

Approx cost guidance only **£11** *plus lamp sets*

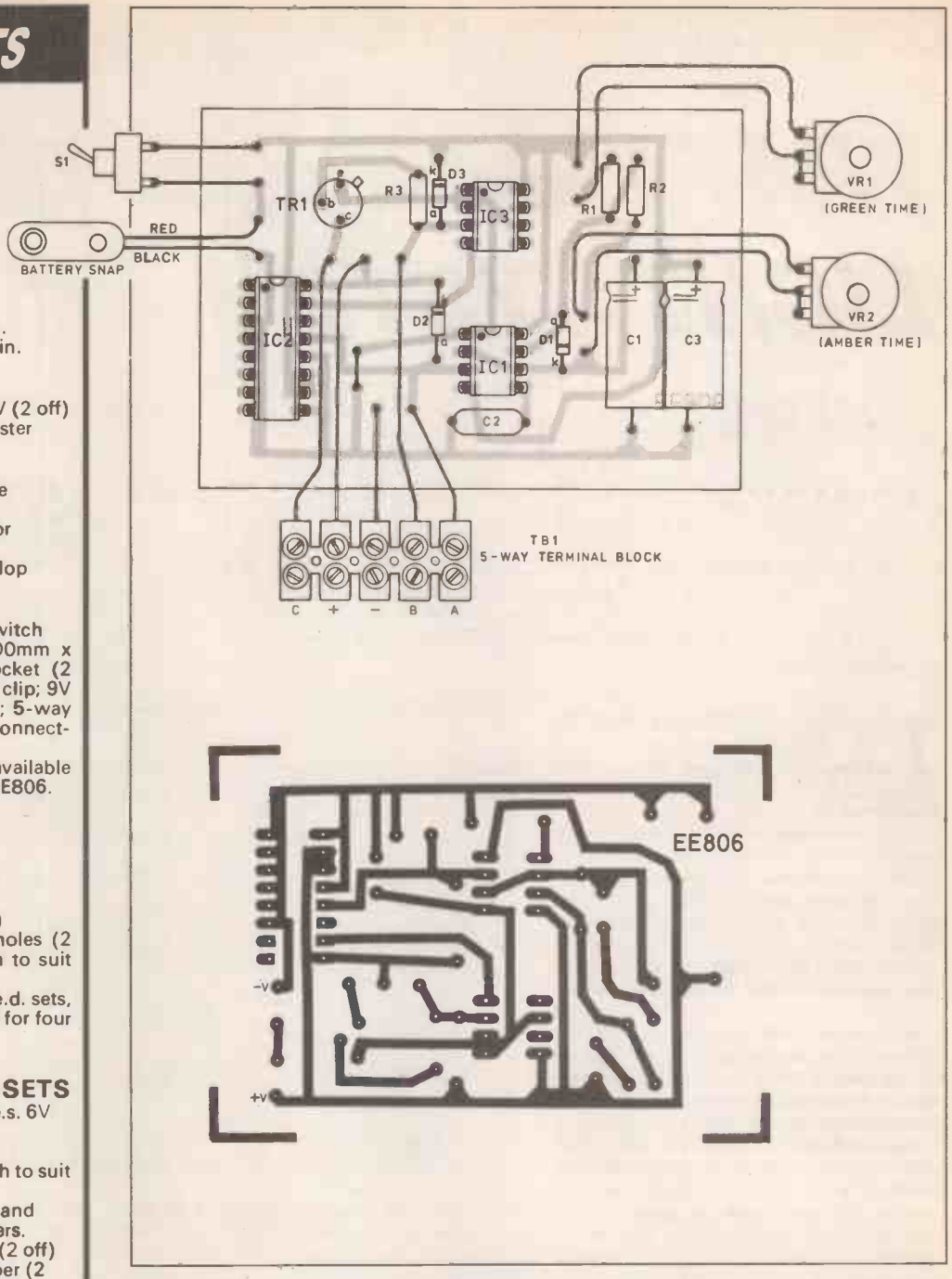


Fig. 3. Printed circuit board component layout, interwiring to board and full size copper foil master pattern.

or relays, so it is buffered by IC3 which is a 555 timer. This is an unusual use for a 555 timer, but its ability to sink or source up to 200mA is ideal for this circuit and it is simpler and cheaper than using transistors to form a suitable buffer.

Diodes D2 and D3 are connected between the outputs of the 555s (IC1, IC3) and the positive supply to protect them from the high voltage spikes generated if relay coils are connected to the control circuit. Transistor TR1 is used to provide an inverse of the flip-flop output.

The "signal" l.e.d.s, lamps or relays are connected to the control circuit by means of a 5-way terminal block TB1. The five connections to this block are as follows:

A: *Output from clock*
B: *Buffered output from flip-flop*
— : *Negative supply*
+ : *Positive supply*
C: *inverted output from flip-flop via transistor TR1*

CONSTRUCTION

The component layout of the control circuit and a full size copper track pattern for the printed circuit board are shown in Fig. 3. This board is available from the *EE PCB Service*, code EE806.

The components may be added to the board in any convenient order, except IC1, IC2 and IC3 which should not be inserted in their sockets until all the soldering is completed. Notice that the board includes one link wire near IC2.

Take care to insert the electrolytic capacitors C1 and C3, the diodes D1-D3, and the transistor TR1 the correct way round. If you are not experienced at soldering it would be wise to use a heatsink (such as a crocodile clip) when soldering the diodes and transistor because they can be damaged by excess heat.

Label the terminal block "A B − + C" as shown to prevent confusion when connecting the l.e.d.s, lamps or relays.

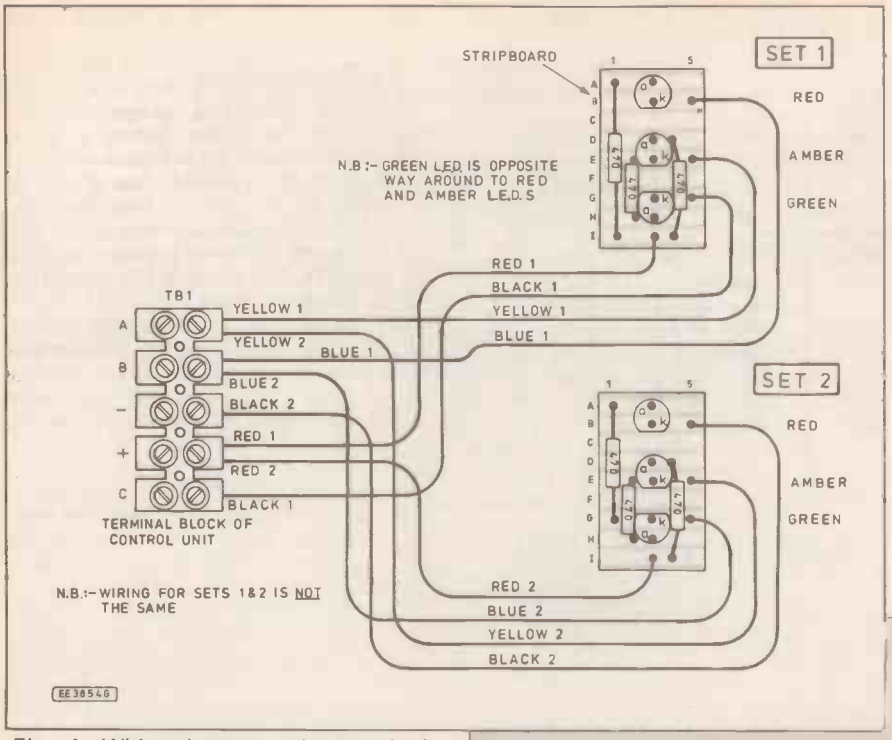


Fig. 4. Wiring between the terminal block and l.e.d. boards.

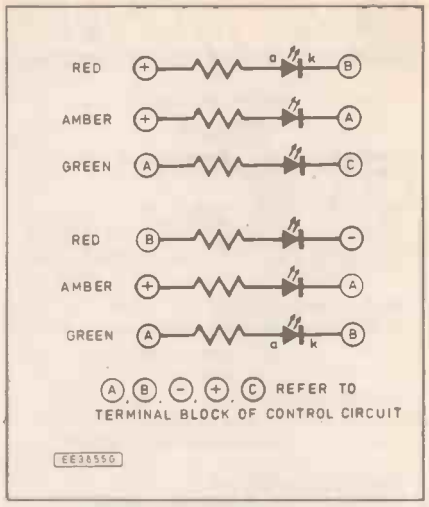


Fig. 5. Circuit connections to the l.e.d.s and limiting resistors. See text for resistor values.

WIRING FOR L.E.D.s

The control circuit can operate up to four sets of l.e.d.s, but these instructions are for two sets because the wiring for the third and fourth sets is identical. They are simply wired in parallel to the terminal block. Each set of l.e.d.s requires three resistors which can be included on the piece of stripboard holding the l.e.d.s as shown in Fig. 4.

Note that the connections to the terminal block and the arrangement of resistors is *not* the same for each set of l.e.d.s. In each case the green l.e.d. is inserted the opposite way round to the red and yellow (amber) l.e.d.s. It is possible, but difficult, to obtain amber l.e.d.s.; however yellow should be satisfactory.

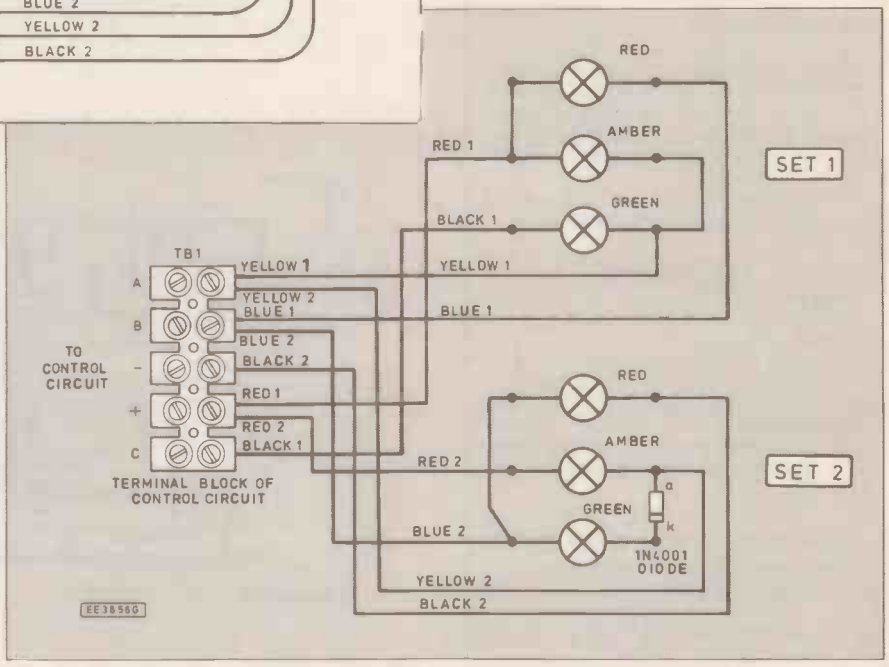
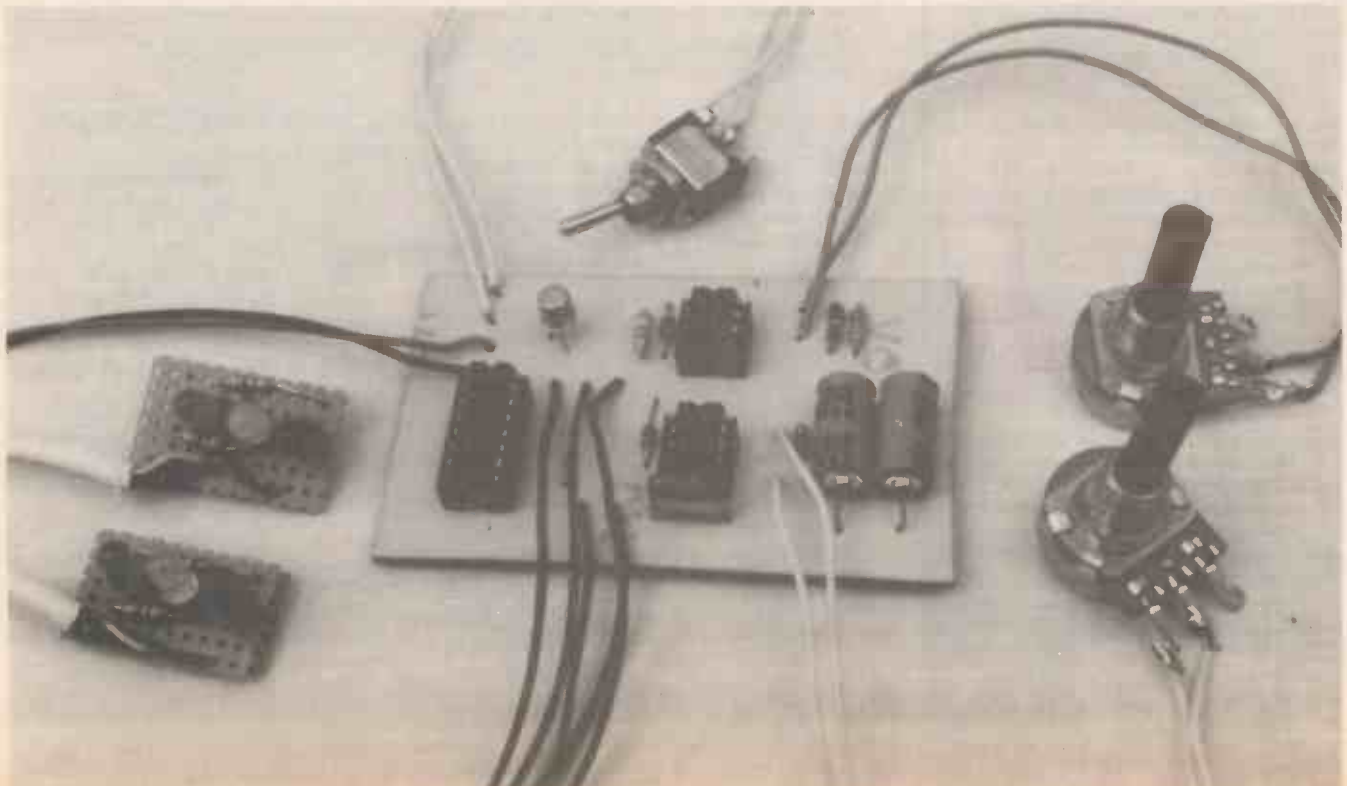


Fig. 6. Wiring details for low current lamp version.



The 470 ohm resistors shown are suitable for most l.e.d.s up to 9V, but for 12V use 680 ohm and for 16V use one kilohm. Fig. 5 shows the l.e.d. and resistor connections for the benefit of constructors who wish to mount the resistors on a separate board to give a smaller traffic light.

LOW CURRENT LAMPS

The control circuit can operate up to two sets of low current (50mA-100mA) lamps which should be connected as shown in Fig. 6. One set requires a diode, and note that the connections for each set are *not* the same.

Two types of lamps are likely to be of interest: 6V 60mA m.e.s. lamps, which can be used with a supply of up to 9V; and "grain of wheat" lamps which normally operate from a 12V-16V supply and consume about 50mA. Lamps which require more than 100mA (such as standard torch bulbs) are not suitable unless they are switched on and off by relays, as described in the following section. If clear lamps are used it will be necessary to use suitable colour filters; some lampholders have these built in.

Grain of wheat lamps are excellent for miniature model lights because they are only about 3mm in diameter and have wires attached. They are normally available in red, amber and green as well as clear. Unfortunately they are not listed in most electronics catalogues, but they can be obtained from some model shops.

HIGH CURRENT LAMPS USING RELAYS

High current lamps consuming more than 100mA can be operated by the control circuit by using suitable relays to switch the high current. How the relays should be connected to the control circuit, which already includes diodes (D2 and D3) to protect the i.c.s from the high voltages produced when the relay coils are switched off, is shown in Fig. 7.

These instructions assume the use of a 12V car battery as a power supply, but experienced constructors may like to consider other arrangements, bearing in mind that the control circuit must have a smooth supply and that it could be independent of the lamp supply if necessary. The author *does NOT* recommend the use of mains lamps, especially if the system is to operate outside, since this introduces a quite unnecessary risk of electric shock unless proper precautions are taken.

There is no danger of electric shock from a 12V car battery, but there is a serious, and often overlooked, danger of severe burns and fire if the battery is short circuited because it can provide a current of 100A or more. A suitable fuse *MUST* be included in the positive lead from the battery, together with a switch with a *high current* rating. For many applications, such as using 12V 24W lamps, a 13A mains type fuse is a suitable choice.

It is important to connect the battery direct to the relays and lamps as shown and not to the control circuit. This is because the copper tracks on the printed circuit board cannot pass the large currents drawn by the lamps.

The battery clip and switch should be omitted from the the control circuit board unless the control circuit is to have its own battery, in which case the wire to "+" on the terminal block TB1 should be omitted.

All wiring to the lamps and battery must be capable of passing the required current, 4-core signal cable for example is not suitable because it is usually rated at 1A. The best choice is likely to be 6A mains flex and two pieces of 2-core flex must be run to each set of traffic lights. The arrangement of the connections on the relays must be checked carefully by referring to the supplier's data or catalogue. □

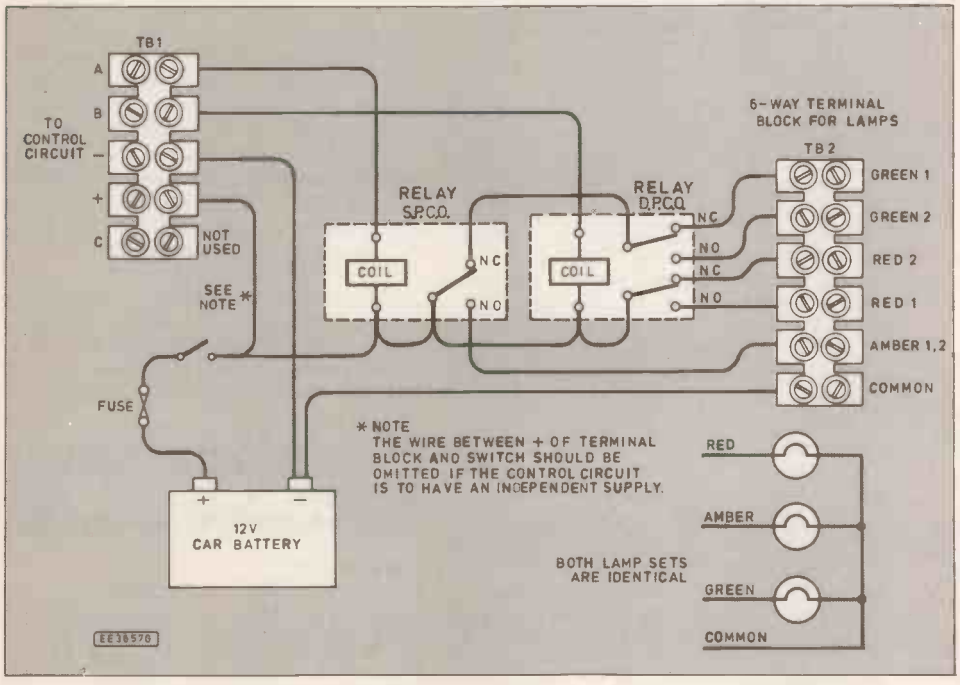
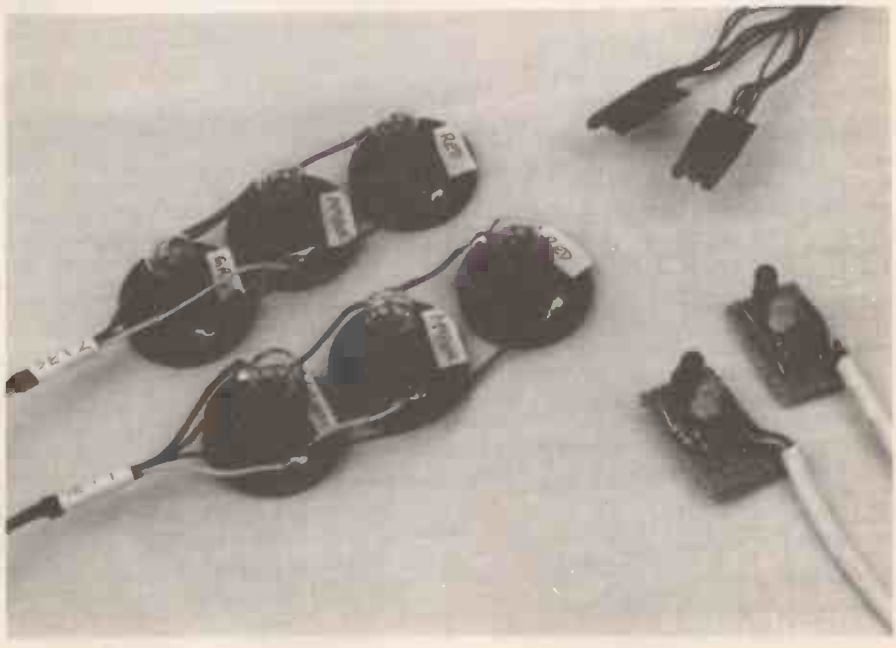


Fig. 6. Wiring details for the use of relays and high current lamps, in-line fuse MUST be included in the positive car battery lead. The lead from the "plus" terminal of TB1 must also be removed if the control circuit is to have an independent supply.



The three different sets of lamps that have been used with the traffic lights system. Left to right, l.e.s. bulbs, "grain of wheat" lamps and l.e.d. boards.

WHISTLE SWITCH

STEVE HOLLAND

Whistle once, it's on; whistle again and it's off. Easy to build versatile project

THE IDEA of this project is to be able to switch electrical items on and off remotely, simply by WHISTLING. As long as you are able to whistle, of course, there should be no problem.

The circuit, is very simple as it uses a dedicated integrated circuit. With just a few external components, it can be used in many different applications.

CIRCUIT DESCRIPTION

The full circuit diagram for the Whistle Switch, excluding the mains transformer secondary winding connections at the input terminals, is shown in Fig. 1 and is based around the UM3763 whistle switch i.c.

The i.c. output is switched each time it detects a sound, via MIC1, in its frequency range. A single whistle will switch the output on, then a further whistle will switch it off and so on.

The main problem is that the i.c. only requires a 3V power supply. The unit also has to be versatile enough to be able to switch relays and bulbs of 12V or over.

The circuit board is supplied with 9V to 15V d.c. or a.c. from a mains transformer secondary winding and this power is then rectified by diode D1. Capacitor C1 then smooths out the supply.

Resistor R1 is used to supply the voltage for the Zener diode D2, which then regulates the voltage to 3V. At point *A*, a voltage of 9V to 20V may be present; at point *B*, there should be exactly 3V present.

The voltage at point *A*, can be used to supply the relay or a bulb. The voltage at point *B* supplies the whistle switch IC1.

The "sound" sensor for this project is an electret microphone insert with a frequency response of around 50Hz to 8kHz. A small piezoelectric transducer was tested but it gave no response whatsoever and so the insert (MIC 1) was used instead, as this gives maximum performance.

The output from IC1 pin 8 triggers transistors TR1 and TR2 via resistors R4 and R5, which will in turn activate the output – i.e. a 12V relay or bulb. If a load greater than 60mA is to be drawn then a larger switching transistor must be used. For example, a BFY50 or BFY51 should be adequate for switching up to 1A.

CONSTRUCTION

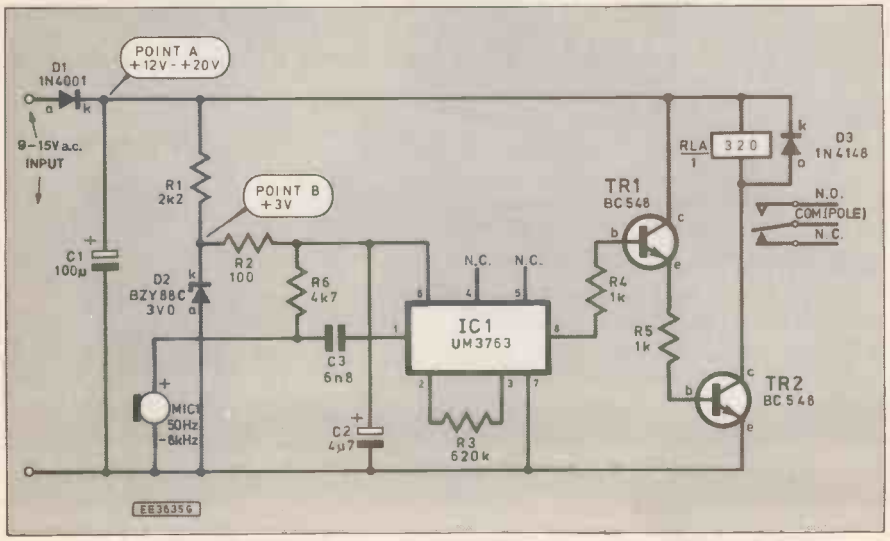
The Whistle Switch is built on a small single-sided printed circuit board (p.c.b.). The component layout and full size copper foil master pattern is shown in Fig. 2. This board is available from the EE PCB Service, code EE805.

Construction should cause very few problems. Before soldering any components check all the tracks of the p.c.b. to make sure there are no breaks or shorts.

When all is well proceed to solder the diodes into their correct positions noting as always their polarity. Do *not forget* the Zener can only go in one place. The Zener is only tiny so be careful not to damage it due to over heating whilst soldering.

Next, solder in the three capacitors, also noting the polarity of C1, and C2. Solder in the six resistors, two transistors and the 8-pin i.c. socket. Finally, insert and solder in the solderpins and/or connecting wires and the relay RLA.

Fig. 1. Circuit diagram of the Whistle Switch.



COMPONENTS

Resistors

R1	2k2	
R2	100	
R3	620k	
R4, R5	1k (2 off)	
R6	4k7	

All 0.25W 5% carbon film

See SHOP TALK Page

Capacitors

C1	100µ radial elect., 35V
C2	4µ7 radial elect., 16V
C3	6n8 ceramic disc

Semiconductors

D1	1N4001 1A 50V diode
D2	BZY88C3V0 500mW 3V Zener diode
D3	1N4148 70mA 100V diode
TR1,TR2	BC548 *npn* transistor (2 off)
IC1	UM3763 whistle switch

Miscellaneous

MIC1	Omnidirectional electret microphone insert
RLA	12V 320 ohm coil relay, single-pole changeover mains contacts

Printed circuit board available from the *EE PCB Service*, code EE805; single-core screened cable; solder pins; solder, etc.

Suitable a.c. or d.c. supply e.g. mains transformer with 12V secondary rated to drive the load used, or plug top power supply with 9V to 15V ourput at the required current (100mA for relay unit).

Approx cost guidance only **£9** *plus supply*

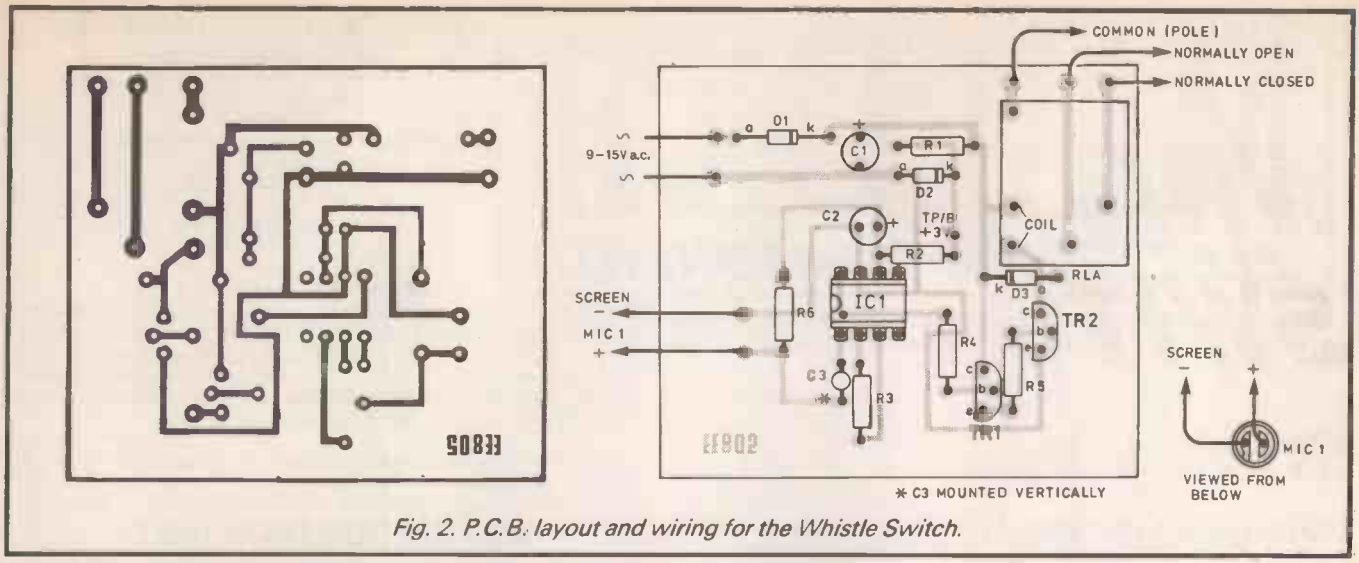


Fig. 2. P.C.B. layout and wiring for the Whistle Switch.

Check the board for any "dry" joints or solder blobs that are causing any shorts. If all is well then the board should be powered up *without* the whistle switch i.c.

TESTING

Once the p.c.b. has been powered up, the following spot checks can be made. At this point check both voltages at point *A* and point *B* and make sure they are correct.

Point *A* can be anywhere from about 9V to 20V and point *B* should be at 3V. If not check and make sure the polarity of the Zener diode D2 is correct, as this will damage itself and IC1.

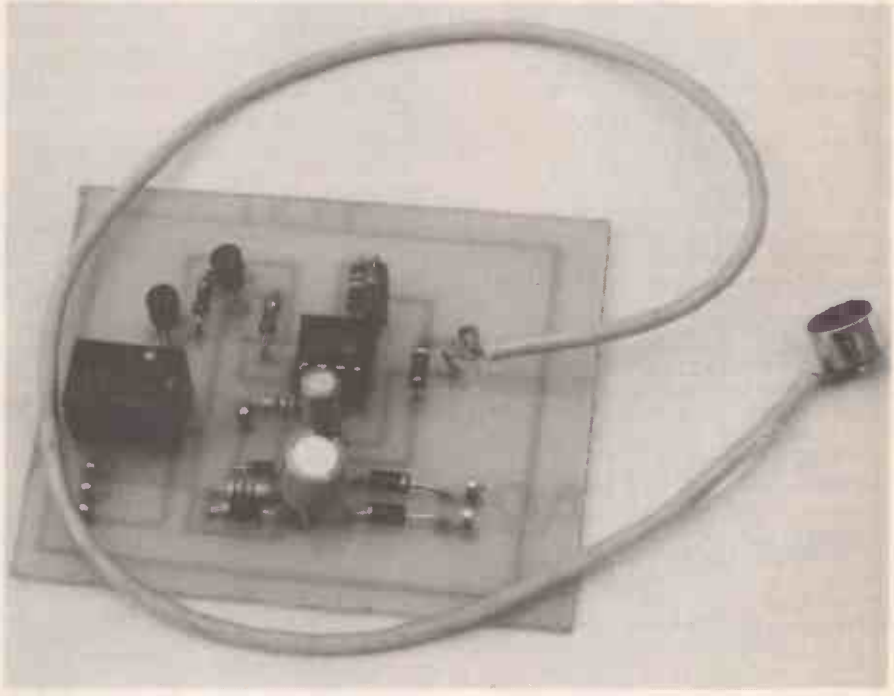
When you are happy that all is well, switch off the power and insert the whistle switch i.c. and power up again. Now WHISTLE! You should hear the relay operate with each whistle. A little practice may be necessary for you to find the higher and lower frequency limits.

IN USE

By using the relay contacts, you are able to use this "sound switch" in anything you want – the choice is yours.

One idea may be to connect it to a mains table lamp and simply by whistling it will activate the light.

The specified relay can be used to switch up to 3A a.c. inductive loads. However if you intend to switch mains appliances the unit must be housed in a fully enclosed Earthed metal box and the supply must be suitably fused. *Do not* attempt to switch mains appliances unless you are experienced in wiring to the mains – *it can kill!* Remember that if you connect a mains appliance mains voltages are then present on the p.c.b. □



The prototype unit, the circuit and relay have been changed in the final version.

MAILTECH

ELECTRONIC COMPONENTS

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MB5	150	100	60	£2.35
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20 ASSORTED FULL SPEC LEDS. Various shapes and colours £1.00

ALARM CONTROL UNIT

Single zone alarm control unit built into a domestic light switch box. Ideal for home, caravan, boat, garage, shed etc.
Facilities: – Normally closed loop for pir sensors, door/window contacts etc.
Normally open loop for pressure mats.
24-hour loop for personal attack button
Visual indication that the system is operational.
Automatic entry/exit delay.
Automatic system reset.
Alarm output cmos logic level.

SIREN
12 volt dc for external use
115db £8.95
BELL BOX
A plastic bell box cover supplied with backplate. Red/yellow/white or blue £6.95 each

PRICE COMPLETE WITH FULL INSTRUCTIONS £8.95
BELL/SIREN INTERFACE BOARD COMPLETE £3.95
BELL/SIREN INTERFACE PCB ONLY £1.50

PASSIVE INFRA-RED ALARM SENSORS

SUB-MINIATURE PASSIVE INFRA-RED SENSOR ONLY £5.95
Brand new passive infra-red sensor, measures only 33mmW x 24mmH x 29mmD. Logic level output. Full data and application notes supplied.

EX INSTALLATION SENSORS tested working.
Type 1. Measures 180 x 112 x 70mm with walk test led, relay output and tamper protection. 12 volt dc supply required £8.50 ea
Type 2. As above but a smaller unit 123 x 62 x 50mm £11.75 ea

DOOR/WINDOW CONTACTS
Surface or flush mounting, white £1.10 ea
JUNCTION BOX
white 6 way 60p

Please note: There may be variations in the size of the above passive infra red sensors depending on stock at the time of ordering. But the unit will certainly be within the stated sizes.

DUAL TECH SENSOR Microwave and passive infra-red combined. Separate led indication for each function. Measures 120 x 75 x 50mm. Relay output 12 volt dc tamper protection £29.95 ea

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SOLAR CELL 2 volt 150mA max, size 60 x 100mm £1.35 ea 5 for £6
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Standard on/off £1.00 each
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PIEZO VIBRATION SENSOR
with data sheet £1.00 each

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173 X 65mm 840TP £5.25 each
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28 pin zero insertion socket £5.95 each
SOLID STATE RELAY
Switch mains up to 7 amp 12 or 5 volt control voltage both types £2.95 ea

6 VOLT NI-CAD PACK 5AA NI-CADS, fast charge type £3.95
CAPACITOR 10,000 mfd 25 volt with fixing clip 60p each
CAPACITOR 470 mfd 400 volt £1.50 each 4 for £5.00
CAPACITOR 0.1mfd 63volt 6p each **10** for 50p
EPROMS 27C256 – 30 27C512 – 25. Once programmed but never used eprom. Mounted on a plastic carrier, can easily be removed from the carrier or used with a low insertion force socket.
27C256 £1.00 each 6 for £5.00 **27C512** £1.20 each 5 for £5.00
Suitable low insertion force socket 28 pin 40p ea 3 for £1.00
MULTITURN PRESETS 20mm RECT, 500R, 1K, 5K, 10K, 20K, 50K, 100K 1MO. 40p ea, 3 for £1.00

All prices include VAT.
Please add 75p carriage to all orders

EVERYDAY NEWS

Regional semi-finalists for the Toshiba Year of Invention have recently been announced. There are forty-four in all and among them are a number of young invertors, with electronic innovations.

FENCING TARGET

In common with most novice fencers, 16-year-old Katherine Brown from Raynes Park in London found that she had problems co-ordinating her speed and point control. During practice at Wimbledon Fencing Club, she came up with the idea of a fencing "dartboard" and developed it into the Electronic Point Efficiency Exerciser (EPEE). Now her invention has won Katherine a place in the regional semi-finals of the national Toshiba Year of Invention competition, organised by the Confederation of British Industry.

"There is no value in being faster than your opponent if you keep missing him," she says. *"Nor is it much good being perfectly on target if he has time to parry you. At present, the only way to achieve both point control and speed is through boring and repetitive exercises."*

Fellow club members had rigged up a number of training devices involving golf balls on strings and electric bell pushes, with varying success. *"None of these was very effective because the fencer could choose the area to attack, thus removing the element of surprise that forces you to make split-second decisions,"* said Katherine. *"I began to develop an alternative as part of my final project for GCSE craft, design and technology."*

EPEE is an electronic target or lunging pad, powered by a six volt battery. It uses a system of logic gates, a binary counter and a pulse generator to indicate an area of the target to be attacked, limit the time available for that attack and provide a response to the success or failure of the attack.

Accurate judging in fencing competitions is now achieved through the use of electric foils, stainless steel lamé jackets and body wires connected to score boxes.

Katherine used this technology as the basis for her invention. *"My design is a padded rectangular board, about 60cm by 40cm, covered in a grid pattern of lamé fabric,"* she explained. *"There are lights at the corners of each fabric rectangle, which flash on and off."*

"If the fencer's electric sword comes into contact with the target area, buzzers sound and a bulb lights up. If he/she misses, nothing happens, but other rectangles continue to flash in sequence. The time limit can be slowed down or speeded up to allow beginners or experienced fencers to use the device."

At the moment, Katherine's electronic lunging pad stands against the wall to prevent it from retreating under impact, but she is investigating other support methods that would also retain height adjustability for use by children and the growing number of wheelchair-bound fencers. With the increasing popularity of fencing worldwide, she believes there is a large potential market for her invention.

Now about to embark on her A-levels at Tiffin Girls School, Kingston-upon-Thames, Katherine has set her sights on a career in nuclear physics.

SWITCH MODE AMP

Other regional finalists include Swansea schoolboy, Jonah Nuttgens who has designed a new lightweight power amplifier ideally suited for miniature hi-fi and disco equipment.

Fourteen-year-old Jonah, who lives at Reynoldston and attends Bishopston Compreshensive School, said he got the idea for the switch mode power amplifier from a light dimmer circuit layout in an electronics project book.

"The main benefits of a switch mode amplifier are that it is cheaper, smaller and lighter than a normal amplifier, because it does not require a large heatsink or a large transformer – both expensive items. This makes it ideal for use in miniature hi-fi's – and easier to transport for discos and stage amplifications. It is 'environmentally friendly' because it uses less electricity."

He explained that in a normal amplifier the voltage sent to the loudspeakers is controlled by changing the resistance of two transistors. It is the resistance of the transistors that causes heat to be generated. In his switch mode design the output transistors are switched on and off many thousands of times per second, giving an output voltage proportional to the time the transistor is kept on. Because the resistance of the transistor is either very high or very low, very little heat is produced.

TEXT PHONE

Richard Mead, 16-year-old schoolboy from Cheltenham College, has for the second time, won a place in the regional semi-finals of the competition. Last February Richard received £5,000 as winner of the schools category for his Powersave energy monitor. His new idea, called Textcall, is a design for a simple-to-use telephone for people with hearing difficulties. Although most learn to lip read and use sign language, the telephone presents an additional problem.

Up to now telephone communication has been almost impossible, the only solution being the use of a textphone or computer modem link, where the user types his or her message into a computer, which is then transmitted via telephone modem to a terminal at the other end of the link. Such systems are expensive, cumbersome and require a unit at each end of the telephone link.

Richard Mead's Textcall requires only one unit at one end of the telephone line. It does not require a transmission unit as messages are sent using the dialling tones of an ordinary tone-dialling 'phone.

The number keys one to nine on a 12-button key pad of the telephone each represent three letters of the alphabet. The bottom three keys, the star, zero and hash symbols are used to identify which of the three letters was meant. A simple sequence of two presses per letter is used to enable rapid transmission of any alphabet letter.

The tone sequences are received by a Textcall unit attached to the ear piece of the non-hearing person's telephone, which decodes these sequences into letters and words, and then displays them so that they can be read. Assuming the non-hearing person can speak and the original sender can hear, the message can be answered verbally. If not, a second Textcall unit can be fitted, enabling two-way communication between two deaf people.

Richard had the bright idea for Textcall when his sister complained about the difficulty she had communicating with a deaf friend outside school time. He began working on his idea as a GCSE electronics project and has now developed a prototype receiver and hopes a microprocessor will eventually carry out the basic logic functions of the unit.

He says his idea is principally for use by deaf people and hopes to interest the Government and other organisations who spend considerable funds installing complicated systems to help these people.

Textcall requires nothing more than one unit, a regular telephone and several keypad overlays which are distributed to those who might call the user, showing them how to send each letter. Richard believes there is nothing available to complete with its simplicity or value for money.

FINALS

Regional judges will be visiting all the semi-finalists, chosen from 4,333 entries. Regional finalists will be announced during September, each of whom will win Toshiba equipment worth approximately £2,000 and at the judges discretion, financial assistance to help develop their inventions for the finals.

The Toshiba Year of Invention, now in its fifth year, offers total prizes valued in excess of £100,000.

POCKET-SIZED EPROM ERASER

A new compact and lightweight UV EPROM eraser, specifically designed for technicians in the field and electronic enthusiasts has been launched by Ultra-Violet Products Ltd. The portable DE-1 can erase EPROMS in about two minutes, is battery-operated and easy to use.

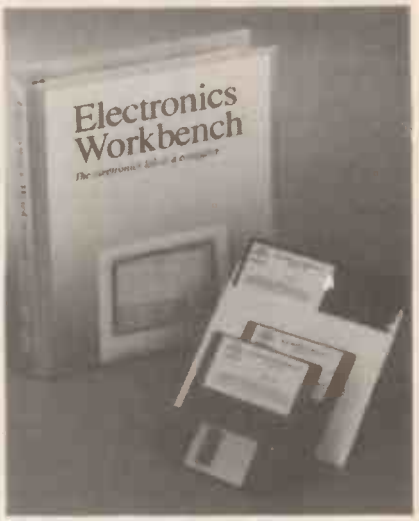
Depending on their size, three to eight EPROMS are simply placed on the eraser's foam padded tray and a UV lamp unit is lowered onto the components. A specially tailored vertical sliding mechanism helps the operator to adjust the lamp to the correct height above the EPROMS.

Weighing only 335 grams and measuring just 3.8cm x 8cm x 17.5cm, the DE-1 readily fits into a pocket or tool kit and is particularly useful when a mains power supply is not at hand. The 4 watt, 254nm UV light source is powered by four standard batteries which operate for at least five hours. The DE-1 retails at £22.00.

Ultra-Violet Products Ltd., Dept. EE, Science Park, Milton Road, Cambridge CB4 4FH. Tel: 0223 420022. Fax: 0223 420561.

CIRCUIT SOFTWARE

DEVELOPED by Interactive Image Technologies Ltd., based in Toronto, Canada, *Electronics Workbench* is a powerful software program that allows electronics students and enthusiasts to build and simulate analogue and digital circuits on a computer. The components are those found in any electronics lab and the traces on the simulated instruments are the same as you'd get on real equipment – at a fraction of the cost.



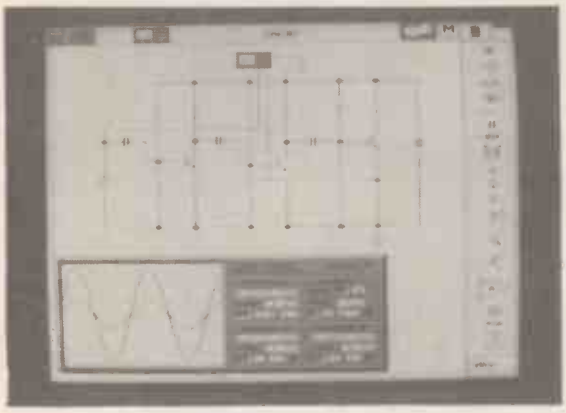
The software consists of two modules. The analogue module simulates the analogue parts and instruments. The digital module provides ideal digital parts and instruments needed to build and test logic circuits.

Both modules are claimed to be simple and intuitive to use with the same click-and-drag interface. If the circuit gets too big for the screen you can scroll and keep building. Because the wires are routed automatically and a grid is available, even complex circuits are readable. All commands can be issued from menus with a mouse, and common operations also have keyboard short-cuts.

You can cut, copy and move groups of parts, or put parts into a "black box" called a macro. Even put one macro inside another to simplify complex circuits. Macros can be used simultaneously in many places in a circuit, and are stored in the parts bin for later use.

Analogue Module includes: SPICE simulation; Transient and steady-state analysis; Resistors, capacitors, inductors, transformers, diodes, Zener diodes, bi-junction transistors, l.e.d.s, bulbs and fuses; A.C. and D.C. voltage and current sources; Function generator for square, triangular and sinusoidal waves; Multimeter; Dual-trace oscilloscope (1Hz to 999MHz); Bode plotter (–200 dB to + 200 dB).

Digital Module includes: Simulation of ideal logic; AND, OR, XOR, NOT, NAND and NOR gates, RS, JK and D flip-flops, half-adder, seven-segment display, l.e.d. and voltmeter; Word generator (16 eight-bit words); Eight-channel logic analyzer (hexadecimal and graphical display); Logic conversion (gate, NAND gate, truth table and boolean expression representations); Logic simplification (Quine-McClusky).



Various versions are available to suit a range of PCs and monitors (including a Macintosh Version). The single user Professional Version costs around £190. For more information contact LJ Technical Systems, Dept EE, Francis Way, Bowthorpe Industrial Estate, Norwich, NR5 9JA. Tel: 0603 748001. Fax: 0603 746340.

COMPACT I.C. TEST

The ChipMaster Compact from ABI Electronics Ltd is claimed to be the first 40-pin full functional i.c. test incorporated into a battery operated handheld unit.

The unit features a single wide entry zero insertion force socket which accommodates all d.i.l. packages while the integral dot matrix l.c.d. display shows test results, i.c. function and pin data. The unit accepts i.c. codes directly from the keypad or will perform a search to identify the device from their characteristics.

It is claimed that unknown, unmarked and housecoded devices can thus easily be identified and tested. Intermittent and temperature related faults are easily found using conditional loop modes. The ChipMaster Compact has many applications anywhere where verification of an i.c. is required. It costs less than £300.

The ChipMaster Compact is based on the ChipMaster product which ABI has been marketing for two years. It has enjoyed considerable success in diverse markets from research and development to quality and education. This development extends its application to those areas where portability is important.

ABI Electronics Ltd., Dept. EE, Mason Way, Platts Common Industrial Park, Barnsley, South Yorkshire, S74 9JG. Tel. 0226 350145 Fax. 0226 350483.

MICROSOFT COMPLAINT UPHELD

Last month Barry Fox took Bill Gates and Microsoft to task in *For Your Entertainment*. Barry also mentioned that he had made a complaint to the ASA concerning Microsoft's advertisements for Windows 3.0 Microsoft claimed that the average time a computer user takes from scratch to master Microsoft Windows 3.0 software was two hours thirty minutes, Barry disputed this and, not surprisingly in our view, the ASA upheld the complaint.

Apparently Microsoft have agreed to amend the advertisement if it is used again – maybe they would do better to spend the time on improving the product! Egg on face for Microsoft and their advertising agency Ogilvy and Mather Advertising. Well done Barry. Another step in the right direction for usable software.

By the way our computer left the last line off Barry's piece last month (human error not software this time). The missing words are "had trouble with an earlier version". If you are still looking for the ending – sorry.

21 YEARS FREE COMPETITION

As a small "advanced" celebration of 21 years of EE we present an easy to enter FREE competition.

Just for those readers that actually read each page – and have done so since the first issue – we have a bit of fun and a dozen new Maplin Catalogues to give away. Thanks Maplin for the prizes.

All you need to do is to send in, on a postcard or the back of a stuck down envelope, the name of the author of the first *Teach-In* and the author of the first *Shop Talk*. Yes both titles have been running since issue No. 1. in November 1971.

As a tie breaker the "dancer" (we use the term loosely) on page 36 of issue No. 1 is the present editor, suggest what he might be saying. Keep it clean, we will publish the best/funniest (if any) and give the names of the prize winners in the December issue. All entries to our editorial address (see page 619) by October 7th 1992.

So come on all you long standing readers let's hear from you.

FOR YOUR ENTERTAINMENT

by Barry Fox

Doomed CD-ROM

Every day I become more sure that there is no mass market future for CD-ROM as a PC peripheral. The system is fine for "vertical" applications, where the PC and ROM drive are set up to run one piece of business software. But any attempt at using the same PC/ROM hardware "horizontally", to run a variety of ROM discs, is doomed to failure.

The root cause of the problem is the "open architecture" of the PC world. With no tight standard specification for competitors to follow (like the standards for music CDs, cassette tapes or mains voltage) hardware and software from different sources will be just sufficiently different to make compatibility a matter of pot luck.

Virgin's software division recently sent me a copy of "North Polar Expedition", a CD-ROM based on expeditions by Sir Ralph Fiennes. I did as the instructions told me and typed "Go" at the DOS prompt for the ROM drive.

The screen went blank and threw up an error message. "Sorry, you have insufficient memory". But my 386 PC has two megabytes of memory, and QEMM memory management to make the best use of it.

The error message on screen told me to try typing "NP", which I did. The computer then locked itself into a cycle of displaying "Invalid directory" over and over again.

After a cold re-start I tried running British Telecom's Phone Disc CD-ROM of telephone directories, just to check that the sytem was not faulty. Phone Disc ran smoothly.

I also tried running the Polar CD-ROM from my multitasking software, Desqview. I got the same error message, but this time the whole system crashed.

On re-booting I found a string of problems. The crash had corrupted a large and valuable data file. Luckily I had a recent back-up so only lost a few entries. But the crash had also corrupted the MSCDEX extension to the MS-DOS operating sytem which is needed to control a CD-ROM drive. It had also corrupted the .EXE file for my wordprocessor.

It took me four hours to find backups and original source file discs, and rebuild the hard disk. I may yet find other files which the crash corrupted.

The instruction manual for the Polar CD-ROM has a section on troubleshooting. It tells me to go through my Config and Autoexec files, looking for drivers to remove. I should also reduce the number of files and buffers. And because other software will need more files and buffers, I should keep and load a special copy of my Config file for running the Polar CD-ROM.

Hey, I've got a better idea. Why don't I leave things as they are and not bother to run the Polar CD-ROM.

If I want to run the Polar progam I will wait until it is available on a "closed architecture" system, like CD-I, where the hardware and software specification is so tight that any program disc is guaranteed to run on any hardware system. I look forward to the day, too, when manufactures will build CD-I players into TV sets, where they surely belong, along with a plug in keyboard to make searching for text data far easier than with a mouse and on-screen menu.

Not A Lot Of People Know This!

It is now nearly two years since unified Germany stopped using SECAM for what had previously been East Germany, and switched to PAL. This happened without any publicity. Even the date of the transition is hazy. Some say January 1991. Others are more specific and say the switch was thrown on 9 December 1990.

What matters is that by 1991 SECAM was out of Germany. It was was out because it was out of the question for Germany, the country which had invented PAL, to go on using France's SECAM anywhere in its new territory.

The change was easy for the East German broadcasters. Many were already using component video studio equipment which needed no conversion. It was only necessary to convert a few transmitters.

All the West German transmitters serving the border areas and Berlin were already beaming PAL programmes into the East. And the East had long since given up trying to stop people watching Western TV, for instance by tricking young schoolchildren into drawing the clock which they saw on their TV screen at home; the East and West used different clocks. It is now very hard to buy new professional SECAM equipment from previous suppliers Thomson and BTS.

There were few complaints from viewers. Since the Eastern authorities relaxed their grip on TV viewing, many people in East Germany had already bought dual standard TV sets capable of receiving PAL and SECAM. They had been using them to watch West German TV programmes which were far more interesting than the drab political diet authorised in the East.

Many people were flush with hard currency exchanged for the toy money previously used in the East. With their new money some bought cheap PAL sets brought in from China. Many bought European sets made by Grundig, Thomson and Philips. Others bought Japanese equipment.

So 1991 was a boom year for the electronics companies in Europe. This disguised the downwards spiral which is best shown by the offtake (that's sales and rental deliveries to homes) of colour TV sets in the isolated UK.

The UK offtake in 1983 was 3.32 million. By 1988 it had climbed to 4.43 million. The number has fallen each year since then, to 3.33 million in 1991, and is expected to be lower again this year.

The East Germans who could afford a TV set have now bought one and there is no more free money to spend. Many ex-Easterners are out of work because the industries they worked for were uncompetitive and folded. So they have little hope of earning spare cash. The manufacturers had geared up to a longer boom and ended up overstocked and filling their warehouses.

This is why German broadcast research facility IRT is now hatching plans to switch other Eastern bloc countries from SECAM to PAL. The most likely first on the list is Czechoslovakia.

In France many sets are already dual standard, PAL and SECAM. French viewers watch PAL programmes from all the surrounding countries. There would be no great problem in switching France from SECAM to PAL, and it would generate some extra sales. But politically it would be dynamite for France to abandon the home-grown system it originally adopted to try and protect its national industry.

Constructional Project

VERSATILE INTERCOM

I. A. DUNCOMBE

A single "master" design, with good quality audio, range over 30m (100 ft), that can be linked to as many identical stations as required. A "conferencing" set up is also possible

INTERCOMS come in various shapes and sizes, from the simple two station connected by wires types to the more elaborate f.m. multi-station wireless types. All have their advantages and disadvantages, some of the more pertinent are compared below:

Two Station A.M. Wire Connected

1 Simple electronics, often using the loudspeaker as the microphone leading to poor quality.
2 Incapable of being expanded. The master may call the slave and the slave may call the master, but a slave may not call another slave, if one was to be connected.
3 Does not suffer from any mains-bourne interference.
4 Extremely cheap and cost effective.

Two Station F.M. Wire Connected

1 More Complicated electronics but slightly better audio quality.
2 and 3 As above.
4 Not particularly cheap but still worthwhile.

Two Station A.M. Wireless

1 Much more complicated electronics having to modulate the audio onto the mains supply.
2 As above.
3 Severe interference from mains click's and pop's. Could also itself cause interference to other sensitive devices connected to the same mains supply.
4 Much increased cost with no real advantages over wire connected types.

Two Station F.M. Wireless

1 Complex electronics but vastly improved audio quality.
2 As above.
3 Not subject to any interference but could still cause interference itself.
4 Cost is high but probably the ultimate in intercoms.

MULTI-STATION INTERCOMS

Up till now we have not considered multi-station systems. These are vastly more complicated either in the connection between each unit, or in the case of wireless types, the electronics.

A simple system consisting of, say master and several slaves are a distinct possibility for wire connected units, but only the "normal" operation of master-to-slave or slave-to-master is possible. A slave cannot call another slave. In this instance of course the wiring between each unit is much more complicated.

With a.m. wireless systems the situation is on one hand simplified and on the other more complicated! As of necessity, each unit must be a master, that is, each unit must be capable of sending and receiving independently. This makes it easier for any unit to call any other unit.

On the other hand only one connection, or conversation between any two units can take place at any one time. Any other unit wishing to call will interrupt the existing connection.

This disadvantage is easily rectified if an f.m. system is used. Since the audio signal must be modulated onto a sub-audio signal and then passed through the mains, it is easy to select different send and receive frequencies for each master unit. In this way multi-connections can take place over the same mains supply.

VERSATILE INTERCOM

The design presented here does not pretend to overcome all the disadvantages set out above, nor is it the ultimate in design. It is essentially a single unit, or station which can be very easily expanded to as many stations as required.

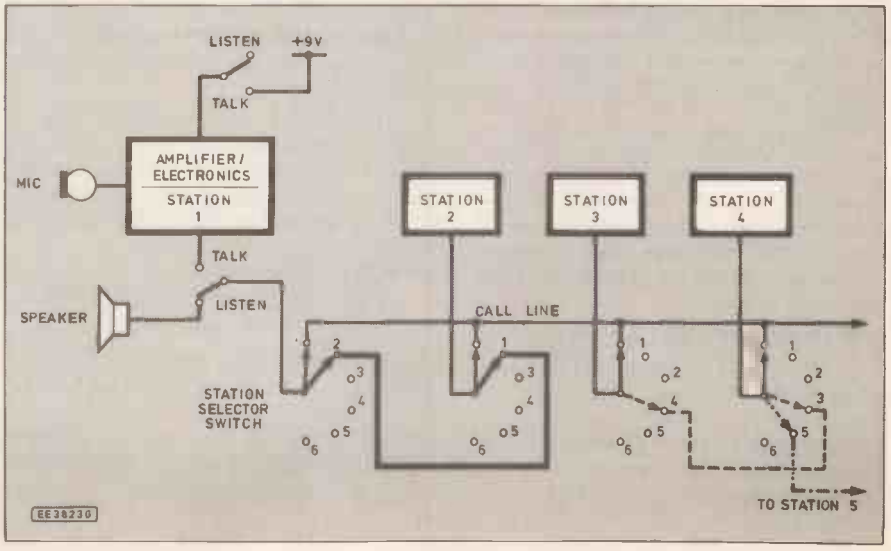
It does however possess several distinct advantages which, when compared with the initial cost rather outweighs the disadvantages:

1 Audio quality is particularly good, employing a microphone instead of using the loudspeaker to perform the same function. Surprisingly, this does not add any considerable cost to the unit as a whole.
2 Each unit is a master making several connections possible. Indeed even a "*conference*" facility is possible as we shall see later.
3 Interference is no problem.
4 Cost is moderately high but not excessive.

DESIGN CRITERIA

As mentioned earlier, one of the disadvantages of simple intercoms is the lack of

Fig. 1. Principle of operation of the Versatile Intercom.



good audio quality. This was the main requirement for this design, and was achieved by using a microphone insert instead of using the loudspeaker. The reason is often put down to cost, but a 90p microphone insert is hardly a worthwhile argument.

The second requirement was to be, to a certain extent, multi-station. As was indicated earlier, if each unit is a master then slave-to-slave communication is simple.

A third and important requirement was that each unit must be permanently *un-connected* to any source of supply voltage until each was used. It is often found in other intercom systems that the batteries or other supply are always connected, although obviously not drawing too much current.

In achieving this requirement the use of a power supply was a distinct possibility, eliminating the cost of buying batteries.

Each unit being a master and each having it's own power supply, the connection between each unit is made by three wires. This greatly simplifies the switching and allows the microphone to be permanently connected to the electronics, whilst the speaker is connected so that it is always in the "Listening" mode.

PRINCIPLE OF OPERATION

The principle of operation is shown in the system block diagram, Fig. 1. This shows one unit with the microphone permanently connected to the electronics and the simple on/off switching used. The loudspeaker is connected, via the station selector switch, to a common connection between all other units. We shall call this connection the "Call Line".

In the normal position the Listen/Talk switch is biased to be always in the listening mode and with the power source disconnected. Thus all units are "listening" on the "call line".

STATION-TO-STATION

Consider now if, say Station One wishes to call Station Two, this is shown by the heavy line. The user of Station One ensures that the Station Selector switch is set to the "call" position. He/she then switches the station to the talk mode and by pressing a switch causes a tone to be heard not only at Station Two, but *all* other stations connected to the system.

By announcing after the tone with whom he wishes to communicate, it should be clear to other stations listening who is being called. Once Station Two answers, each station then selects the appropriate position on the selector switch and a private conversation will have been set up.

Now consider if say Station Four wishes to call Station Three, this is shown in the diagram by the dotted line. Station Four follows the procedure just described for calling, and once Station Three replies, each set their station selector switch to the correct position. Thus, two *independent* conversations have now been set up on the same circuit.

CONFERENCING

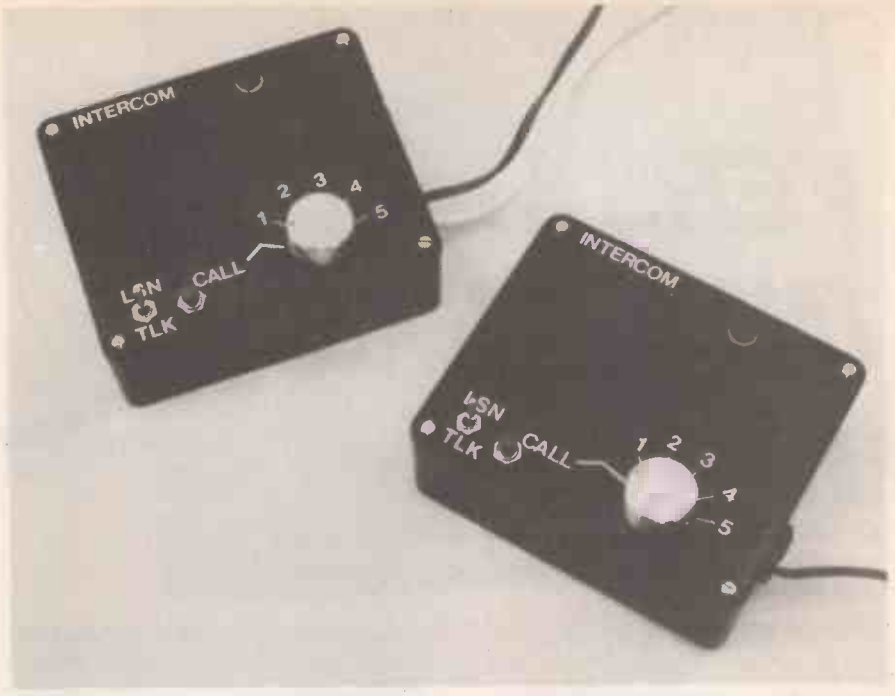
The conference facility is a little arranged, but is the best that could be accomplished with such a simple switching system.

Assuming that Station (1) wishes to call a conference with Stations (2) and (3) but not (4). He simply follows the same calling procedure using the "call line". Once each station has replied they remain on the "call line" and the conference follows.

It is assumed that Station Four will very kindly set the station selector switch to an arbitrary position and not listen in! The conference facility is not private.

If more than four stations are on the circuit, it is quite in order for say, Station (4) to call Station (5) on the "call line", and then for each to set up their own private connection (dashed/dot line). Only a brief interruption of the "conference" will have taken place.

One disadvantage should now be apparent. If any station does not return the Station Selector switch to the "Call" position, it cannot be contacted further. The only way it could be called, is if the station previously in contact with it calls on the direct connection as shown previously by the heavy and dashed lines.



CIRCUIT DESCRIPTION

The full circuit diagram for the Versatile Intercom is shown in Fig. 2. The power supply circuits are shown in Fig. 3.

Two i.c.s are used as the basis, with IC1 operating as a pre-amplifier and IC2 as a power amplifier. Transistor TR1 operates as a tone generator.

Pre-amplifier

Resistors R1 and R2 form a potential divider applying about 1·5V to the condenser microphone insert MIC1. This voltage may

COMPONENTS

Resistors

R1	15k
R2	10k
R3	680
R4, R5	47k (2 off)
R6	22k
R7	12k
R8, R9	120 (2 off)
R10	1k5

All 0.3W 10% carbon film

See SHOP TALK Page

Capacitors

C1, C4, C8, C9	100n Mylar or polyester (4 off)
C2	560p polystyrene
C3, C5	4µ7 radial elect, 16V (2 off)
C6	100µ radial elect, 16V
C7	1000µ radial elect, 16V
C10	47n Mylar or polyester

Semiconductors

D3	5mm Red light emitting diode
TR1	2N2646 unijunction transistor
IC1	LF351 op-amp
IC2	LM380N audio amplifier

Miscellaneous

MIC1	600 ohm condenser microphone insert
LS1	8 ohm, 75mm dia. loudspeaker
S1	d.p.d.t., biased one way min. toggle switch
S2	1-pole 6-way rotary switch
S3	s.p.s.t. press-to-make switch

Plastic ABS case, size 118mm x 98mm x 45mm; stripboard, size 20 strips x 36 holes; control knob, 22mm diameter; l.e.d. mounting clip; screened cable; 8-pin i.c. socket; 14-pin i.c. socket; plastic screw terminal block, 7-way; connecting wire, hardware etc.

BATTERY VERSION ADD

B1	PP3 battery

PP3 battery clip; 12mm (½in) "Terry" clip

MAINS VERSION ADD

T1	mains transformer: 240V primary; 9V-0V-9V 100mA secondary
D1, D2	1N4002 1A 100V rec. diode (2 off)
C11	100n Mylar or polyester
C12	1000µ radial elect, 16V

Stripboard, size 10 strips x 20 holes; mains cable

Approx cost guidance only

Per Unit: £18 (Mains) £15 (Batt)

vary and is not too critical. The output from the microphone insert is applied, via the d.c. blocking capacitor C1 and input resistor R3, to the inverting input, pin 2 of IC1.

Resistors R4 and R5 bias the non-inverting input, pin 3, at about half the supply voltage, and C3 provides d.c. stabilisation, and also filters out any hum or noise on the supply lines. Capacitor C2 provides a slight amount of low frequency cut, improving the audio, which often sounds "muffled" with inexpensive intercoms.

Resistor R3 matches the impedance of the microphone insert, typically 600 ohms, to the inverting input, pin 2 of IC1. Together, resistors R6 and R3 set the gain of the i.c. at about 32.

Amplifier

The boosted output from IC1 is passed to the non-inverting input, pin 2 of IC2 via d.c. blocking capacitor C4. This i.c. has a fixed gain of around 40 and provides just a little less than one watt output. Capacitor C5 provides hum rejection, and capacitors C7 and C8 provide filtering of the supply lines for both battery and mains supplies.

The output from IC2 is connected via capacitor C6 and one half of the Talk/Listen switch, S1a, to the pole of S2 and hence to other units.

TONE GENERATOR

The tone generator, which is used to call other units, is based around a unijunction transistor TR1. A tone is required, as calling by voice may get lost in the background noise.

The circuit may look unfamiliar to many readers. It is a relaxation oscillator using a unijunction transistor. UJT's, as they are often called, are not found very often in designs nowadays so a detailed explanation will be given.

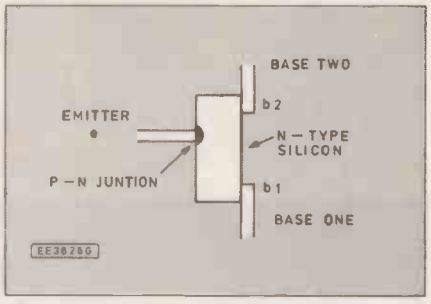


Fig. 4. Unijunction transistor construction.

Unijunction

First refer to Fig. 4, this is a schematic of a UJT. It has a single layer of, say, *n*-type silicon with two ohmic connections at each end, and a *p-n* junction near the centre. The two end connections are called base one (b1) and base two (b2), while the junction is called the emitter (e).

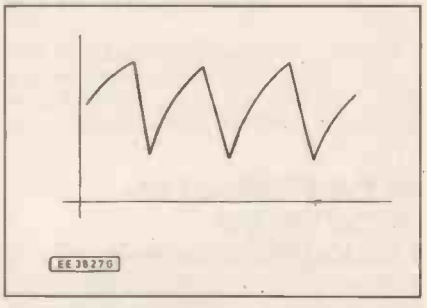
If the junction is reverse biased, the resistance between b1 and b2 is fairly high, having a typical resistance of >10k. By forward biasing the junction the resistance can be substantially reduced to just a few tens of ohms.

Oscillator

Refer now to the main circuit diagram Fig. 2. It is assumed that when power is first applied, capacitor C10 is uncharged and the emitter of TR1 is near 0V.

Current flows via R7 charging C10. As the capacitor follows the normal exponential law, a point is reached where the emitter junction becomes forward biased. At this point, around half the supply voltage, the junction conducts and the resistance between b1 and b2 falls.

The reduction in resistance allows the emitter junction current to flow to the most negative part of the circuit. In this case it is towards 0V. The emitter junction is effectively at ground potential and C10 discharges. This discharge causes a pulse to appear at the emitter.



Fig, 5. Oscillator saw-tooth output waveform.

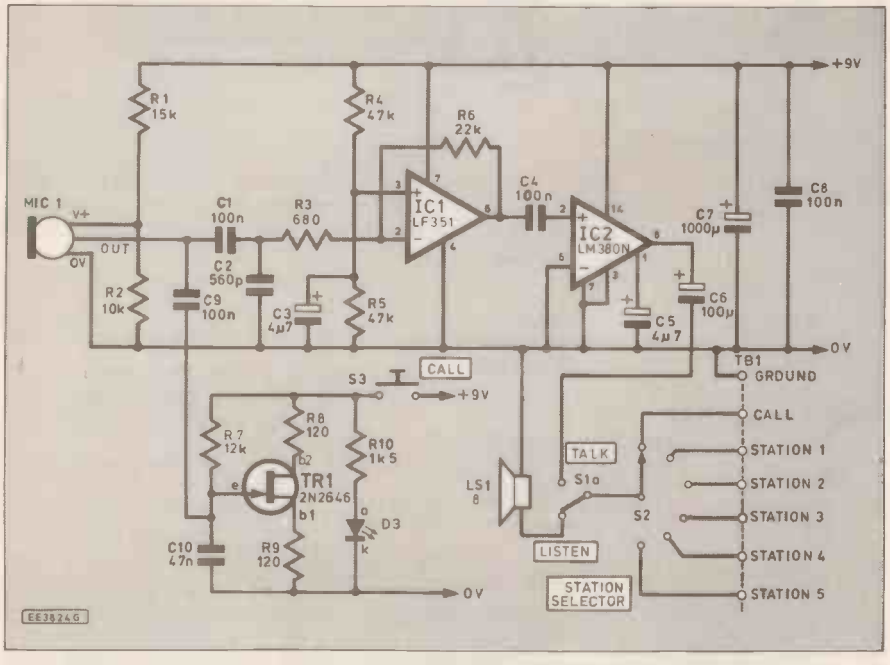


Fig. 2. Circuit diagram, excluding power supply for the Versatile Intercom.

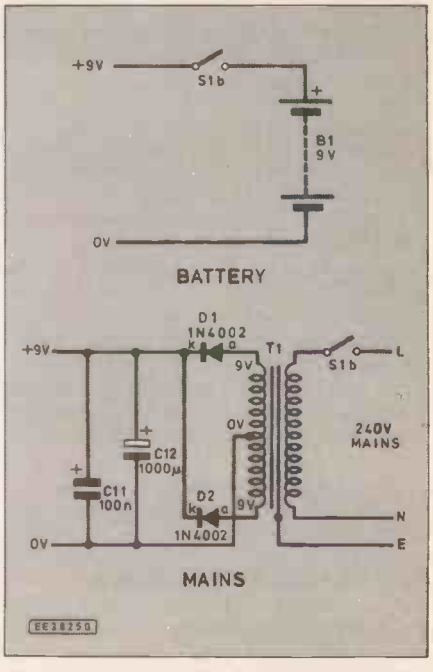


Fig. 3. Battery and mains power supply

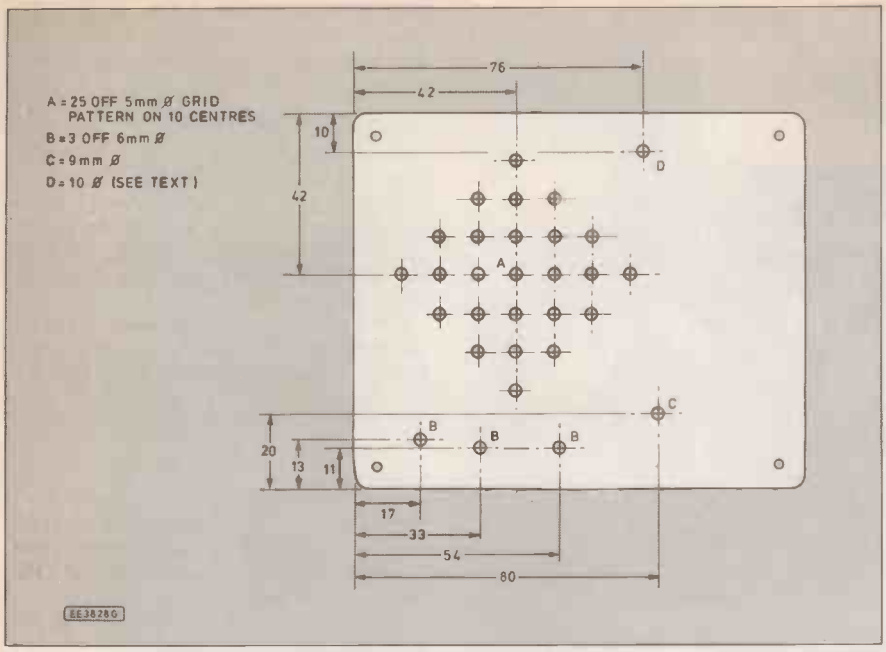


Fig. 6. Front panel drilling details for both versions.

measurements may of course be varied depending on the case you are using.

The grid pattern for the loudspeaker should however be adhered to. There is little to be gained increasing the size or number of holes to obtain a louder output.

Holes marked with asterisks are for the mains version only. The dimensions of the two upper holes will depend on the size of mains transformer you are using. The other two holes are used to mount the small power supply stripboard.

Holes marked "B" are for mounting the unit on the wall and could be omitted if desired. They are made by first drilling an 8mm hole and then by using a small needle file to file out the slot.

Make the hole for the microphone insert slightly larger than that indicated. Do not over enlarge though. Push the insert into the hole and secure using clear adhesive (Bostik or similar) on the underside of the panel.

For mounting the loudspeaker, carefully cut out a ring of cardboard equal to the speaker's diameter and about 5mm wide. Very carefully stick this to the loudspeaker using clear adhesive, carefully avoiding the actual speaker cone.

As the capacitor continues to discharge a point is reached where the junction potential falls below the turn-on voltage of TR1, and the resistance between b1 and b2 begins to rise. This increase in resistance allows the emitter potential to return back to its previous state and the cycle repeats.

With the values given the cycle repeats at a rate approximately equal to 0·8RC, and produces an audible output with a frequency of around 1·7kHz. The waveform generated, Fig. 5, is called a "sawtooth" and gives quite a "rasping" sound.

Push switch, S3 connects power to this part of the circuit momentarily, thus connecting the "call tone" to the input of IC1. The combination of resistor R10 and l.e.d. D3 provides a simple voltage monitoring circuit giving a rough indication of the state of the battery (if used).

POWER SUPPLY

The two circuit diagrams making up Fig. 3, show the details of the battery and mains circuits.

The basic intercom unit may be powered by either a battery or mains supply. Considering the typical use an intercom might receive in, say, a home environment, there is little to choose between the two.

Of course the battery is initially the cheapest, but in the long run it might be better to consider the mains version. Although the hum level may be inconvenient.

The battery circuit is self explanatory. The second half of S1 (the Talk/Listen switch), simply applies power to the whole circuit.

The mains supply consists of the mains transformer T1, used to step down the mains voltage, and diodes D1 and D2 provides a full-wave rectified d.c. output of about 9V. Capacitors C11 and C12 smooth the d.c. to provide a 9V output.

Notice that in this circuit, the mains supply is switched on and off by S1 (biased off – Listen). Thus in both versions no power is applied to the circuit considerably reducing running costs.

CONSTRUCTION

Construction is best commenced with the case. Drilling details for the case, as used in the prototype, are shown in Fig. 6 (front panel) and Fig. 7 (rear panel). These

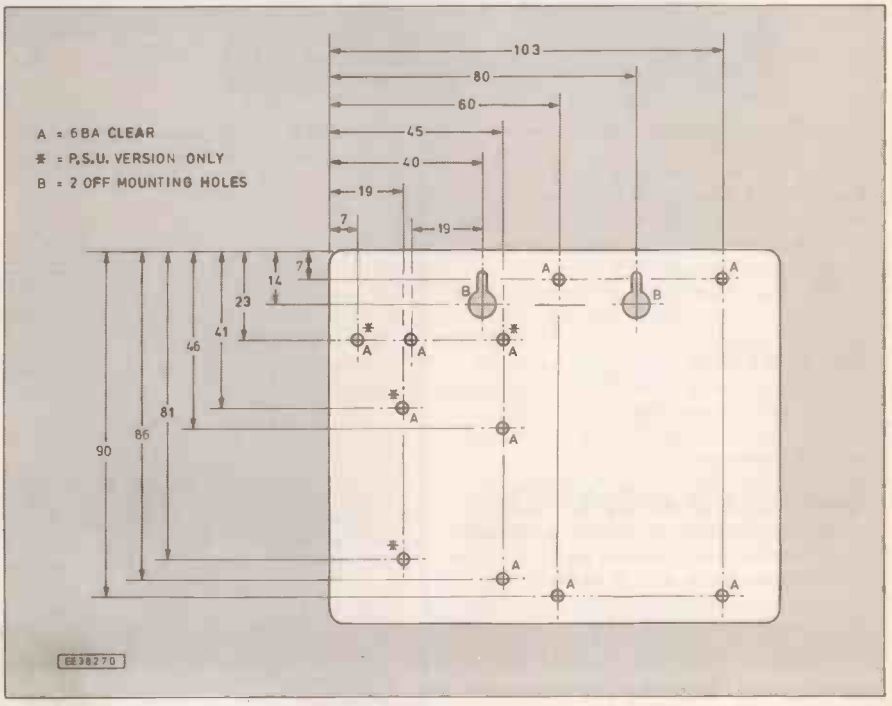
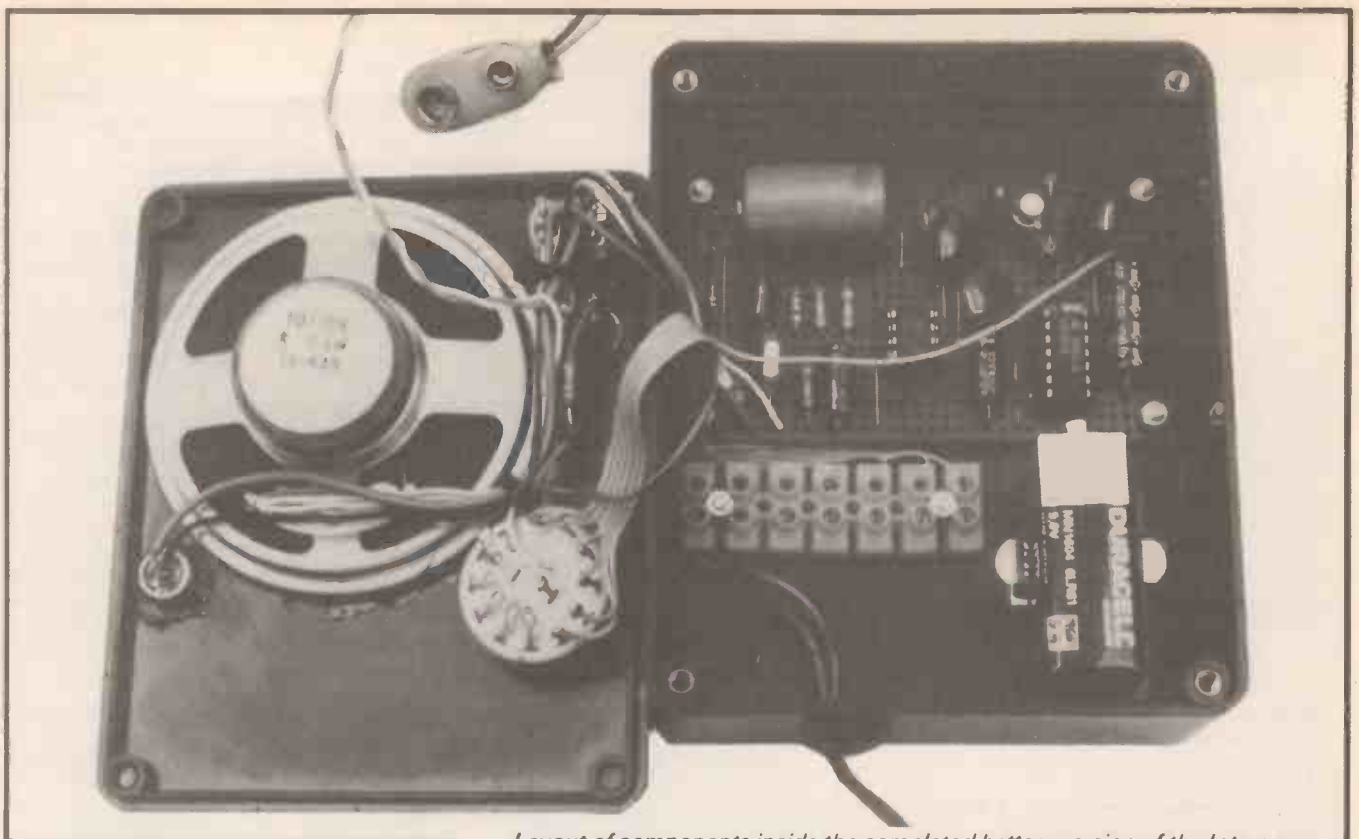


Fig. 7 . Drilling details for the rear panel.



Layout of components inside the completed battery version of the Intercom.

Allow to dry and then fix in place on the front panel using a similar method. The reason for doing this is to avoid damage to the speaker cone, if, for any reason the speaker needs to be removed.

The front panel can be lettered using dry rub-down transfers and then given a coat of clear varnish. Annotate as follows: S1 – LSN & TLK; S3 – CALL and S2 – CALL 1, 2, 3, 4, 5. You can then write the individual locations, bedroom, kitchen etc, of each station on a small piece of card stuck on the front panel.

CIRCUIT BOARD

The main circuit stripboard component layout and details of breaks required in the underside copper tracks is given in Fig. 8. Also shown are details of the small mains supply component board (Fig. 9), less mains transformer.

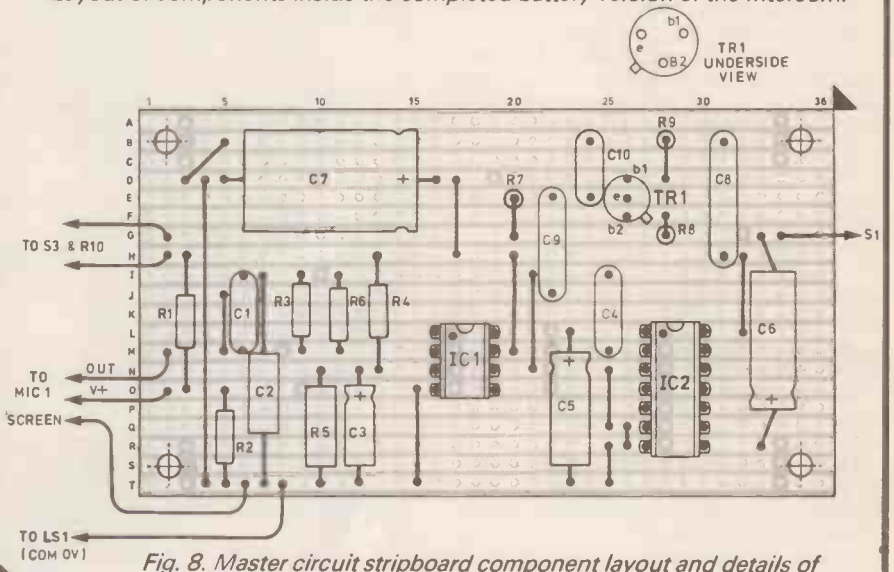


Fig. 8. Master circuit stripboard component layout and details of breaks required in the underside copper tracks.

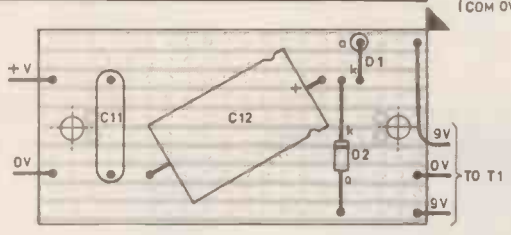
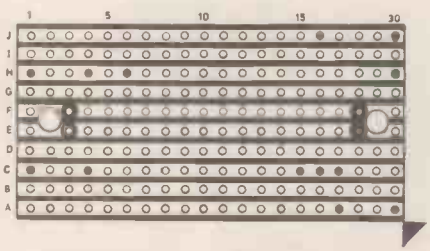
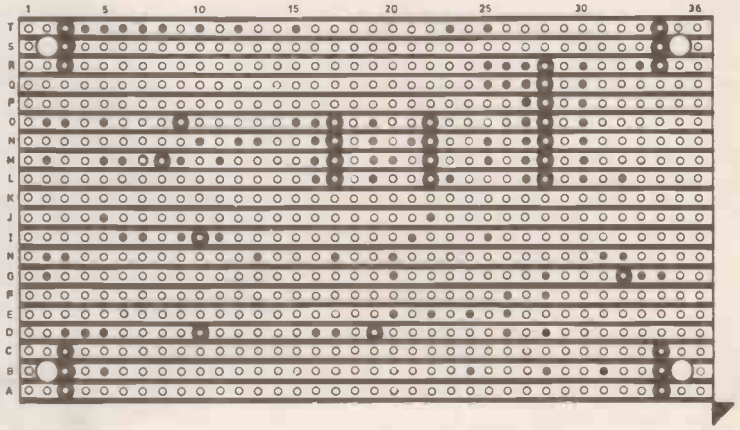


Fig. 9. Mains power supply (p.s.u.) stripboard component layout, less transformer.





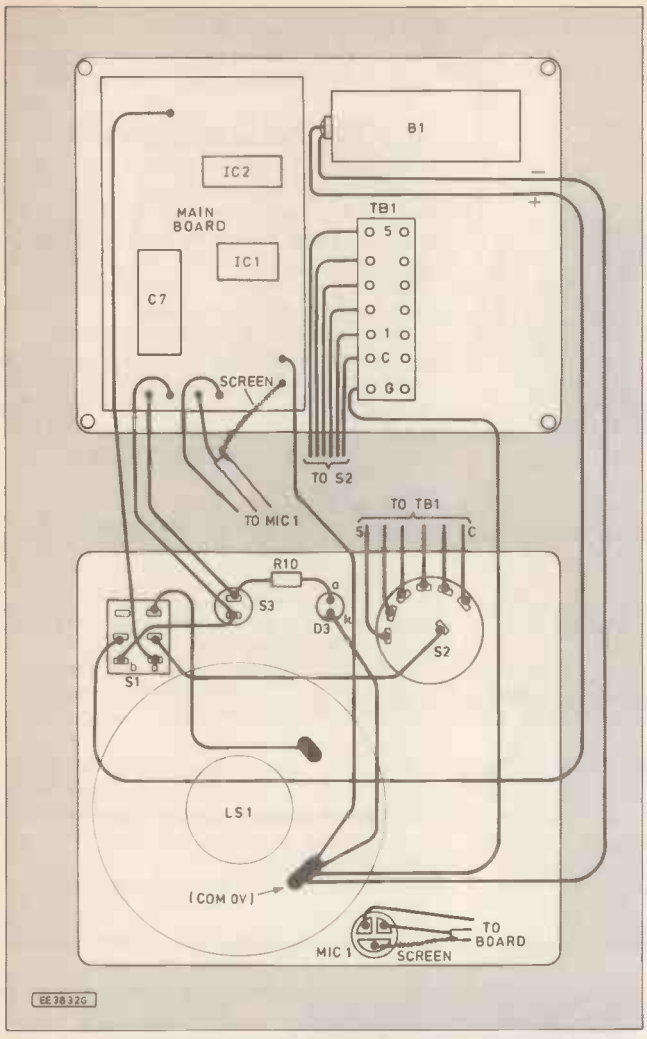


Fig. 10. Interwiring details for the battery version of the Versatile Intercom.

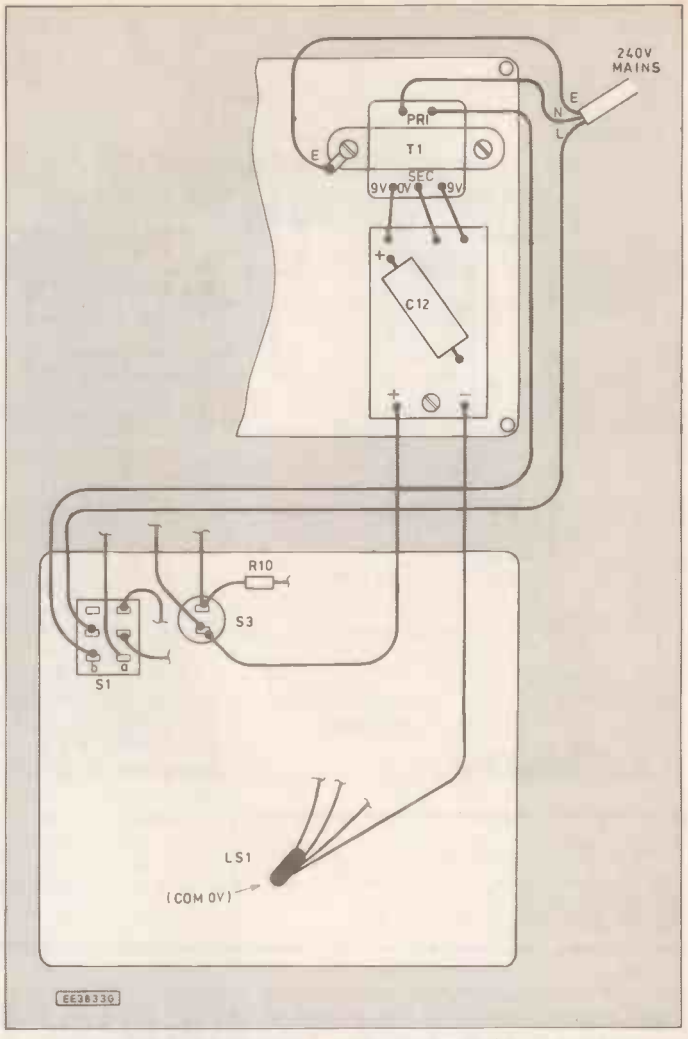


Fig. 11. Final interwiring for the mains version. It is important the S1b tags be covered with insulating tape.

Starting with the main circuit board, the mounting holes are drilled first and then the i.c. sockets are mounted. The breaks in the copper tracks under the i.c.s can be made at this stage, although it might be better to make the remaining breaks as construction progresses.

Wire links can now be fitted followed by the remaining components. Note that the positive end of C6 is in the opposite direction to the other polarised capacitors.

Off-board leads are made using stranded connecting wire about 15cm long. Use different coloured wire to aid identification later.

Turning now to the power supply board (see Fig. 9), follow a similar procedure as before – mounting holes and then copper breaks, finally followed by the other components. Observe the polarity of the diodes and the electrolytic capacitor.

FINAL WIRING

The final interwiring details are shown in Fig. 10. When making connections to the microphone insert try to be as brief as possible with the soldering iron, as the inserts can easily be damaged.

Ribbon cable or stranded wire can be used when wiring S2 to the 7-way screw terminal block TB1. The battery is held in place using a small "Terry" clip.

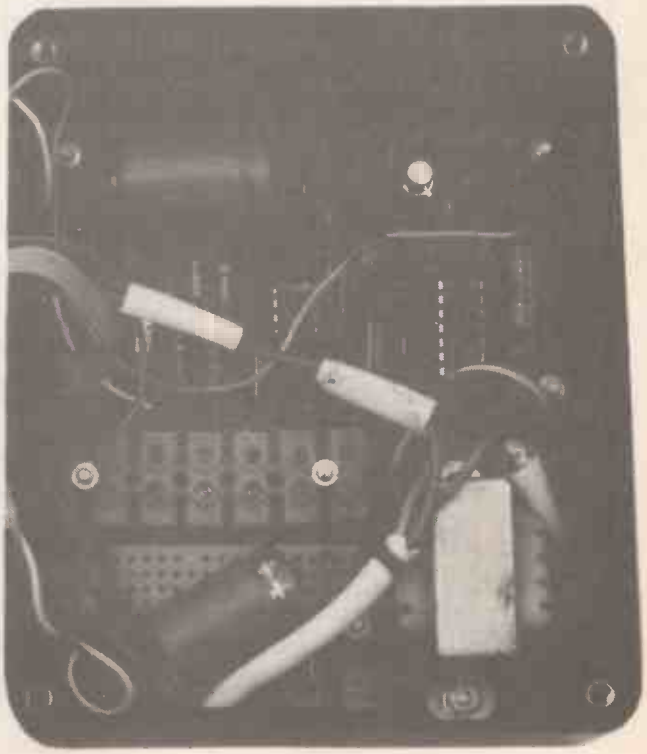
The stripboard is mounted using short spacers, rubber grommets or just a single nut. There is not a lot of space between the board and loudspeaker and some components on the stripboard may need to be bent over.

MAINS OPTION

The mains transformer and mains supply stripboard are mounted as shown using holes marked "A*" in Fig. 7. The mains cable can be rated at three amps. Remember to use a solder tag under one transformer fixing hole, to form an "Earth" connection.

It may be necessary to join the individual wires of the mains cable to those of the transformer. If this is the case, you *MUST* use sleeving over the joints. Also use sleeving over *all* the tags on switch S1b.

It is *essential* NOT to connect the wire from S1b to push switch S3 as shown in Fig. 10. Follow the layout shown in Fig. 11, very carefully, and *check thoroughly that mains voltages cannot touch any other part of the unit.*



Layout of components inside the mains driver version of the Versatile Intercom.

The mains transformer occupies the position of the battery and the p.s.u. board sits below the interconnecting terminal block. Compare with photo on opposite page.

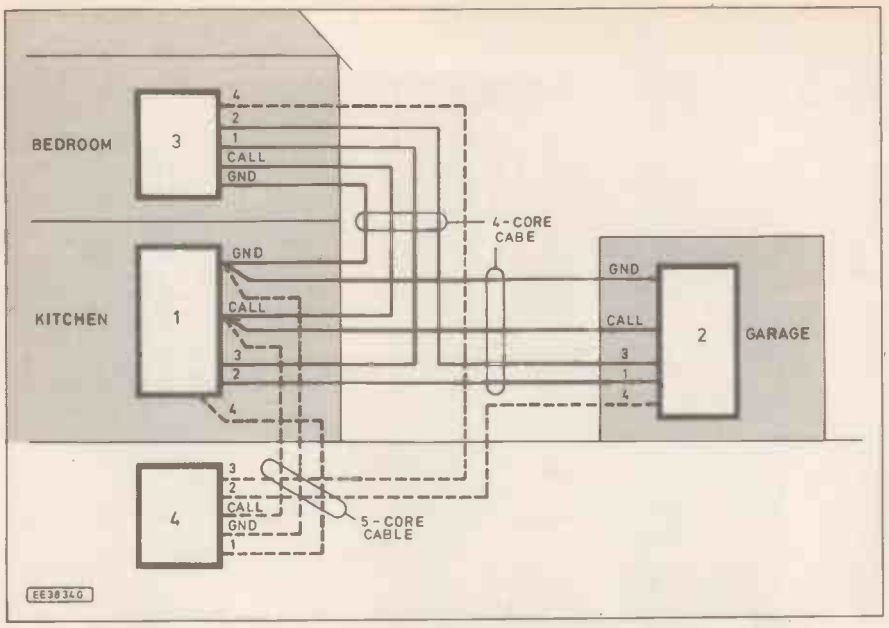


Fig. 12. Typical wiring set-up for a three/four station layout in a home.

Two holes are drilled on the right-hand side of the case to allow the mains cable and connection cable to other units to pass.

TESTING

It is advisable to test all the units (stations) before wiring them together. For this, a second person located some distance away is required. Connect the units together using just a pair of wires, between the ground terminals and the common call line.

Operate switch S1 on one of the units, some background noise should be heard in the second unit. Press and then release the Call button, S3, a tone should be heard. Speak near the microphone. It is not necessary to get too close – arms length is quite sufficient.

Ask the person at the second unit to do a similar test. That is, operate the Talk/Listen switch S1 and then, briefly, the Call button (S3). If you have constructed more than two units do the same tests with each one.

If all is well then the units can be located in their final positions and wired permanently.

TYPICAL WIRING

Choose the locations for each unit as required. A typical wiring layout is shown in Fig. 12. Four-core cable, perhaps telephone cable is all that is required to connect three units. Also shown are the connections required if a fourth unit is connected. In this case, five core cable is required.

None of the wiring need be screened, so any type of cable can be used. By careful routing of the cable around the house, the number of cores in each cable can be kept down to the number of stations plus one. So for five stations, 6-core cable is required.

IN USE

Much of the principle of operation has already been discussed, so just a brief reminder.

When you wish to call a particular station, make sure that the Station Selector switch (S2) is in the Call position.

Put S1 to the Talk position and press the Call button. If necessary announce after you release the button to whom you wish to converse. Release S1 to listen.

Once the station answers you can then either select the appropriate position with the selector switch to ensure a private conversation. Or if just a brief word or two, leave the switch as it is.

When finished, be sure to return the Station Selector switch to the Call position. □.

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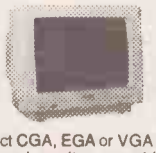

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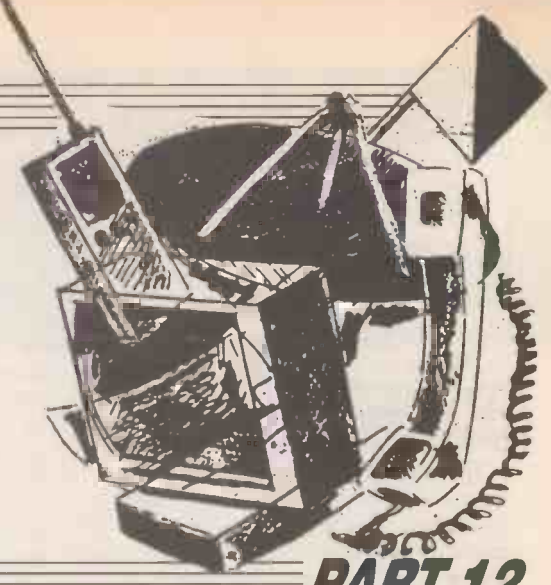


INFORMATION TECHNOLOGY

AND THE NATIONAL CURRICULUM

T. R. de VAUX BALBIRNIE

PART 12

THIS is the final article in a 12-part series concerning Information Technology, electrical measurements, electrical calculations and related matters in the Science National Curriculum.

This month we shall look at Ohm's Law, power calculations and potential dividers. We shall also discuss measuring instruments – ammeters, voltmeters and oscilloscopes – how they are used in circuits and the degree of trust we should put in their readings.

In an effort to avoid mathematical detail there have been, up to now, a few things left unsaid. The National Curriculum requires a knowledge of *Ohm's Law* and the ability to do *power calculations*. Students pursuing GCSE science, electronics, and technology courses need to be able to do this type of calculation.

ELECTRICAL QUANTITIES

There are two main electrical quantities which may be measured directly – *current* and *voltage*. Looking at it very simply, current is the *flow of electric charge* in a circuit (that is, it is related to the number of electrons passing a point per second). Electric current, then, is rather like *water* current.

Voltage, on the other hand, is the *driving force* which pushes the electrons along – this may be provided by a battery, dynamo, solar cell, etc. Voltage may be likened to the *height* through which water falls to make it flow.

It may be helpful to refer to Parts 2 and 6 in this series (December, 1991 and April, 1992 issues) since in these there was some basic information about simple series and parallel circuits. To measure the current (I) flowing through, for example, a bulb we use an *ammeter* connected in series with the circuit (see Fig. 1). The meter will then give a reading in amps (A). In practice the meter will often be a *milliammeter* measuring in *thousandths* of an amp (mA) or a *microammeter* reading in *millionths* of an amp (μA).

To measure *voltage* a *voltmeter* is used, connected in parallel with the circuit component in question. Fig. 2 shows three separate voltmeters being used to measure the voltage (V) across the battery and across each bulb in the circuit. Students should be encouraged to build these circuits and take readings, several things emerge. Firstly the current is found to be the same throughout a series circuit.

The ammeter could be placed anywhere and the reading would be the same. One common mistake is to think that the current becomes weaker as it flows through the various components. A practical point about traditional pointer-on-scale ammeters and voltmeters is that they are *polarised* – they must be connected the correct way round or the pointer will try to move backwards.

CURRENT IN A PARALLEL CIRCUIT

In a *branched* circuit (for example, the parallel circuit shown in Fig. 3) the current entering a junction is found to equal the current leaving. Suppose, for example, the readings A1, A2 and A3 on the milliammeters are 20mA, 15mA and 5mA respectively. The current flowing into point X (20mA) is the same as the total current flowing out of it i.e. (15mA + 5mA).

If we measure the voltage directly across the battery and across the individual circuit components (see Fig. 2) it is found that the supply voltage is equal to the sum of the voltages across the bulbs. For example, if the battery voltage is 6V, it may be found that 3.5V exists across one bulb and 2.5V across the other one.

Perhaps the biggest mistake made by students is to talk about the "voltage flowing" in a circuit. This is nonsense and anything which can be done to prevent it would be welcomed by the examinations boards. Unfortunately, "voltage flowing" is a term often seen in the media and even used by professionals who should know better. Only *charge* or *current* flow. Students must always be encouraged to say "voltage across".

OHM SWEET OHM

Ohm's Law relates the three main quantities – *current, voltage and resistance*. Resistance (measured in ohms, Ω) is a measure of *how difficult* it is for current to flow in circuit. Taking the water analogy one stage further, a high resistance is rather like a narrow-bore hosepipe – the water flows through it with difficulty. Large resistances are often expressed in thousands (kΩ) or millions (MΩ) of ohms.

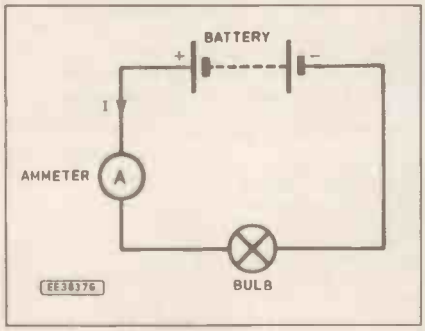


Fig. 1. Connecting an ammeter in circuit.

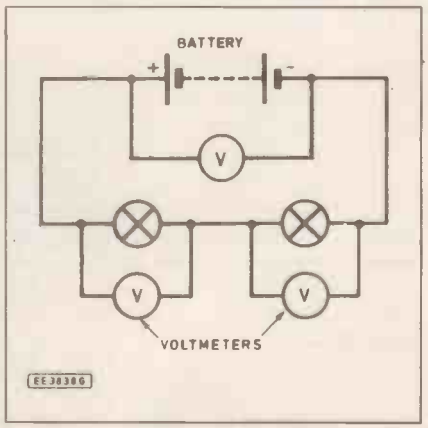


Fig. 2 Voltmeters connected in a circuit.

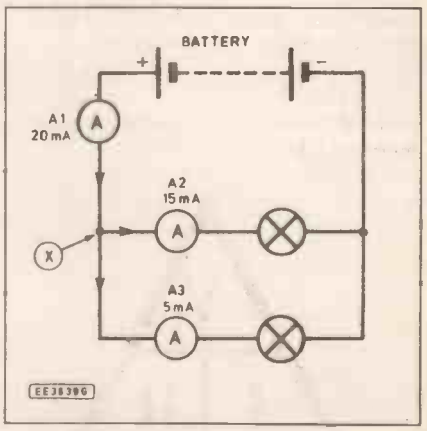


Fig. 3. Currents at a junction.

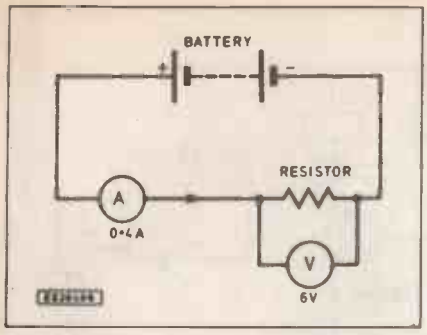


Fig. 4. Measuring voltage across a resistor.

The resistance of a circuit component is equal to the voltage across it divided by the current flowing through it – this is called *Ohm's Law*. Consider the circuit shown in Fig. 4. Suppose the current flowing through the resistor is 0.4A and the voltage across it 6V. The value of the resistor is given by:

$$R = V/I = 6/0.4 = \mathbf{15\ ohms}$$

We must be careful if the current is expressed in *milliamps* (mA) or *microamps* (μA) instead of amps. These would need to be converted into amps (by dividing by one thousand or one million respectively) before being used in the formula above. Similarly, if a voltage is given in mV (millivolts) this must be divided by 1000 to turn it into volts.

Examples: A 16V supply is connected to a buzzer and a current of 20mA flows. Find the resistance of the buzzer.

$$R = V/I = 16/0.02 = \mathbf{800\ ohms}$$

A 3V battery is connected to a resistor and the current flowing is found to be 15μA. Find the resistance.

$$R = V/I = 3/0.000015 = \mathbf{200{,}000\ ohms}\ (200k\Omega)$$

A 20mV supply is connected to a coil of wire and a current of 0.1A flows. Find the resistance of the wire:

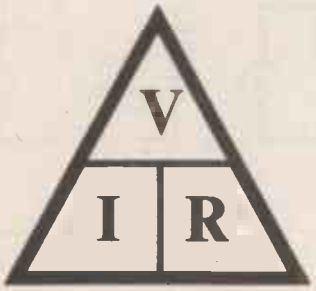
$$R = V/I = 0.02/0.1 = \mathbf{0.2\ ohms}$$

TRIANGLE

The foregoing is all very well if it is the *resistance* which is needed, knowing the current and voltage. However, it often happens that we wish to find the *current* or the *voltage* knowing the other two. For this, we use *swapped around* versions of Ohm's Law. Mathematically-inclined readers will have no difficulty seeing that these alternative versions are true:

$$I = V/R \text{ and } V = I \times R$$

Some students find *The Triangle* a useful memory aid:



The idea is to cover up the quantity to be found and *The Triangle* will tell you what you need to do with the other two.

In any Ohm's Law calculation, we must first be clear which quantity out of V, I and R we wish to find, check that we know the other two, then use the appropriate equation. Students should get into the habit of (a) stating the correct version of the formula they are going to use, (b) putting the numbers into it, (c) working out the numerical answer and (d) putting the correct unit at the end. In this way, if an error is made, any marks due for the *method* will be gained – in practice, this could be *most* of the marks.

Use *The Triangle* to check the following examples:

Examples: A 12V supply is connected to a motor of resistance 24 ohms. Find the current flowing in the motor windings.

$$I = V/R = 12/24 = \mathbf{0.5A}$$

A coil of wire of resistance 200 ohms has a current of 20mA flowing through it. Find the voltage of the supply.

$$V = I \times R = 0.02 \times 200 = \mathbf{4V}$$

(Note that *The Triangle* here puts I and R on the same line and this means *multiply*.

CHARGE AND ENERGY

Charge (Q) is the quantity of electricity flowing through a circuit component. Its unit is the coulomb (C). To calculate charge, multiply the current by the time, t, (in seconds) during which it flows.

Example: A current of 2A flows through a lamp for 2 minutes (120 seconds). Find the total charge flowing.

$$Q = I \times t = 2 \times 120 = \mathbf{240C}$$

When electricity flows through a component, energy is converted into some other form or forms. In the case of a lamp it is *light* and *heat* energy which are produced. Energy (E) is measured in joules (J). When 1C is carried through 1V, 1J of energy is converted. The following equation then holds true:

$$E = V \times Q$$

Examples: 240C flows through a bulb when 12V is measured across it. What is the total energy converted into heat and light?

$$E = V \times Q = 12 \times 240 = \mathbf{2880J}$$

POWER TO THE PEOPLE

A similar equation to Ohm's Law is used if we wish to find the *electrical power* (P) of a piece of equipment. Power is expressed in *watts* (W) and is a measure of *the amount of energy converted per second* by the device.

The formula used for *electrical power* must not be confused with Ohm's Law. Whereas Ohm's Law relates Voltage, Current and Resistance, the power formula relates Voltage, Current and Power. This is the Power Formula:

$$P = I \times V$$

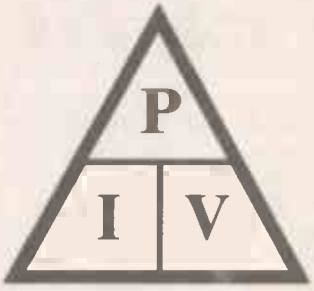
Examples: A soldering iron is connected to the 240V mains supply and a current of 100mA flows. Find the power of the soldering iron.

$$P = I \times V = 0.1 \times 240 = \mathbf{24W}$$

As with Ohm's Law, there are also *swapped around* versions of the power formula and we use the appropriate one for the job. These are:

$$I = P/V \text{ and } V = P/I$$

Again, *The Triangle* comes to the rescue:



This is used like the Ohm's Law triangle – cover over the quantity you want to find. Check *The Triangle* in the following:

Example: a 750W electric iron is connected to a 250V supply. Find the current flowing.

$$I = P/V = 750/250 = \mathbf{3A}$$

A 10W lamp has 0.2A flowing through its filament. Find the voltage of the supply:

$$V = P/I = 10/0.2 = \mathbf{50V}$$

We must be careful when the power is expressed in *kilowatts* (kW) that is, *thousands* of watts. This must be changed into *watts* (by multiplying by one thousand) before using it in the power formula.

Example: a 2.4kW electric kettle is connected to the 240V mains. Find the current flowing in the element.

Firstly, 2.4kW = 2400W then:

$$I = P/V = 2400/240 = \mathbf{10A}$$

We may use the above formula to calculate *fuse values* – the correct fuse to be used in a mains plug, for example.

Example: a 600W coffee-maker is connected to the 240V mains supply. What value of fuse should be used in the plug?

$$I = P/V = 600/240 = \mathbf{2.5A}$$

– so a 3A fuse will be adequate.

TWO STAGES

Sometimes we need a *two stage* calculation to solve a problem – that is, *Ohm's Law* followed by the *power formula*.

Example: A heating coil, having a resistance of 100 ohms, is connected to a 50V supply. Find the power of the heater.

We notice that neither Ohm's Law nor the power formula can find this directly. However, Ohm's Law may be used to find the *current* and then the power formula may be applied.

$$I = V/R \text{ (Ohm's Law)} = 50/100 = 0.5A$$

$$\text{Then } P = I \times V \text{ (power formula)} = 0.5 \times 50 = \mathbf{25W}$$

In electronics work, the power formula

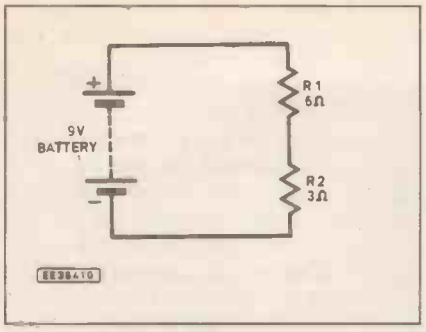


Fig. 5. A potential divider.

is often used to select the correct *power rating* of a resistor to make sure that it will not burn out or overheat in service. Small resistors of the type normally encountered in project work often have a *power rating* of 0.25W or 0.5W.

Example: A 220 ohm resistor is to be connected to a 9V supply. Find the minimum adequate power rating of the resistor.

$I = V/R$ (Ohm's Law) $= 9/220 = 0.041A$

$P = I \times V$ (power formula) $=$
$0.041 \times 9 =$ **0.37W**

Thus, we could use a 0.5W rating resistor but a 0.25W one would overheat.

Engineers doing this sort of calculation regularly use combined equations which work in one operation. However, for occasional use, learning them is not really worthwhile.

POTENTIAL DIVIDERS

Several times in this series we have touched on the subject of *potential dividers* but have avoided exploring the topic in any detail. However, students do need to know a little about it.

A potential divider (sometimes called a voltage divider) is formed when two (or more) resistors are connected in series with a power supply. It is almost always sufficient to consider only *two* resistors in a potential divider and this is what we shall do here. Since a potential divider is a series circuit, we find that some of the supply voltage appears across one resistor and the rest across the other one.

A potential divider circuit consisting of the pair of resistors, R1 (6Ω) and R2 (3Ω), connected to a 9V battery is shown in Fig. 5. It is a relatively simple matter to calculate the voltage appearing across either resistor. In this example, the total resistance is 9 ohms. Since a 9V supply is used, the current flowing through the resistor chain can be found using Ohm's Law:

$I = V/R = 9/9 =$ **1A**

Remembering that the same current – 1A – flows through *both* resistors, the voltage appearing across the 6 ohm resistor can be found, again, by using by Ohm's Law:

$V = I \times R = 1 \times 6 =$ **6V**

and the voltage across the 3 ohm resistor will be:

$V = I \times R = 1 \times 3 =$ **3V**

As expected, the individual voltages add up to 9V – the voltage of the supply.

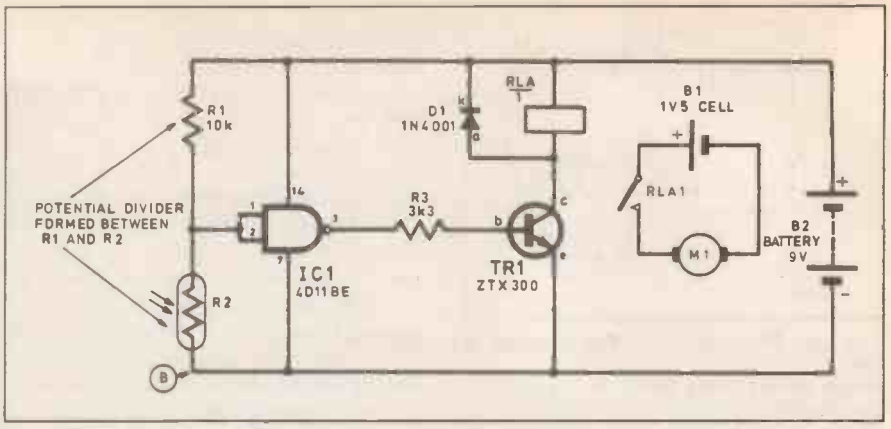


Fig. 6. Motor control circuit.

We also notice that the voltage splits into parts *in proportion to the individual resistances* – that is, there is twice as much voltage appearing across the 6 ohm resistor as the 3 ohm one.

In simple examples it is often possible to find these voltages by common sense without the need to do a calculation. Suppose in a potential divider one resistor had a value of 20 ohms and the other 4 ohms and they are connected across a 12V supply. There must be *five times* more voltage across the 20 ohm resistor than across the 4 ohm one. There must therefore be 10V across the 20 ohm resistor and 2V across the 4 ohm one.

Potential dividers are useful in *control systems*. Remember the motor control circuit which was used in Part 7 of the series (May, 1992 issue) – this is reproduced again as Fig. 6. A potential divider is formed between fixed resistor, R1, and light-dependent resistor, R2. When the light level falls, the resistance of the LDR rises. The voltage appearing across the LDR will therefore also rise. This is used to operate the NOT gate in the manner discussed at the time.

THE POTENTIOMETER

Consider the potentiometer circuit shown in Fig. 7 – a potentiometer is familiar as the volume control in a radio, television or amplifier. Here, a sliding contact can be moved along a track. The track may be *circular* (rotary potentiometer) or *straight* (linear potentiometer). The resistance of the potentiometer, as marked on the body, is the total resistance of the track measured from end to end (i.e. between points A and C).

Imagine we have a 1 kilohm (1k) potentiometer with the sliding contact set at the middle of the track – Fig. 7(a). There will then be 500 ohms above and 500 ohms below the sliding contact. This may be regarded as a potential divider with equal "arms". If the supply voltage is 9V as shown, then there will be 4.5V between points C and B.

If the sliding contact is moved to a higher position (Fig. 7b), the voltage between points C and B will rise (because there is a higher resistance between these points) and if it is taken lower (Fig. 7c), there will be a smaller voltage. In this way, a potentiometer can "tap off" a smoothly-varying voltage from zero to full supply voltage. This is useful in many circuits. Students should build the potentiometer circuit shown in Fig. 7 with a voltmeter connected as shown to check its operation for themselves.

THE WHOLE TRUTH

Supposing we wish to use a voltmeter to check the voltage across the lower 100k resistor in the potential divider shown in Fig. 8(a). Before the voltmeter is connected, the potential divider has equal arms so there will be equal voltages across each – that is, 3V. When the voltmeter is connected, there is now a problem because the voltmeter itself has resistance – in this case 50k – and this is connected in parallel with the lower arm (Fig. 8b). This, in effect, alters the potential divider and leads to a false reading. We say that the potential divider has been *loaded*.

Where two resistors, R1 and R2, are connected in parallel, their combined resistance (that is, the single resistor

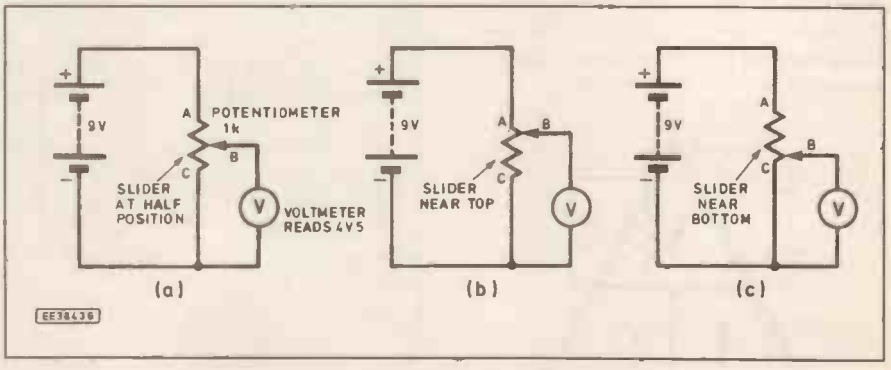


Fig. 7. Potentiometer circuits.

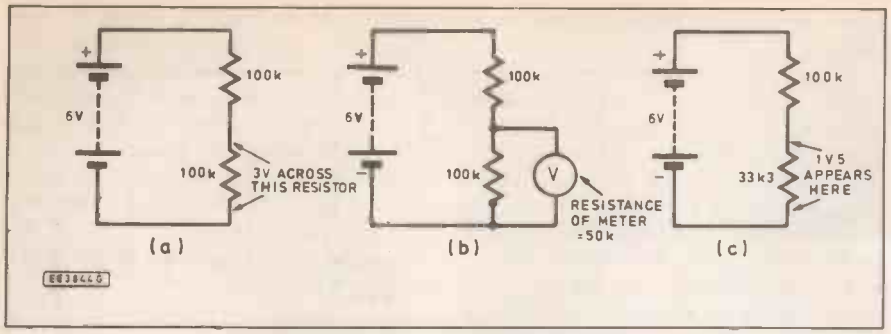


Fig. 8. Loading a potential divider.

which could replace them), R, is given by the formula:

$$1/R = 1/R1 + 1/R2$$

Applying this to the voltmeter and lower arm of the potential divider in Fig. 8b:

$$1/R = 1/100{,}000 + 1/50{,}000 = 0.00001 + 0.00002 = 0.00003$$

$$R = 1/0.00003$$

$$R = \mathbf{33{,}300\ ohms}\ (33.3k)$$

The point to note here is that the presence of the voltmeter has effectively reduced the value of the lower limb of the potential divider. The total resistance is now 133,300 ohms so the current flowing from the 6V battery will now be:

$$I = V/R = 6/133300 = 0.000045A$$

The voltage appearing across the voltmeter (and hence the reading) will therefore be:

$$V = I \times R = 0.000045 \times 33300 = \mathbf{1.5V}$$

This is important. The voltage without the meter present was 3V. Now that the meter is included, the reading is only 1.5V i.e. the reading is *distorted*. This does not mean that the meter is *inaccurate* – it provides a faithful reading of the voltage which now exists – not as it was before it was connected.

DISTORTION

This distortion is rather like a school inspector coming round to observe a lesson. The fact that he or she is in the classroom means that the lesson will not proceed in the way it would have done had he or she not been there. That is to say, *the very thing which was to be observed has changed.*

Users of voltmeters must always be on their guard for this. Whenever a voltage is measured across a resistor, perhaps in the course of fault-finding, it may be that the reading is not true. Further calculation will show that, providing the resistance of the meter is much greater than the other resistors in the potential divider, the loading effect will be small. The worst distortions occur when the voltmeter has a resistance approaching – or even less than – the other resistor values as in Fig. 8.

To illustrate this, suppose we use a meter with a resistance of 1M – *a high-resistance* voltmeter. The meter is now placed in the potential divider circuit shown in Fig. 9. to measure the voltage across the 10k resistor in the lower arm. Before the voltmeter is connected there will be an equal split of supply voltage between top and bottom arms – i.e. 3V. With the volmeter present we must first calculate the effective resistance of the voltmeter and 10k resistor in parallel:

$$1/R = 1/R + 1/R2 = 1/1000000 + 1/10000 = 0.000001 + 0.0001$$

$$1/R = 0.000101$$

$$R = 1/0.000101 = \mathbf{9{,}901\ ohms}$$

The total resistance is now 19,901 ohms so we can now calculate the current flowing in the potential divider chain:

$$I = V/R = 6/19901 = 0.0003A$$

So the voltage recorded by the meter is:

$$V = I \times R = 0.0003 \times 9901 = \mathbf{2.97V}$$

Here, the voltmeter has made very little difference to the value of the lower limb of the potential divider and hence to the voltage existing across it. This is because the resistance of the voltmeter is very high.

As a general rule, the higher the resistance of a voltmeter, the better. Electronic voltmeters now commonly have a resistance of 10M and these will cause little disturbance unless, of course, the other resistors in the circuit are of this order of magnitude and, unfortunately, this may very well be the case with modern equipment! Pointer-on-scale voltmeters have a lower resistance and their readings must be treated with caution.

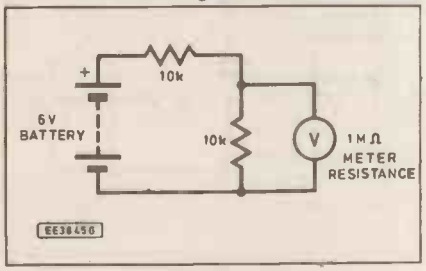


Fig. 9. Using a high resistance voltmeter.

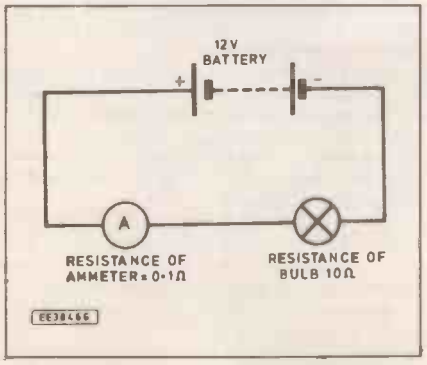


Fig. 10. Effect of an ammeter in circuit.

AMMETERS

Like a voltmeter, an ammeter also causes a disturbance to the circuit in which it is connected. The ammeter has a resistance of its own and the current being measured flows through this as well as the other circuit components. This reduces the current to a value less than it would have been if the ammeter had not been there.

Unlike a voltmeter, it can be seen that there will be least disturbance to the "true" current if the ammeter has as *low* a resistance as possible – that is, a resistance very low compared with other resistances in the circuit. Refer to Fig. 10. Here an ammeter of resistance 0.1 ohms is measuring the current flowing through a bulb of resistance 10 ohms, from a 12V battery. Before the ammeter is connected, the current will be:

$$I = V/R = 12/10 = \mathbf{1.2A}$$

With the ammeter in the circuit, the total resistance is now 10.1 ohms so the current will be:

$$I = V/R = 12/10.1 = \mathbf{1.19A}$$

Thus, the ammeter has made very little difference to the current flowing in the circuit. This exercise should be repeated using a meter resistance of 1 ohm instead of 0.1 ohm and the results compared.

SCOPE FOR STUDY

One of the most useful instruments available is the *oscilloscope*. This can be used as an a.c. or d.c. voltmeter, as a timing device and also to display waveforms. It is therefore a very *versatile* instrument. However, the information obtained from an oscilloscope may also need *interpretation*.

An oscilloscope appears rather like a small television set but often it has a *green* screen. The screen has a *graticule* in front marked off rather like graph paper in squares (divisions) and measurements can be made from this.

When first switched on, we normally see a spot of light or a horizontal line on the screen. If it is a spot of light, we need to turn on the *timebase* and this makes the spot sweep across the screen from left to right to give a line. A control can alter the sweep speed as required within wide limits – this is usually expressed in seconds per division. School oscilloscope timebase settings often vary between one second per division and one microsecond (one millionth of a second) or less per division.

At the slowest sweep speeds, the spot will be seen to move from left to right then suddenly re-appear (flyback) at the left-hand side of the screen to start another sweep. This display is familiar in hospitals as an electrocardiograph to monitor the heartbeat.

At slightly higher timebase speeds, the spot appears as a flickering line on the screen but at greater speeds the flickering

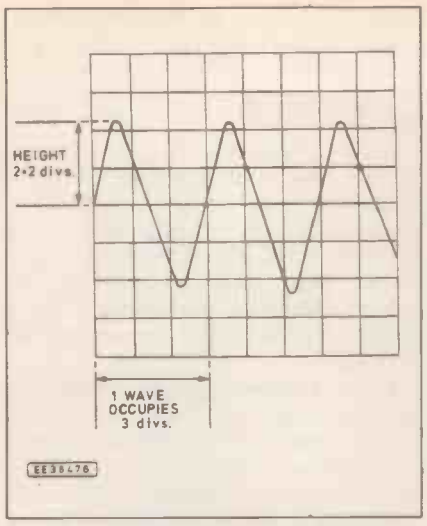


Fig. 11. An oscilloscope display.

disappears. We call the horizontal motion the *X direction* and various controls refer to it. For example, the *X-shift* moves the line to the left or right, *X-gain* makes the line longer or shorter, etc.

Y-WORRY

If all an oscilloscope did was move a spot or line in the X-direction this would not be very useful or interesting. However, by making connections to an input socket on the front panel, we can move the line in a *vertical* direction (called the *Y-direction*) at the same time. We can also position it vertically using the *Y-shift* control.

A control on the panel (often marked "V/div") determines the *voltage* required at the input socket to move the line up or down by one division. This is called the *Y-sensitivity*. One very basic use for an oscilloscope is as a *voltmeter*. By connecting a battery or other supply to the input socket and adjusting the "V/div" switch to a convenient setting, the line will move up (or down) on the screen. By noting how far it moves on the graticule and by knowing the V/div. setting, the voltage may be calculated.

Example: A bulb is connected to a battery and the voltage across the bulb is found by connecting an oscilloscope across it. The Y-sensitivity switch is set to 2 V/div. The line moves up on the screen a distance of 3.4 cm. Find the voltage across the bulb:

$$V = 2 \times 3.4 = 6.8V$$

The input resistance of an oscilloscope is very high so it behaves as a near-perfect voltmeter. Note that the sweep speed is irrelevant for voltage measurements. The timebase is simply made fast enough to provide a flicker-free display.

Using an oscilloscope as a voltmeter may not seem very useful since an ordinary voltmeter could be used and would be easier to read. However, if the voltage to be measured was a.c. (alternating current) rather than d.c. (direct current), *waves* would be displayed. It would now be possible to read off the *peak* (highest) value and, by looking at the X-calibration, the time taken for one wave (time period, T) could be found.

Consider the typical display shown in Fig. 11. Here, the timebase is set to 10ms per div. and the Y-sensitivity to 2V/div. The peak voltage and time period of the wave are found thus:

$$\text{Peak } V = \text{V/div.} \times \text{divs.} = 2 \times 2.2 = 4.4V$$

$$T = \text{T/div.} \times \text{divs.} = 0.01 \times 3 = 0.03\text{s (30ms)}$$

We can find the *frequency*, f, of the wave (the number of waves per second measured in Hz) by using the formula:

$$f = 1/T$$

In this case: $f = 1/0.03 = 33.33\text{Hz}$

Apart from the above uses, we may use an oscilloscope as a display device. Various shapes of wave may be fed in and the result observed on the screen. This is invaluable for fault-finding – perhaps looking for distortion – in electronic circuits. □

That concludes the series. We hope it has been found enjoyable and useful either for general reading or as a source of information for school and college courses.

SHOP TALK

with David Barrington

Versatile Intercom

We do not expect too many problems to arise when shopping for parts for the *Versatile Intercom* as there is plenty of room for adaption.

The unijunction transistor should be fairly widely available, the one used in the model being purchased from **Cricklewood Electronics** (☎ *081 452 0161*). The Listen/Talk toggle switch must be the biased "one way" type and is stocked.

The microphone insert used in the model was also bought from the above mentioned company. This is a electret condenser type having an impedance of 600 ohms, frequency response 50 to 20,00Hz and powered from a 1·5V supply. When soldering to the microphone insert be as quick as possible with the soldering iron as they definitely do *not* like heat!

The small cases used in the two prototype were obtained from **Greenweld** (☎ *0703 236363*), code V216. As a point of interest we see they have just received a delivery of quantities of solar panels and kits.

If you opt for the mains operated version, remember to cover *ALL* solder joints to mains carrying leads, i.e. transformer connections, with insulating sleeving. The biased switch S1 must be mains rated and the connecting tags, once soldered of course, must also be covered with insulating sleeves. Do not forget to *omit* the lead from S1b to the push switch (shown in the battery version) for the mains model.

The inclusion of the additional supply smoothing capacitors C11 and C12 for the mains set-up was found to be necessary to reduce "mains hum".

Some additional interesting information supplied by the author is that the battery has been in use for over a year now. Also, to use the unit as a "baby alarm" simply replace the Listen/Talk switch S1 with a non-biased type.

Whistle Switch

Several changes have been made to the original prototype version of the *Whistle Switch* shown in the photograph of the article.

The UM3763 whistle switch i.c. is a special "custom" device and was purchased from one of the **Maplin** stores, code UJ47B (UM3763). The omnidirectional mic. insert was purchased from the same source, type EM-6; the EM-4 could also be used. The mic. insert has built in f.e.t., is rated at 1 kilohm impedance, frequency response of 50Hz to 8kHz and will run from 1·5V to 9V supplies. Identical ones, with the same spec., should be carried by most of our components advertisers.

The relay used in the prototype was fairly low rated and has been replaced by a miniature, high power, mains one. This relay has contacts rated at 240V a.c., 30V d.c., and current rating 10A d.c. resistive and 3A a.c. inductive. The coil operating voltage is from 9V to 19·2V and coil resistance is 320 ohms. This relay is listed by Maplin, code YX97F (10A Mains Rly).

As mains voltage and current may be present on the circuit board, depending on application, it is suggested that the copper tracks from the relay switching contacts be "thickened" by soldering lengths wires along their lengths. Alternatively, mains leads could be soldered direct to the switching contacts.

The printed circuit board is available from the *EE PCB Service*, code EE805 (see page 675).

Extended Range Capacitance Meter

We have only encountered one small problem likely to cause constructors concern when sourcing components for the *Extended Range Capacitance Meter* and that is the programmable unijunction. The 2N6027 seems to appear in only the **Cricklewood, Greenweld** and **Electromail** listings.

Unlike normal unijunctions, this three-pin device has its pinouts labelled k, g and a. To add to the confusion, Maplin list the BRY39 as an equivalent to the 2N6027, but this is a four lead device. To use as a programmable unijunction it tells you that the cathode gate (G_K) should not be used.

The panel meter used in the model is the 1mA 100 ohm type T24 from **Electrovalue** (☎ *0784 433603*). However, identical dimensions and ratings appear in most of our component advertiser's current listings.

The printed circuit board for the capacitance meter is available from the EE PCB Service, code EE804 (see page 674).

Traffic Light System

Looking down the list of components for the *Traffic Light System*, everything seems straightforward until you come to the lighting circuits. The l.e.d.s and m.e.s. bulbs and holders should be stocked by most component suppliers, but the "grain of wheat" lamps may only be carried by the larger model shops.

When building up the "high current" lamp version it is important that the wiring to the lamps can handle the required current. The use of 6A mains flex or high current auto-wire (from motor spares shops) may be best here.

If powering the high current version from a car battery, a suitable in-line safety fuse MUST be included in the positive (+) lead from the battery. Note also the higher rating of the output terminal block TB2 and the high current rating of the relay contacts and on/off switch. It is important to connect the car battery *directly* to the relays and lamps.

The printed circuit board is obtainable from the *EE PCB Service*, code EE806 (see page 674).

Lights-On Warning

We cannot forsee any component sourcing problems for those wishing to build the car *Lights-On Warning* project. The Scotchlok connector and 3A auto-type wire can be purchased from most car spare parts counters.

The 12V piezoelectric sounder, is the type with an integral drive circuit and operates at a resonant frequency of about 2 to 3kHz.

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R T V C

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MO27	3	2200μF 25V d.c. can type electrolytic size 45mm x 25mm	£1
MO28	1	15000μF 40V d.c. can type 23A electrolytic size 113mm x 50mm	£1
MO29	1	33000μF 16V 27A can type electrolytic size 113mm x 50mm	£1
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MO32	2	10k + 10k wirewound precision potentiometer	£1
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MO34	5	100k multiturn Varicap type tuning potentiometer with knob size 45mm x 5mm	£1
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MO37	1	Large Tuning meter 125μA-0-125μA size 55mm x 47mm	£1.75
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MO49	1	Cassette tape transport mechanism, belt-drive, top loading, six plano key operation with knobs, stereo record/replay erase heads, heavy fly-wheel	£6.50 + £2.65 p&p
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MO53	1	FM stereo decoder module with diagram. *Made by Mullard*	£1
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MO56	2	6V-0V-6V 4VA p.c.b. mount mains transformer 240V Input, size 42mm x 33mm x 35mm. *UK Made*	£1
MO57	25	4 Volt miniature wire-ended bulbs	£1
MO57A	1	SRBP Copper Clad Printed Circuit Board. Size 410mm x 360mm x2mm	£3.65 + 75 p&p
MO58	2	Mono cassette tape heads. *Japan Made*	£1
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Constructional Project

LIGHTS-ON WARNING

T. R. de VAUX-BALBIRNIE

Essential for the absent-minded – an anti-theft facility too!

THE Lights-On Warning has been designed to serve those absent-minded readers who leave their car lights switched on and return to find the battery "flat".

If the lights are switched on and a door is opened, the Lights-On Warning gives a signal in the form of a high-pitched pulsing tone. This acts as a reminder to switch them off. If the lights are to be left on intentionally, then the warning is simply ignored since it will go off when the door is closed from the outside.

The circuit draws current from the car battery so needs no independent supply. With the lights off, the current requirement (continuous current drain) is 100μA approximately and this may be regarded as negligible. With the unit operating, the circuit requires 15mA approximately.

The whole device is mounted in a plastic box size 75mm x 50mm x 25mm with a piece of screw terminal block mounted on the base to which the external connections are made. There is also a two-position switch on the side to select the operating mode – *normal* or *anti-theft*. The purpose of this will be described presently.

The car must be fitted with the usual type of courtesy light(s) which operate when a door is opened so this point should be checked before beginning construction work. Check also whether the car has a delay unit or other modification to the courtesy light circuit. If it has, the Lights-On Warning may not work.

ANTI-THEFT FACILITY

When the Normal/Anti-Theft switch is set to the *anti-theft* position, a warning is given when a door is opened irrespective of whether the lights are on or not. Thus a thief on opening the door will trigger the unit, hear the warning sound, and assume that some more sophisticated circuit or alarm has been put into action.

In practice, this usually means that he will leave the car quickly and try his luck elsewhere. Most car break-ins are of the opportunist kind and anything out of the ordinary is likely to deter a potential thief.

If the circuit is left in anti-theft mode by mistake, this will be self-checking since the user will realize this when the door is next opened and the warning sounds. The anti-theft switch could be omitted if desired – if, for example, the owner has fitted a real car alarm.

HOW IT WORKS

As stated previously, this circuit is triggered by the existing interior light (courtesy light) circuit. Fig. 1 shows the usual arrangement. Switch S1 is one of two or more spring-loaded normally-closed switches mounted in the car door pillars.

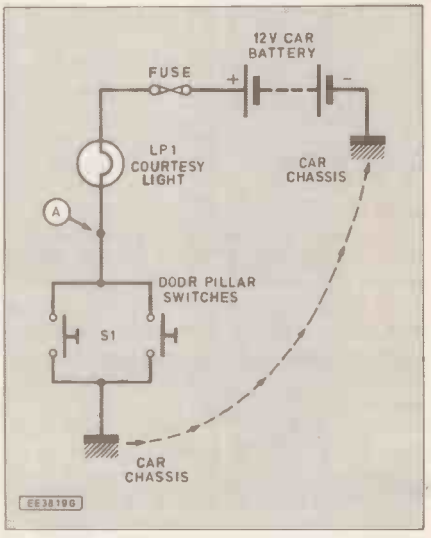

Fig. 1. Vehicle interior courtesy light circuit.

One contact of each switch is permanently connected to the car chassis ("earth"). The negative car battery terminal is also connected to the car body.

The doors, when closed, press the switches and hold their contacts in the *open* position. Current is therefore prevented from flowing from the car battery. When a door is opened, one of the sets of door switch contacts are closed by spring pressure and a circuit is completed from the battery positive terminal through the existing fuse, courtesy light bulb(s) LP1 and switch S1 hence to the battery negative terminal via the car bodywork (dotted line).

With S1 contacts open (door closed) point *A* will have a voltage of +12V (via LP1) between itself and the car chassis. When the contacts close (door open) the voltage falls to zero since Point *A* is now connected direct to the car chassis. It is these voltage levels which operate the device.

CIRCUIT DESCRIPTION

The full circuit diagram for the Lights-On Warning is shown in Fig. 2. The existing car courtesy light section appears to the left of the dotted line, but note that only one door pillar switch is shown.

The circuit is built around a bipolar 555 timer IC1. With switch S1 set to *normal* and with the car sidelights on, operating current is supplied from the lighting circuit via fuse, FS1 and diode, D1. With S1 set to anti-theft, current is supplied direct from the car supply.

The timer IC1 is used in astable mode. This means that the output (pin 3) switches on and off continuously as long as a supply is connected and pin 4 (reset input) is high (near positive supply voltage).

The rate at which pulses are provided depends on the values of fixed resistor, R3, preset potentiometer VR1 and capacitor, C2. VR1 will be adjusted at the end of construction to provide four pulses per second approximately – this providing the "right" sound.

The reset pin (4) of IC1 is kept low (negative supply voltage) while the vehicle doors are closed to disable the i.c. and so prevent it from providing pulses. This is done by the inverting action of transistor, TR1 and associated components.

With the doors closed, the pillar switches are held in the open condition. Current then flows to TR1 base through the existing fuse, courtesy light bulb and resistor, R1. This turns the transistor on and collector current flows through resistor, R2. The collector is now low and this low state is applied to IC1 pin 4.

When a door is opened, the pillar switch contacts close and point *A* is effectively connected to the car chassis. TR1 base receives no current and the transistor turns off. IC1 pin 4 is now high and IC1 is enabled – pulses are then provided at pin 3 and the audible warning device, WD1, connected to it operates.

Note that with the door closed, TR1 base current is insufficient (100μA approximately) to make the car interior courtesy lamp glow. It is essential to buy the correct type of audible warning device as specified in the components list. Devices which require external drive circuitry would not work in this circuit.

PROTECTION

Diode, D1, protects the circuit from the effects of reversed battery polarity if connected up incorrectly to the car system. Fuse, FS1, provides protection in the event of excessive current being drawn from the car battery – perhaps due to a short-circuit formed by faulty construction. *For safety reasons, it is therefore essential* to include this fuse in the circuit.

Capacitors C2 and C3 are necessary for stable operation of IC1. Note that if no anti-theft facility is required, switch S1 is simply omitted and the fuse FS1 connected directly to the terminal block point TB1/2. TB1/3 is then redundant.

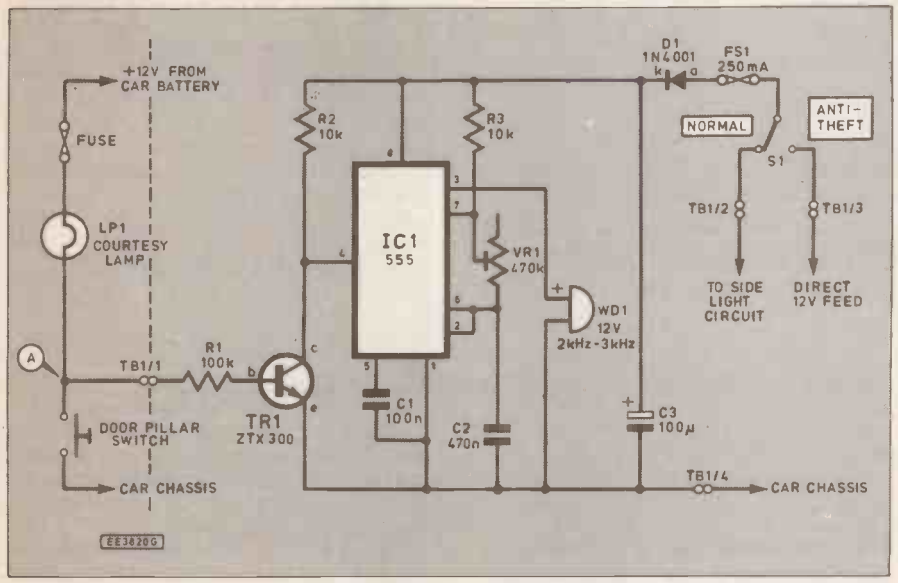

Fig. 2. Complete circuit diagram for the Lights-On Warning. The circuit to the left of the dotted line is the car "courtesy light" section.

CONSTRUCTION

Construction of the Lights-On Warning is based on a circuit panel made from a piece of 0.1in. matrix stripboard, size 10 strips × 17 holes. Full topside component layout and underside details of breaks in the copper tracks are shown in Fig. 3.

Begin construction by drilling the two mounting holes and filing off the corners of the board to clear the lid securing pillars in the specified box (see photograph). Follow with the track breaks (do not forget those between the rows of IC1 pins) and solder the four topside inter-strip link wires into position as indicated.

Mount the on-board components noting that capacitor C3 and diode D1 are polarity-sensitive and must be connected the correct way round. Take care also over the orientation of transistor, TR1.

Complete the circuit panel by soldering 8cm pieces of light-duty stranded connecting wire to copper strips *D*, *F* and *I* on the left-hand side and to strips *C* and *J* on the right-hand side. Insert the i.c. into its socket with the correct orientation and adjust preset VR1 to approximately mid-track position.

Prepare the box by drilling holes in the base to align with those already made in the circuit board, for the fuseholder, audible warning device (depending on the type) and switch, S1 (if required). Drill two holes in the base of the box for the four-section (three-section if S1 has been omitted) piece of screw terminal block TB1. Drill a hole to accommodate the wires passing through from the circuit panel to the terminal block.

Refering to Fig. 4, mount the remaining components using a piece of cardboard on the underside of the circuit board to provide some padding. Use small fixings for circuit board, terminal block, audible warning device and switch (if of this type) mounting.

COMPONENTS

See SHOP TALK Page

Resistors

R1	100k
R2, R3	10k (2 off)

All resistors 0·25W 5% carbon.

Potentionmeter

VR1	470k sub-min. preset, vertical

Capacitors

C1	100n ceramic
C2	470n ceramic
C3	100µ p.c.b. elect., 16V

Semiconductor

D1	1N4001 50V 1A rec. diode
TR1	ZTX300 *npn* silicon transistor
IC1	NE555V bipolar timer i.c.

Miscellaneous

S1	Miniature 2-way slide or toggle switch
WD1	12V piezoelectric audible warning device, with internal drive circuitry. 2kHz-3kHz operating frequency
FS1	25mm chassis fuseholder and 250mA fuse to fit
TB1	3A screw terminal block – 4 sections required (or 3 sections – see text).

Stripboard, 0·1in. matrix size 10 strips × 17 holes; plastic box, size approx. 75mm × 50mm × 25mm; 8-pin d.i.l. socket; 3A auto-type wire; stranded connecting wire; Scotchlok car connectors; small fixings; solder, etc.

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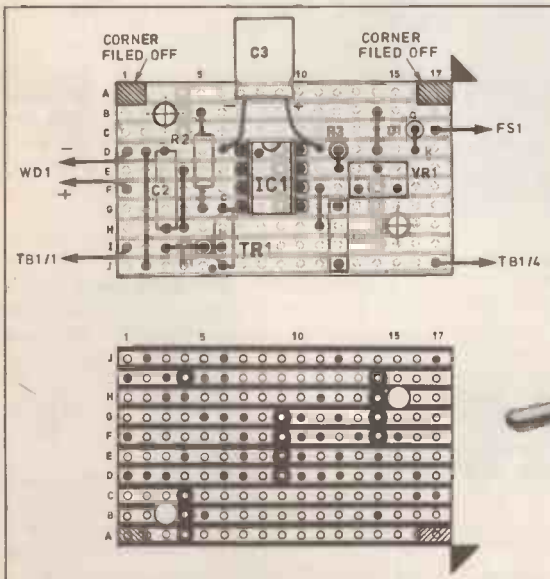
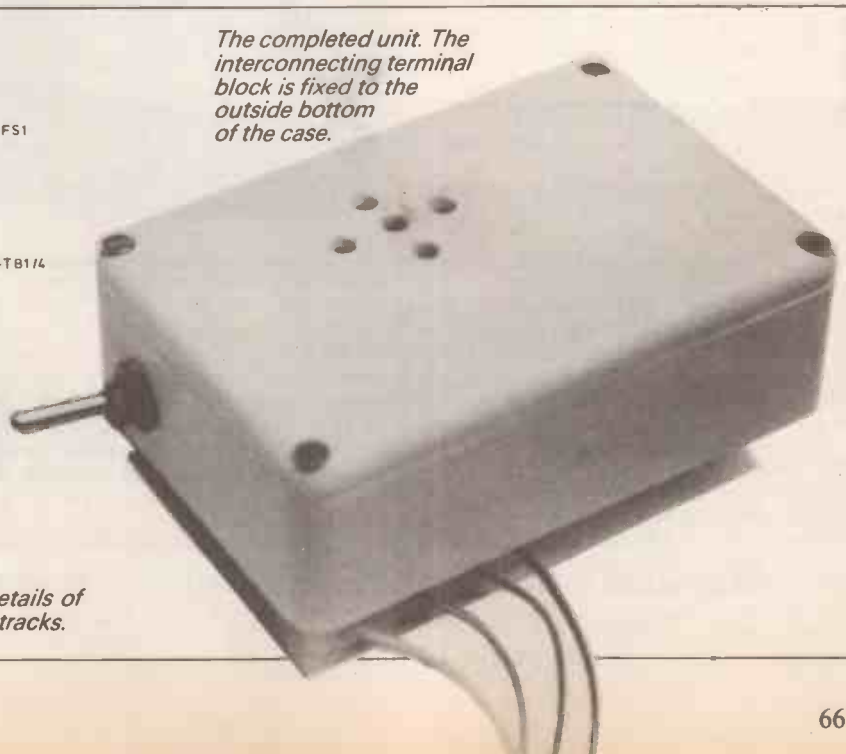


Fig. 3. Stripboard component layout and details of the breaks required in the underside copper tracks.



The completed unit. The interconnecting terminal block is fixed to the outside bottom of the case.

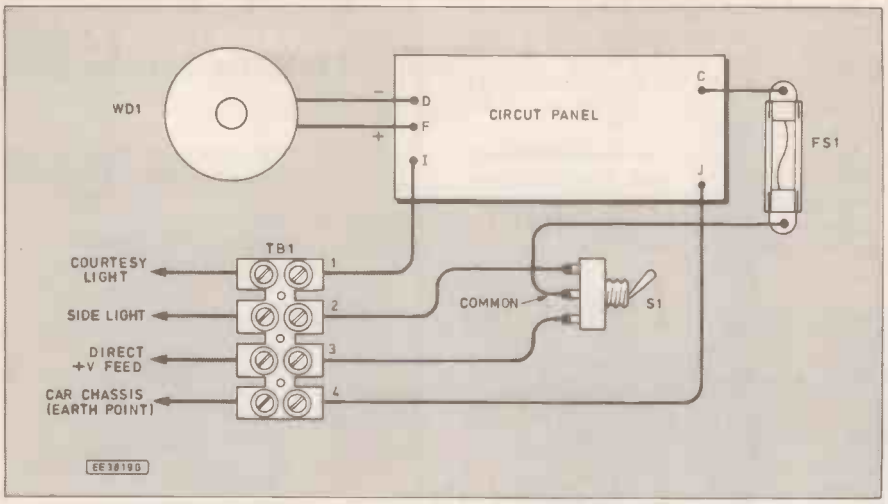


Fig. 4. Interwiring from the circuit board to the off-board components. A hole is drilled in the bottom of the case to allow leads through to the terminal block.

Complete the internal interwiring shortening any wires as necessary. Note that the audible warning device is polarity-sensitive so must be connected in the correct sense as indicated.

For audible warning devices having no fixing holes, an adhesive fixing pad is acceptable to attach it to the case but make sure that it is secure and will not break free in service. Drill a few small holes in the lid of the box above WD1 position to allow the sound to pass out.

Note that everything is mounted in the main section of the case with nothing on the lid. This minimises strain on the internal wiring. Leave the lid off the case for the moment.

TESTING

The unit may be tested and adjusted using a 9V battery as a power supply before installing it in the car. Note, however, that the sound will be slightly quieter than it will be when connected to the 12V car supply.

Connect short pieces of stranded wire to TB1 terminals one, two and four. Insert the fuse and switch S1 (if used) to normal operation. Connect TB1/2 to the positive terminal of the battery and TB1/4 to the negative one. The buzzer should bleep regularly.

Now, touch the wire connected to TB1/1 on to the battery positive terminal. The buzzer should go silent. Adjust preset VR1 to provide the pulse rate required.

INSTALLATION

Before installing the Lights-On Warning in the vehicle, first disconnect the car battery completely. For all external TB1 connections, it is essential to use light-duty auto-type stranded wire. Do not use any other type. Where any wires pass through a hole drilled in metal, a rubber grommet must be used.

Referring again to Fig. 4, carry out the external wiring. Connect TB1/2 to the live side (that is, the side which is NOT connected to the car chassis – "metalwork") of one of the sidelights.

This may be done by referring to the wiring diagram of the car, locating the correct colour of wire and making an in-line connection using a Scotchlok connector (these are available from car accessory shops). Do NOT use makeshift connecting methods such as breaking the wire and using p.v.c. taped joints.

Now make a similar connection between TB1/1 and the side of the courtesy light which is connected to the pillar switch (this could be made at the pillar switch itself if this is easier). Note that some cars have separate courtesy light circuits – one for each side of the car. It so, wire into the driver's side.

If using the anti-theft facility, you will also need a connection which is "live" all the time (that is, independent of the ignition switch) made to TB1/3. This must be made at the *outlet* side of an existing low-current fuse at the fusebox. It would be possible to use the courtesy light live feed wire for this purpose – again, make an in-line connection using a Scotchlok.

Make an "Earth" (car chassis) connection to TB1/4. If a suitable existing earth point is not available nearby, drill a small hole in a metal part, scrape away the paint around it and use a small crimp-type eyelet secured with a self-tapping screw.

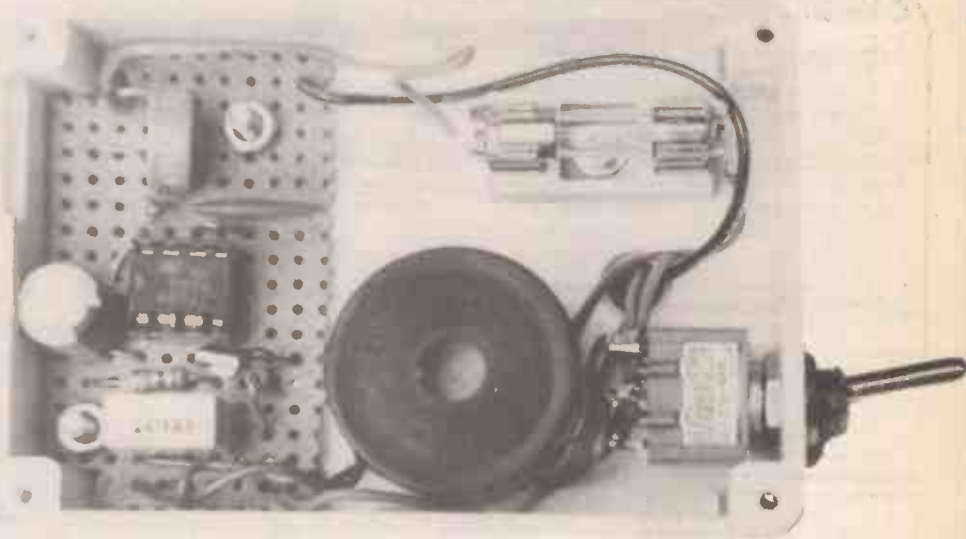
After making all TB1 connections, fit the lid and mount the unit in its final position using a small *plastic* bracket or a self-tapping screw through the back. Finally, reconnect the car battery and check the system for correct operation. It may be found necessary to tape over some or all of the holes if the warning is too loud.

If the unit is left in anti-theft mode for a long period, for example while on holiday, there will be a continuous current requirement of 15mA. A well-charged battery will be able to supply this for several months so there should be no problem.

Note that if the side lights are switched on and the courtesy light is operated manually, or if the courtesy lamp bulb blows, the unit will sound. This is unlikely to be of much concern.

No more flat batteries with the Lights-On Warning! □

Layout of components inside the small plastic case.



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INTERFACE

Robert Penfold

THIS month we continue with the bar code reader circuit. Before proceeding to the software side of things I would like to suggest a few minor changes to the bar code reader circuit.

The prototype functioned well for some time, but then developed a tendency to latch-up. This would seem to be due to a problem with the CA3140E. The modern versions of this component have a tendency to latch-up when used in the comparator mode with a low supply voltage. The best solution to the problem is to use a CA3130E instead.

Interface

The output of the reader circuit is capable of driving most digital inputs properly, but I ran into difficulty when trying to interface it to port A of an 8255A card. Reducing R8 from 470 ohm to 220 ohm ensures that the output can drive any five volt logic input.

Despite the inclusion of a trigger stage in the circuit, glitches can still occur as the output switches from one state to the other. More hysteresis can be introduced to the trigger circuit by making R5 lower in value. However, a lot more hysteresis could severely "smear" the output signal, possibly making it impossible to find a setting for VR1 that permits both wide and narrow bars to produce proper output signals. It is better to have the software filter out the odd glitch here and there.

It was my original intention to interface the bar code reader to the joystick port of a PC. Initial experiments were not very successful though, so I eventually interfaced it via an 8255A. Details of interfacing an 8255A to the PC have been provided in previous *Interface* articles, and there are commercial 8255A cards available. I used a Maplin 24 line PC I/O card, and this kit offers a relatively cheap and simple means of interfacing user add-ons to a PC.

The 8255A is at addresses from &H300 to &H303 (768 to 771 in decimal), and the output of the bar code reader connects to input D7 on port A. Obviously the reader program will need slight modification if the circuit is interfaced to the PC by some other means.

Experiment with the setting of VR1. There will be a small range of settings that give output pulses from both wide and narrow bars, but some settings are much better than others at discriminating between the two bar widths.

The best setting is not necessarily one that accurately reflects the two to one ratio of the bar widths. A setting that results in the narrow bars only just being detected seems to give an enhanced ratio, making it easier for the software to distinguish between the two bar widths. It would probably be worthwhile using a multi-turn trimpot for VR1.

Experimental barcode reading program

```
'Set up port
OUT 771, 128

'This array is deliberately made oversize to allow for possible stray reads
DIM v%(1 TO 40)
CONST TRUE = -1, FALSE = 0

'This is the start of the outer program loop
DO WHILE INKEY$ = ""
        DO
        'Wait for white paper
        LOOP UNTIL INP(768) = 0
        BEEP
        DO
        'now wait for black bar
        LOOP UNTIL INP(768) = 128

        'Set up variables used in the read loop
        count% = 0
        ind% = 1
        test% = 128
        endit = FALSE
        DO
                'This loop continues as long as the port value
                'does not change
                DO WHILE test% = INP(768)
                        count% = count% + 1
                        IF count% > 10000 THEN
                                endit = TRUE
                                EXIT DO
                        END IF
                LOOP
                'Disregard any stray zero reads
                IF count% <> 0 THEN
                        'black bars stored as negative values
                        IF test% = 128 THEN count% = -count%
                        v%(ind%) = count%
                        ind% = ind% + 1
                        test% = INP(768)
                        count% = 0
                END IF
        LOOP UNTIL endit

        REDIM bars%(-1 TO 8)
        n% = -1
        zerocount% = 0
        FOR i% = 1 TO ind% - 2
                'find and store negative values
                IF v%(i%) < 0 THEN
                        bars%(n%) = v%(i%)
                        n% = n% + 1
                        IF n% > 8 THEN EXIT FOR
                END IF
        NEXT i%

        'This loop finds the narrowest bar
        'This will often be the first bar
        minwidth% = bars%(-1)
        FOR i% = 0 TO 8
                IF bars%(i%) < minwidth% THEN minwidth% = bars%(i%)
        NEXT i%

        'This loop finds the widest bar
        'This should be the last bar
        maxwidth% = bars%(8)
        FOR i% = 0 TO 7
                IF bars%(i%) > maxwidth% THEN maxwidth% = bars%(i%)
        NEXT i%

        'The valread% variable must be zeroed for each swipe
        valread% = 0
        FOR i% = 0 TO 7
                'Find the wide bars...
                IF (bars%(i%) - minwidth%) < (maxwidth% - bars%(i%)) THEN
                        '...and add in the appropriate value
                        valread% = valread% + 2 ^ i%
                END IF
        NEXT i%
        PRINT "Value read: "; valread%
LOOP
```

Software

The software provided is not intended to be a fully-finished program, but is intended to show the principles involved. In particular, it includes no error checking. With any bar code system there will inevitably be errors. Apart from anything else, it is probable that some of the bar codes will not be in perfect condition and properly readable.

Before using the program in any serious application it would be essential to add at

least a basic form of error checking to the system. The program is suitable for initial experimentation and can be altered and extended as needed.

A problem with the IBM PC is that the standard timer has a granularity of only 18.2 milliseconds, approximately 1/55 of a second. This is woefully inadequate for this purpose. It is possible to reprogram the timer, but this would be beyond the scope of this project. Instead, this program uses a free-running loop, and judges the widths of the bars by the number of times round.

Loops

The whole program is a succession of loops. The first loop continues until the value read from the port is 0, indicating that the sensor has been placed on the paper. The program beeps at this point to show that it is ready to start reading. The second loop waits until the reading is 128, indicating that the first bar has been encountered.

The program then enters the free-running loop. This counts as long as the value read from the port, recorded in the variable test%, remains unchanged. When the value read changes, the count in count% is stored in the array v%(), the array index (ind%) is incremented, test% is set to the new value, and count% is zeroed. Note that the readings for the bars are stored as negative values, the white spaces as positive values.

The terminating method for this loop is admittedly clumsy. It occurs when the value stored in count% exceeds 10,000. This value should never be reached when scanning, unless you move the sensor exceeding slowly, but it ends the loop reasonably quickly when the sensor is lifted from the paper. Note that this value was determined for a 33MHz 386 machine. It may need to be reduced on slower machines.

This procedure will sometimes pick up stray zero readings. For this reason, a test is included for these readings, and they are not stored in the array.

Bars

This program only uses the black bar values, not the white spaces, so the next stage is to select these, and store them in an array called bars%(). This is a dynamic array, declared with REDIM, so it is automatically zeroed each time through the program.

This part of the program is a fairly straightforward loop which finds negative (i.e. less than zero) values in v%() and transfers them to bars%(), using n% as an index to bars%(). Note the declaration of bars%(). It has 10 values, from −1 to 8. This is so that the eight bars in the middle, which represent binary digits, have the conventional 0 to 7 indexes. This simplifies programming later on.

The method used here to determine whether a bar is wide or narrow is to find the widths of the widest and narrowest bars (the two next FOR . . . NEXT loops), and then to determine which value each digit bar is nearer. This method is crude, but has proved successful.

If the width of a bar is nearer to the widest, it is regarded as a 1. If nearer to the narrowest, it is regarded as a 0. Using i% as an index to the bars%() array in a FOR...NEXT loop, and with index values from 0 to 7, the value can be recreated by adding 2 to the power of i% to the value for each wide bar. The finished value is printed out.

In Use

Provided everything is set up correctly the system provides a high degree of reliability, but the occasional wrong answer does crop up. Results are best if the "pen" is swept at a slow to medium speed. Moving it fast across the bar codes invariably produces an incorrect reading. The hardware seems to be able to keep up with fast sweeps, so the problem is presumably a software one, or is perhaps due to variations in the speed of the pen.

Do-it-yourself barcodes certainly provide an interesting line of investigation for the experimenter, and provided you have suitable computer hardware, the cost is very low.

Smoking Trains

A letter published in a recent *Everyday Readout* warned of the dangers, or supposed dangers, of using pulse type model train controllers. I have used these for many years, and cannot really agree that there is any risk involved. If smoke starts to rise from a model train this surely reflects deficiencies in the overload protection, and has no bearing on the system of control in use.

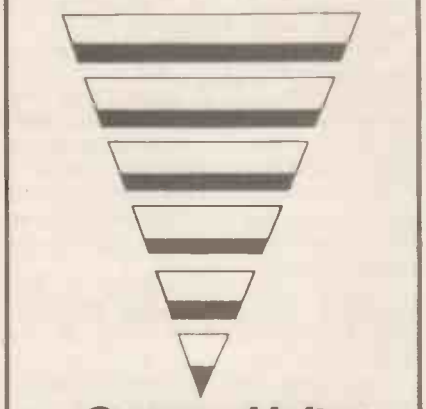
The pulsed controller design featured in a previous *Interface* article does not have any form of built-in overload protection. However, the mains power supply unit includes a monolithic voltage regulator which provides fold-back current limiting.

A stalled motor might try to draw a very high current, but the current limiting circuit would actually ensure that the current flow was less than the normal maximum level. This makes it almost impossible to burn out a motor, even if you deliberately try to do so.

The criticism of noise from the motor is a more valid one, and there is no easy solution to this. It can be worthwhile trying slightly different timing capacitor values in the controller, so as to produce different operating frequencies.

Due to mechanical resonances, the motors are more efficient sound generators at some frequencies than at others. Using a very low pulse frequency avoids the problem completely, but the results look rather jerky and unrealistic.

DOWN TO EARTH



George Hylton

SIMULATED REACTANCES

A bedside clock radio worked well in my flat, but not in my son's. The problem showed up when he tried to listen to 198kHz (the BBC's long-wave Radio Four transmission).

This frequency is used, outside domestic broadcasting hours, to carry the *BBC World Service,* which he likes to listen to in the very early morning.

The poor reception was probably caused by the screening effect of the steel-girder frame used in constructing the 1930s block of flats where my son lives. Mine dates from 1835, before steel frames had come into use.

Experience shows that even in a metal-framed structure there is often some spot where reception is good. It may well be, of course, that the good-reception spot isn't a convenient one for keeping the radio, but it might still be possible to place an aerial at the good spot and connect it to the radio by some sort of feeder cable.

A loop or frame aerial made by wrapping one or more turns of wire round a large vertical support such as a picture frame or the back of a wardrobe is a good bet. Calculations showed that a single large turn picks up more signal than a number of smaller turns made with the same piece of wire.

This, however, raised a practical problem which is the real subject of this article. So I'll set aside my particular problem and look at this more general one, which may well be of more interest to readers.

LOOP CIRCUITS

The equivalent circuit of an "untuned" loop or frame aerial (Fig. 1a) contains the inductance (*L*) of the wire, its resistance (*R*) and a "generator" which represents the signal voltage induced in the wire by passing radio waves.

An untuned loop is usually an insensitive aerial because the amount of current which can be driven by the signal voltage is restricted by the impedance of the loop inductance. By adding the correct capacitance (*C*, Fig. 1b) the impedance of the inductance is cancelled and the only impediment to current flow is the resistance *R*.

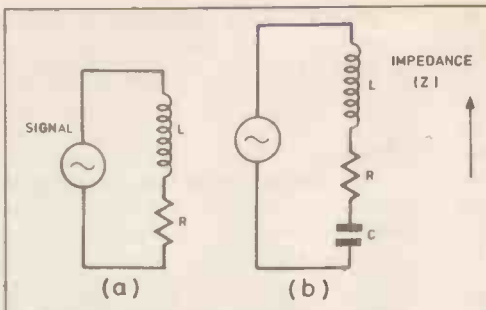


Fig. 1(a). Equivalent circuit of an untuned loop aerial (frame aerial); (b) Tuned loop.

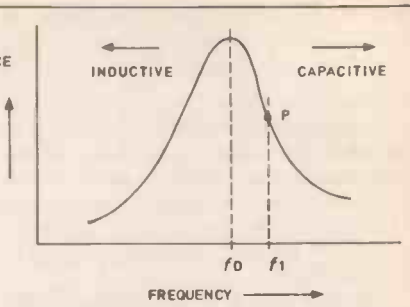


Fig. 2. Impedance-frequency curves for parallel resonant circuit.

It is easy to make *R* small. A large current then flows at the series-resonant frequency. This sets up a large (comparatively) voltage across *C*, and also a large magnetic field inside the loop. Either voltage or current or field can be made use of.

In an ordinary long or medium wave receiver there is an internal "tuned" loop (on a ferrite-rod aerial). Energy has to be transferred to this internal loop from the external one. To use the field you just place the receiver close to the loop and orient it for good pickup.

To use the loop current you pass it through one turn of insulated wire wrapped round the receiver's cabinet, in the right way to couple to the ferrite rod aerial. With either method a large external loop can give a substantial boost to signals, and without the need for any electronics. (It's not usually practicable to use the loop voltage on long waves, though you can do so with a short wave loop by weak capacitive coupling to the "whip" aerial).

TUNING PROBLEMS

The snag appears when you discover how low the loop inductance is. A single-turn loop run round my bookcase (about a metre square) turned out to have an inductance of about 8μH. This was about twice what I expected, but even so it needs about 8000pF (80nF) to tune to 198kHz.

To tune such a loop I could connect a fixed capacitor then make the loop bigger or smaller to set the frequency. Inconvenient!

One alternative is to connect a small variable inductor in series with the loop, or a larger one in parallel. This is more practical, but I didn't have a suitable coil to hand, and being lazy didn't want to go to the trouble of winding one. What I did have was a collection of i.f. transformers, frequency 455kHz or thereabouts, with a low-inductance coupling winding for driving the base of a transistor.

OFF-TUNE *LC* CIRCUITS

The impedance versus frequency curve for a parallel-tuned circuit (Fig. 2) shows the familiar peak at the resonant frequency f_0. Below f_0 the impedance falls sharply as frequency is reduced.

Now, the impedance of an inductance falls like this, so the tuned circuit below f_0 behaves as an inductance of sorts. Above f_0 the impedance falls as frequency rises.

This is rather like a capacitance. Varying the tuning moves the curve to the right or left.

At frequency f_1, the response is set at *P*. If the peak tuning now shifts to a rather *higher* frequency *P* moves up closer to the peak. This means that the capacitive reactance is greater, which means that the effective capacitance is lower.

In the same fashion, tuning to a *lower* frequency moves *P* down to a lower impedance point, indicating a higher effective capacitance. In this off-tune condition the LC circuit can be used as a sort of variable capacitance.

LOOP TUNING

To apply this to the loop-tuning problem the *LC* is connected in series with the loop (fig. 3a). As the frequency rises the impedance shows a high peak at

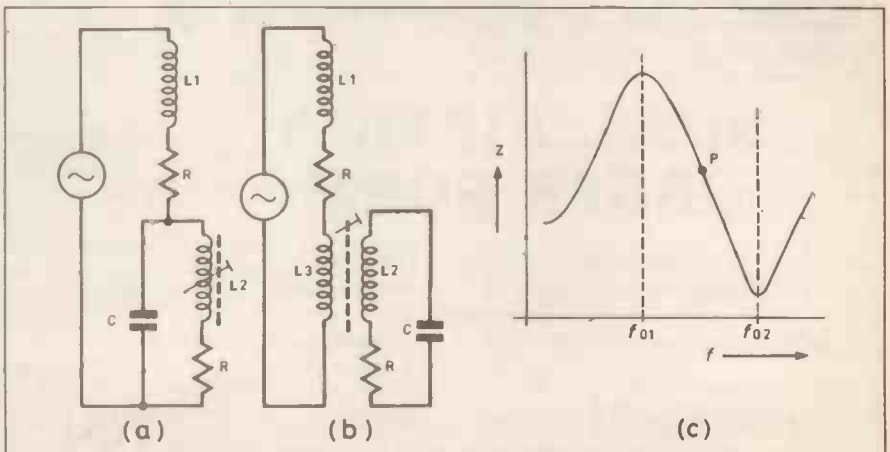


Fig. 3(a). An LC circuit can be substituted for C in Fig. 1a. (b) The effective size of C is magnified by transformer (c) Impedance-frequency graph.

f_{01}, the resonant frequency of C and L2, then a dip at f_{02} where L1 series-resonates with the capacitive region of the C, L2 response.

This shows that if L1 is the inductance of a loop aerial tuning can be effected by means of the added C, L2 circuit. However, this is only of use if the effective capacitance has the correct value to tune L1 to the wanted frequency. With my L1 of 8µH we need an effective capacitance of about 80nF.

Consideration of the response shown in Fig. 2 tells you that the impedance on the capacitive side of the peak is high, certainly higher than the impedance of C on its own. So Fig. 3a doesn't help unless C is higher than the value needed to resonate L1 in the absence of L2. We know that this value of C is uncomfortably high, so Fig. 3a isn't any use.

Fortunately there's an easy way out. A winding (L3, Fig. 3b) on L2, with a much smaller number of turns than L2, steps down the impedance. A lower capacitive impedance means a higher effective capacitance, which is what we need.

This is where my i.f. transformers come in. The low-impedance coupling winding provides about the right amount of impedance reduction. The tuned frequency of the i.f. transformer (455kHz) is wrong, or course, but easily reduced by adding more capacitance. The actual amount needed is affected by the number of turns on the coupling winding and has to be found by trial and error. For the record, my particular transformers were tuned to 455kHz with 200pF. To get 198kHz with the loop connected this had to be increased to 1330pF. Turning the tuning "slug" (ferrite core) then gave the range 174kHz-203kHz.

IN THE FRAME

This arrangement gave quite good boosting of the signal. However, for my son's problem I ended up by using a different solution: a multi-turn coil round a picture frame. By adjusting the number of turns this could be set to tune to 198kHz with a fixed capacitance of 3300pF.

I thought that, being smaller, the picture frame aerial would be easier to position to find the best signal. In fact it turned out that it worked well enough when placed close enough to the receiver to give magnetic-field coupling. Even though signal strength was low in this position the picture frame was so much more effective than the internal ferrite-rod aerial that an adequate signal was picked up.

By making my large loop I had, in fact, over-engineered the job. The large loop does, however, have possible use as a means of DX-ing long and medium wave stations. And anyway it was fun experimenting.

For anybody who wants to try out the large-loop idea one simple rule gives a pointer to the capacitance needed to retune the i.f. transformer. The loop inductance being in parallel with the coupling winding causes an increase in the tuned frequency of the i.f.t.

It follows that the added capacitance must be greater than what is needed to tune the i.f.t. to the wanted frequency before the loop is connected. If you know the value of the built-in capacitance, this total capacitance is easily calculated.

Divide the nominal frequency of the i.f.t. by the wanted frequency, square the answer and multiply the built-in capacitance by it.

Example: i.f. = 450kHz, built-in capacitor 200pF, wanted frequency 150kHz: 450/150 = 3; 3^2 = 9; total capacitance needed = 9 × 200 = 1800pF. With the loop in situ more than this is needed, but you are in the right area.

For the record, my i.f.t. needed a total of 1056pF for 198kHz, in the absence of the loop. With my loop connected the value required turned out to be 1330pF total.

EVERYDAY READOUT

WOOFER

Dear Ed.,

I was intrigued to see the idea of using two speakers face to face in the project *Sub-Woofer* by Paul Henderson in the August issue of EE.

Presumably this means that the external speaker could transmit twice its normal maximum rating, half from its own magnet/coil assembly and half by air pressure from the internal speaker. Would the speaker surround be able to take this?

Similarly the internal speaker cone could move twice its rated maximum displacement and in this case would the speaker box be large enough?

If the author is right and the face to face speaker arrangement gives twice the output for a given box size, then this seems to me to be quite a breakthrough in the quest for smaller loudspeaker cabinets.

My own interest is more in P.A. work and I would like to ask for the author's views on the feasibility of using two speakers face to face, together with a piezo-electric tweeter to cover the audio range – say 45Hz to 16kHz. The circuitry would then be the sub-woofer circuit of the article together with a direct connection to the normal power amplifier output. This would hopefully give the boosted low frequencies together with the unboosted remainder of the audio range.

I shall be grateful for your comments.

C. F. Stevenson
London SW19

I would first like to thank Mr. Steventon for his letter regarding the Sub-Woofer *project. Unfortunately he appears to have got the wrong end of the stick regarding how the system operates. Both drivers are connected face to face and are operated electrically in antiphase. The result is that both speaker cones move in the same direction and act as a single cone.*

The advantage of this mode of operation are far from obvious, at first sight. However doubling the mass of the moving cone allows a 50% reduction in the case volume over that required with a single speaker. Furthermore the two drivers are working as a mechanical analog to a push-pull output stage. The push-pull action leads to the elimination of even harmonic distortion. In speaker systems frequency doubling, second harmonic distortion, is the major non linearity at low frequencies.

So by using two speakers in this manner we both halve case size and eliminate the major source of distortion. These two factors, taken together, more than justify the extra expense of a second driver.

As far as the system as a whole is concerned the sensitivity is the same as if a single driver had been used.

As for the possibility of using the Sub-Woofer *as part of a full range system I can see no insuperable obstacles. Removing the top cut filter will give the* Sub-Woofer *a response that extends to the upper midrange while preserving the bass. A piezo tweeter could be simply connected in parallel with the woofers to produce the required response. I must stress that I haven't tried this myself and I can forsee a possible problem with diffraction effects caused by the outward facing speaker magnet in the midrange.*

Paul Henderson

FULL CERTIFICATE

Dear Ed.,

I read with interest the item about City and Guilds in *Everyday News* (July '92). But what I would like to know is why they won't allow anyone to take the 726/361 Final on advanced level in Digital Electronics.

I, like thousands of other unemployed people, go on E.T. courses to obtain a C&G qualification, but after completing the 341 you find they will not send out the 361 documentation. Admittedly the course is interesting but if you are after a "full" certificate you are wasting time and money, in fact, for those on E.T., Government money.

My tutor rang them and they said there was no call for this level, but in fact I had written to them and my tutor rang them on an earlier occasion and was informed to the effect that there was not a fourth level. We persisted because four levels are quoted in their booklets.

I wonder if you could print a statement from them on their policy concerning this matter, or print something to say those who wish to take the fourth should persist in applying to C&G. May I say that we use your *Introductory Digital Electronics, Teach-In 4* book and very useful it is to.

J. G. Wood
Newport

I have checked out the position relating to the module on Digital Electronics raised by J. G. Wood.

Information Technology (7261) is a modular scheme intended *to cover the complete range of IT at four levels. Not every topic area is yet covered at four levels.*

New modules are being developed all the time in response to demand from centres, but we have had to establish a priority rating and, at present, module 361 is quite a long way down the list. That situation is unlikely to change in the short term unless we have evidence of great demand.

In summary, therefore, the documentation required by Mr. Wood cannot be sent to him because there is none to send. Notwithstanding this, a full Certificate (or depending upon the mix of modules, a Diploma or Advanced Diploma) is still available and Mr. Wood's Centre should also be eligible for ET funding.

If his centre wishes to submit their own proposals for a centre-devised version of module 361, City and Guilds will be pleased to vet them for technical content and administer the scheme in the normal way. Application should be made to Division 13,

I trust this answers all the points raised by Mr. Wood in his letter.

A. A. W. Sich
Head of Marketing
and Public Relations
City and Guilds

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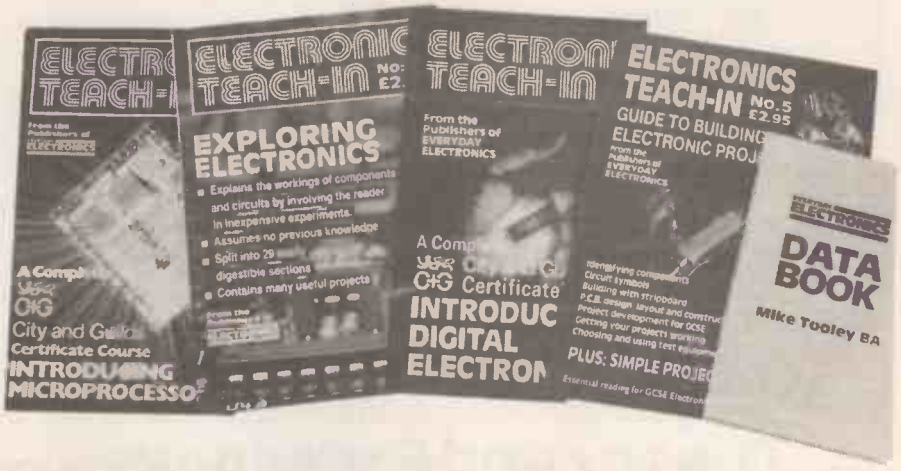

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A. Pickford
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Lego/Logo & Spectrum		660	£6.49
Wash Pro	NOV'89	643	£3.83
Logo/lego & Sepctrum Interface		664	£5.60

PCB SERVICE

See opposite page for ordering details.

PROJECT TITLE		Order Code	Cost
Biofeedback Monitor – Front End	NOV '89	661	£4.52
Processor		662	£4.56
EEG Electrode Impedance Meter	DEC '89	665	£3.98
Biofeedback Signal Generator	JAN '90	666	£4.08
Quick Cap Tester	FEB '90	668	£3.92
Weather Stn: Anemom. – Freq./Volt Board		670	£3.94
Optional Display		669	£3.73
Wind Direction		673/674	£4.22
System Power Supply		675	£3.59
Prophet In-Car Ioniser		676	£3.18
Weather Stn: Display Driver	MAR '90	672 & 678	£4.22
Display and Sensor		671	£4.47
Fermostat Mk2		677	£4.28
Superhet Broadcast Receiver/Tuner/Amp		679/680	£4.22
Stereo Noise Generator	APR '90	681	£4.24
Digital Experimenter's Unit – Pulse Generator		682	£4.46
Power Supply		683	£3.66
Enlarger Timer		684	£4.28
Weather Stn: Rainfall/Sunlight Display		685	£4.27
Rainfall Sen and Sunlight Sen		686/687	£4.16
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Mains Appliance Remote Control			
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LM723 Module		713	£4.21
Spatial Power Display	JAN '91	714	£5.33
Amstrad PCW Sound Generator		715	£5.03
Teach-In '91, Part 2 – G.P. Transistor Amp		717	£3.77
Dual Op.Amp Module		718	£3.83
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R.F. section (726), Voltage Regulator (727)		726/7/8	£3.06 per board
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Pocket Tone Dialler	MAR '91	729	£4.36
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Digilogue Car Tachometer	JUN '91	744	£5.63
Modular Disco Lights – Simple Chaser		745	£5.00
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PROJECT TITLE		Order Code	Cost
Automatic Light Control – PSU Board	JUN '91	747	£4.88
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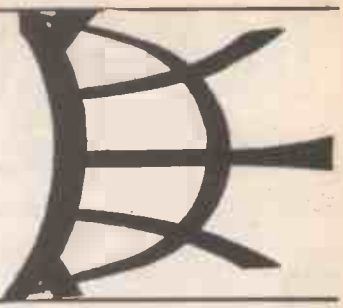
REPORTING AMATEUR RADIO



Tony Smith G4FAI

AMATEURS TO THE RESCUE!

The days of amateur radio coming to the rescue of seafarers in distress are not yet over. A recent report in the *W5YI Report*, an amateur radio newsletter published in the USA, describes how three amateurs in Hawaii assisted a ship in trouble on June 7 this year.

The amateurs were in the shack of Jim Reid, KH6/W6KPI, who runs the intriguingly titled "Lawailoa Bed and Breakfast Retreat for Hams" on the island of Kauai. At 0240 UTC, John Hamby, WB4UZW, was talking to friends in North Carolina and Virginia on the 20 metre band when the trio, completed by Bill Tise, KB4UZN, suddenly heard a distress call breaking in on the conversation and signing "WYZ 2403". This claimed an emergency situation on board a ship off the coast of Cuba with its navigation system no longer working after the ship had been struck by lightning.

At first this was thought to be a hoax but the breaker identified himself as the skipper of the commercial vessel *Sea Harvest* out of Fort Meyers, Florida. Not knowing where he was or where he was headed he was worried that he might enter hostile Cuban waters. He had stopped his engine and had begun making distress calls without getting a response, finally moving into the amateur band to seek help.

John contacted an amateur friend in North Carolina who called the Coast Guard. Within minutes NMA-Miami, a Coast Guard communications station, appeared on the amateur frequency calling *Sea Harvest* but the ship could not hear it.

SOS LIGHT SIGNALS

For the next few hours Jim Reid's station relayed information between *Sea Harvest* and the Coast Guard with the three amateurs taking it in turns at the microphone. The ship reported pitch dark clouded skies with frequent squalls and lightning strikes.

An unidentified vessel approached and the Coast Guard suggested the ship send SOS light signals. The unlit mystery vessel gave no response but circled the *Sea Harvest*, gradually closing in.

With all messages still relayed through Hawaii, the Coast Guard was informed that the other vessel appeared to have about 50 men on deck, none of whom spoke English. The Coast Guard suggested several Spanish phrases for the captain to shout, such as "Which way is Cayman Island?" and "Which direction is south?"

By this time, other amateurs were on frequency, following the drama, and a Mexican station suggested he shout "ayuda", the Spanish word for "help". Eventually the Spanish-speaking sailors understood and pointed to the south. The captain took this to mean this would keep him clear of Cuban waters, and the other boat sailed away to the east.

Sea Harvest and the Coast Guard finally established direct radio contact and the ship was directed to start its engine and sail south out of harm's way. At 0635 UTC the three amateurs in Hawaii signed off. The captain, Eddie Jacobsen, expressed his deep thanks to them and all the other amateurs who had helped with the relay link, marvelling that he could obtain help literally from the other side of the planet via amateur radio. He and the Coast Guard then changed over to a marine frequency.

Interestingly, Jim Reid is currently involved with a local restriction that could force him to lower his 45 foot antenna to 30 feet and has to appear before a hearing to argue why the extra height is necessary. Without that extra height his station might never have established contact with the *Sea Harvest*, and it is to be hoped that the hearing will recognise that on occasions amateur radio can be very much more than "just a hobby".

NEW RADIO SPECTRUM REVIEW

The President of the Board of Trade has announced a third radio spectrum review by an independent committee, this time to examine the frequency range 28-470MHz which among other services contains several amateur radio bands.

According to a DTI press release of July 14, this frequency range is one of the most intensively used parts of the radio spectrum and demand for access is increasing. The aim of the review is to examine existing and planned use of the spectrum and to make recommendations on that use taking into account national and international developments in radiocommunications, current and foreseen.

The Committee will welcome evidence from those having an interest in use of this part of the radio spectrum and will complete its report by October 1993. The amateur bands concerned are: 28·00-29·70; 50·00-52·00; 70·00-70·50; 144·0-146·0; and 430·0-440·0 MHz, and presumably the Radio Society of Great Britain (RSGB) will be submitting evidence to the Committee relating to amateur use of these frequencies.

PREVIOUS RECOMMENDATIONS

When management consultants previously reported to the government on the possible benefits of introducing market forces and a price mechanism into radio spectrum management (reported in this column August 1987) the RSGB over-optimistically anticipated that amateur radio would fall well outside the scope of that review.

In fact, the report, while recognising that amateurs have a special place in the radio spectrum, recommended against further frequency allocations for amateurs and suggested that reductions of existing allocations might be considered.

After the report was published, the Society was apparently still confident that amateur radio was safe in the face of ever-increasing commercial demands for limited spectrum and one can only hope they were right. In the USA, however, amateurs have already lost the 220-222 MHz band as a result of pressure from the giant United Parcel Service (UPS) and, again according to the *W5YI Report*, the Federal Communications Commission (FCC) currently has 60,000 applications for licenses in that band, including 174 for nationwide channels.

A warning note can be detected in a repeated call from the FCC's Chairman for authority from Congress to auction licenses to the highest bidder rather than simply charge processing fees. With governments everywhere continually looking for extra revenue it must surely be only a question of time before the radio spectrum is commercially valued. It will then be the task of the RSGB and other national radio societies to fight to ensure that the traditional non-commercial use of the spectrum by amateurs can continue to exist within such a framework.

NEW RE-CHARGEABLE BATTERY

After writing recently about the reservations and provisos necessary to obtain optimum performance from NiCad batteries (EE, December 1991), I was interested to discover that an article in *Batteries International*, January 1992, reports that reusable 1·2 volt alkaline-manganese (RAM) high energy cells are expected to be marketed sometime soon, possibly at half the cost of equivalent size NiCad cells.

Apparently, in the 1960's Ever-Ready (US) sold a rechargeable version for portable TVs and lanterns which was withdrawn later due partly to safety considerations. Recent technology has overcome the original problems and the new product is claimed to have advantages over NiCads and even lead acid batteries (in a flat-plate version).

An AA-size RAM, for instance, is claimed to produce 2000mAh of energy compared with 500-600mAh for the same size standard NiCad. Other advantages claimed include a charge retention period of up to three years compared to 3-6 months for NiCads, no "memory" effect, and non-toxicity in mercury-free versions.

From the information given it sounds as if these new batteries will overcome most of the disadvantages of NiCads in amateur radio which I described previously. I hope, however, that the price of chargers won't be exorbitant and that at least one version will be available to charge ten cells in one go!

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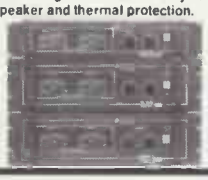

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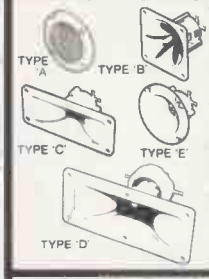

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OMP/MF 200 Mos-Fet Output power 200 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 50V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 300 x 155 x 100mm.
PRICE £64.35 + £4.00 P&P

OMP/MF 300 Mos-Fet Output power 300 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 60V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 330 x 175 x 100mm.
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OMP/MF 450 Mos-Fet Output power 450 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 75V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB, Fan Cooled, D.C. Loudspeaker Protection, 2 Second Anti-Thump Delay. Size 385 x 210 x 105mm.
PRICE £132.85 + £5.00 P&P
NOTE: MOS-FET MODULES ARE AVAILABLE IN TWO VERSIONS: STANDARD - INPUT SENS 500mV, BAND WIDTH 100KHz. PEC (PROFESSIONAL EQUIPMENT COMPATIBLE) - INPUT SENS 775mV, BAND WIDTH 50KHz. ORDER STANDARD OR PEC.

Vu METER Compatible with our four amplifiers detailed above. A very accurate visual display employing 11 L.E.D.s (7 green, 4 red) plus an additional on/off indicator. Sophisticated logic control for very fast rise and decay times. Tough moulded plastic case, with acrylic tinted front. Size 84 x 27 x 45mm.
PRICE £8.70 + 50p P&P

LOUDSPEAKERS

LARGE SELECTION OF SPECIALIST LOUDSPEAKERS AVAILABLE, INCLUDING CABINET FITTINGS, SPEAKER GRILLES, CROSS-OVERS AND HIGH POWER, HIGH FREQUENCY BULLETS AND HORNS, LARGE (A4) S.A.E. (50p STAMPED) FOR COMPLETE LIST.
P - From McKenzie Professional Series
S - From McKenzie Studio Series

McKENZIE:- INSTRUMENTS, P.A., DISCO, ETC

ALL McKENZIE UNITS 8 OHMS IMPEDANCE
8" 100 WATT P C8-100GP GEN. PURPOSE, LEAD GUITAR, EXCELLENT MID, DISCO.
RES. FREQ. 80Hz, FREQ. RESP. TO 7KHz, SENS 96dB. PRICE £31.45 + £2.00 P&P
10" 100WATT S C10-100GP GUITAR, VOICE, KEYBOARD, DISCO, EXCELLENT MID.
RES. FREQ. 72Hz, FREQ. RESP. TO 6KHz, SENS97dB. PRICE £38.89 + £2.50 P&P
10" 200WATT S C10-200GP GUITAR, KEYB'D, DISCO, EXCELLENT HIGH POWER MID.
RES. FREQ. 69Hz, FREQ. RESP. TO 5KHz, SENS 97dB. PRICE £53.21 + £2.50 P&P
12" 100WATT P C12-100GP HIGH POWER GEN. PURPOSE, LEAD GUITAR, DISCO.
RES.FREQ. 49Hz, FREQ. RESP. TO 7KHz, SENS 98dB. PRICE £40.35 + £3.50 P&P
12" 100WATT P C12-100TC (TWIN CONE) HIGH POWER, WIDE RESPONSE, P.A., VOICE, DISCO.
RES. FREQ 45Hz, FREQ. RESP. TO 12KHz, SENS 97dB. PRICE £41.39 + £3.50 P&P
12" 200WATT S C12-200B HIGH POWER BASS, KEYBOARDS, DISCO, P.A.
RES. FREQ. 45Hz, FREQ. RESP. TO 5KHz, SENS 99dB. PRICE £71.91 + £3.50 P&P
12" 300WATT S C12-300GP HIGH POWER BASS, LEAD GUITAR, KEYBOARDS, DISCO ETC.
RES. FREQ. 49Hz, FREQ. RESP. TO 7KHz, SENS 100dB. PRICE £95.66 + £3.50 P&P
15" 100WATT P C15-100BS BASS GUITAR, LOW FREQUENCY, P.A., DISCO.
RES. FREQ. 40Hz, FREQ. RESP. TO 5KHz, SENS 98dB. PRICE £ 59.05 + £4.00 P&P
15" 200WATT P C15-200BS VERY HIGH POWER BASS.
RES. FREQ. 40Hz, FREQ. RESP. TO 3KHz, SENS 98dB. PRICE £80.57 + £4.00 P&P
15" 250WATT S C15-250BS VERY HIGH POWER BASS.
RES. FREQ. 39Hz, FREQ. RESP. TO 4KHz, SENS 99dB. PRICE £90.23 + £4.50 P&P
15" 400WATT S C15-400BS VERY HIGH POWER, LOW FREQUENCY BASS.
RES. FREQ. 40Hz, FREQ. RESP. TO 4 KHz, SENS 100dB. PRICE £105.46 + £4.50 P&P
18" 500WATT S C18-500BS EXTREMELY HIGH POWER, LOW FREQUENCY BASS.
RES. FREQ. 27Hz, FREQ. RESP. TO 2KHz, SENS. 98dB. PRICE £174.97 + £5.00 P&P

EARBENDERS:- HI-FI, STUDIO, IN-CAR, ETC

ALL EARBENDER UNITS 8 OHMS (Except EB8-50 & EB10-50 which are dual impedance tapped @ 4 & 8 ohm)
BASS, SINGLE CONE, HIGH COMPLIANCE, ROLLED SURROUND
8" 50watt EB8-50 DUAL IMPEDENCE, TAPPED 4/8 OHM BASS, HI-FI, IN-CAR.
RES. FREQ. 40Hz, FREQ. RESP. TO 7KHz SENS 97dB. PRICE £8.90 + £2.00 P&P
10" 50WATT EB10-50 DUAL IMPEDENCE, TAPPED 4/8 OHM BASS, HI-FI, IN-CAR.
RES. FREQ. 40Hz, FREQ. RESP. TO 5KHz, SENS. 99dB. PRICE £13.65 + £2.50 P&P
10" 100WATT EB10-100 BASS, HI-FI, STUDIO.
RES. FREQ. 35Hz, FREQ. RESP. TO 3KHz, SENS 96dB. PRICE £30.39 + £3.50 P&P
12" 100WATT EB12-100 BASS, STUDIO, HI-FI, EXCELLENT DISCO.
RES. FREQ. 26Hz, FREQ. RESP. TO 3 KHz, SENS 93dB. PRICE £42.12 + £3.50 P&P
FULL RANGE TWIN CONE, HIGH COMPLIANCE, ROLLED SURROUND
5¼" 60WATT EB5-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC.
RES. FREQ. 63Hz, FREQ. RESP. TO 20KHz, SENS 92dB. PRICE £9.99 + £1.50 P&P
6½" 60WATT EB6-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC.
RES. FREQ. 38Hz, FREQ. RESP. TO 20KHz, SENS 94dB. PRICE £10.99 + 1.50 P&P
8" 60WATT EB8-60TC (TWIN CONE) HI-FI, MILTI-ARRAY DISCO ETC.
RES. FREQ. 40Hz, FREQ. RESP. TO 18KHz, SENS 89dB. PRICE £12.99 + £1.50 P&P
10" 60WATT EB10-60TC (TWIN CONE) HI-FI, MULTI ARRAY DISCO ETC.
RES. FREQ. 35Hz, FREQ. RESP. TO 12KHz, SENS 98dB. PRICE £16.49 + £2.00 P&P

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PROVEN TRANSMITTER DESIGNS INCLUDING GLASS FIBRE PRINTED CIRCUIT BOARD AND HIGH QUALITY COMPONENTS COMPLETE WITH CIRCUIT AND INSTRUCTIONS

3W TRANSMITTER 80-108MHz. VARICAP CONTROLLED PROFESSIONAL PERFORMANCE, RANGE UP TO 3 MILES, SIZE 38 x 123mm, SUPPLY 12V @ 0.5AMP.
PRICE £14.85 + £1.00 P&P

FM MICRO TRANSMITTER 100-108MHz, VARICAP TUNED, COMPLETE WITH VERY SENS FET MIC, RANGE 100-300m, SIZE 56 x 46mm. SUPPLY 9V BATTERY.
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PHOTO: 3W FM TRANSMITTER

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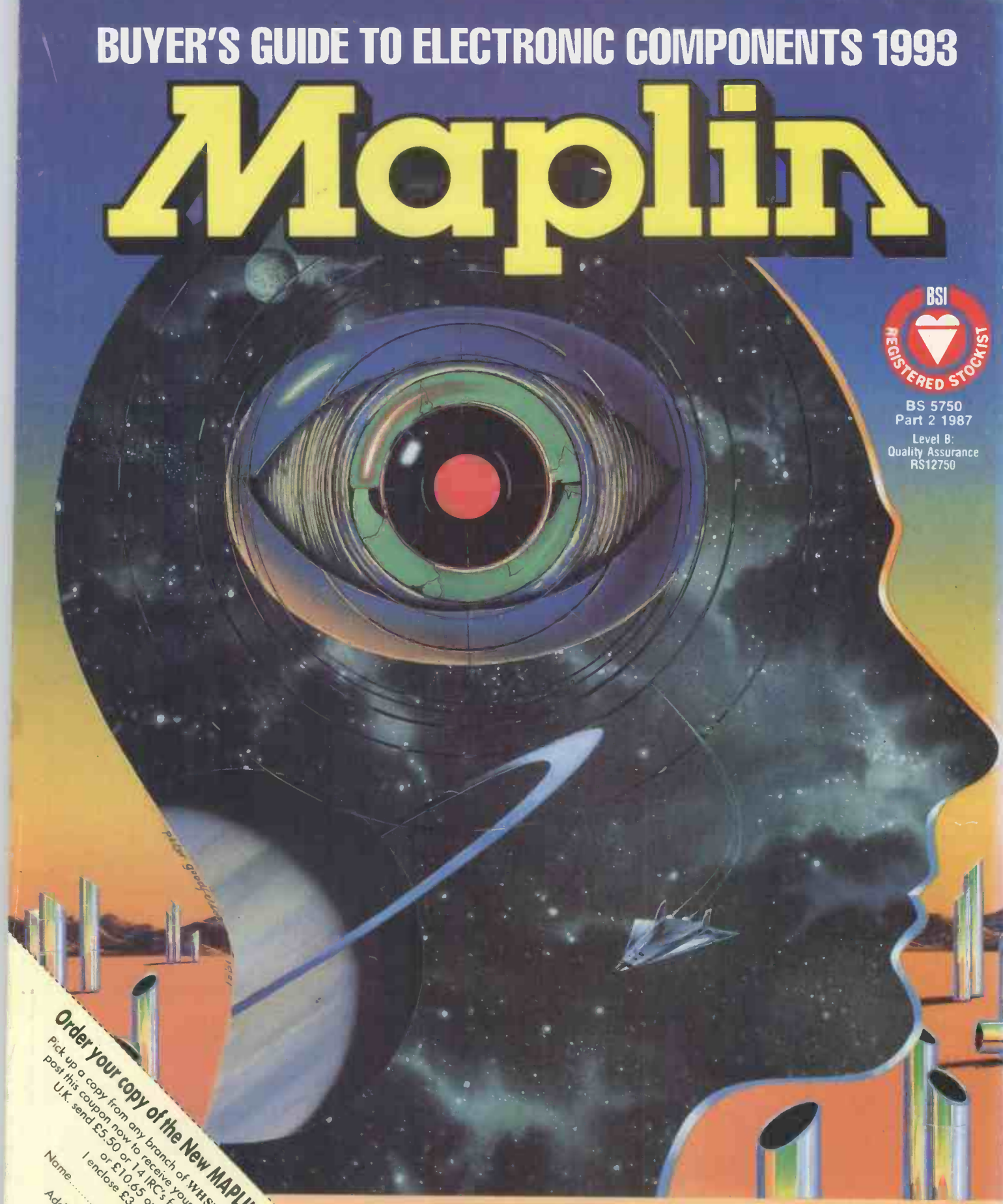

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FULL DETAILS SEE PAGE 27

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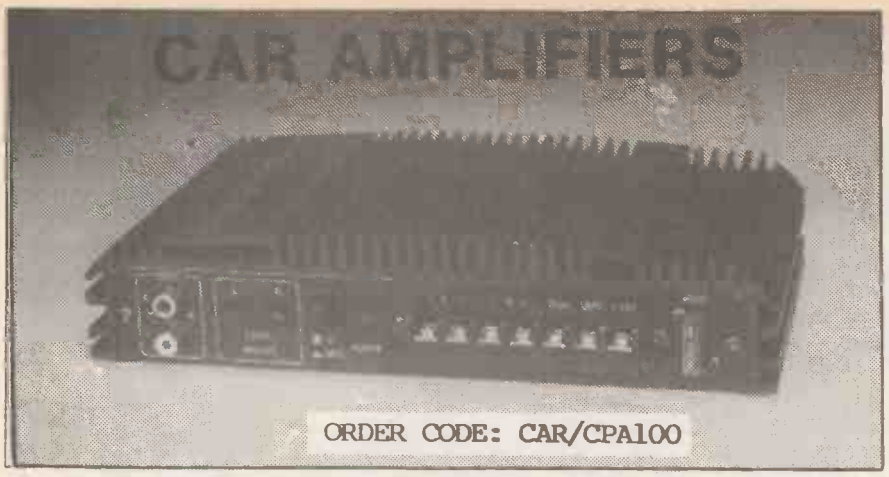
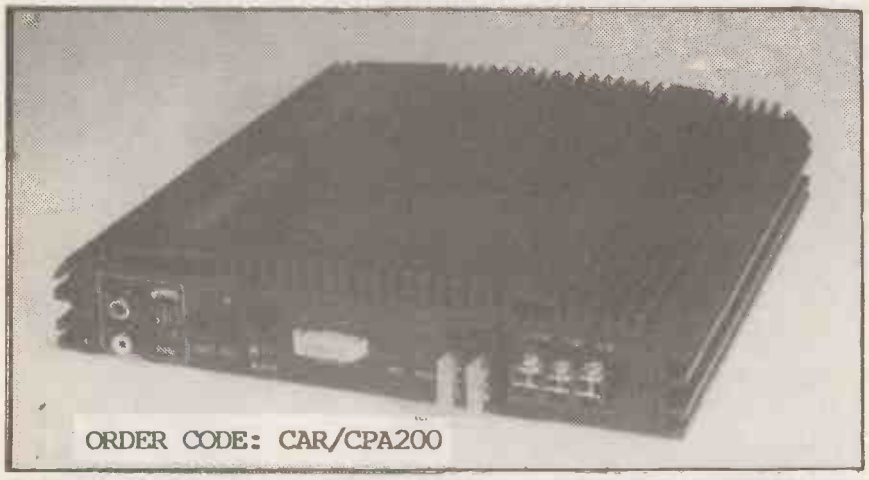


2 x 60W CLASS A AMPLIFIER
B005LA (CPA100)

Class A stereo in-car amplifier capable of delivering 2 x 60W stereo or 120W mono in bridge mode. Inputs are low level phono, with left and right level controls. Full thermal and overload protection.

Output power	2 x 60W stereo 0.1%THD 120W mono 0.1%THD
Signal to noise ratio	>80dB
Frequency response	20-20000Hz
Input sensitivity	100mV-3V adjustable
Input impedance	Low level input 20kΩ
Output impedance	4Ω
Power	14.4Vdc 15A
Dims	240 x 120 x 50mm

£41-50



2x 200W CLASS A AMPLIFIER
B005M CPA200

High power class A amplifier capable of delivering 2x 200W stereo or 400W mono in bridge mode. Inputs are direct from the speaker outputs of the car radio/cassette or low level phono inputs, with left and right level controls. Full thermal and overload protection.

Output power	2x 200W stereo 0.08%THD 400W mono 0.2% THD
Signal to noise ratio	>90dB
Frequency response	10-50000Hz
Input sensitivity	100mV-3V adjustable
Input impedance	High level input 100Ω Low level input 20kΩ
Output impedance	4Ω
Damping factor	>180 into 4Ω
Power	14.4Vdc 43A nom
Dims	240 x 180 x 50mm

£109-50

4 x 120W CLASS A AMPLIFIER
B005N (CPA504)

High power 4-channel class A amplifier, capable of delivering 4 x 120W or 2 x 240W in bridge mode. Inputs are direct from the speaker outputs of the car radio cassette, or low level phono inputs with left and right level controls. Full thermal overload protection.

Output power	4 x 120W or 2 x 240W (bridged)
Signal to noise ratio	>90dB
Frequency response	10-50000Hz
Input sensitivity	100mV-3V adjustable
Input impedance	High level input 100Ω Low level input 20kΩ
Power	14.4Vdc 60A
Dims	400 x 240 x 50mm

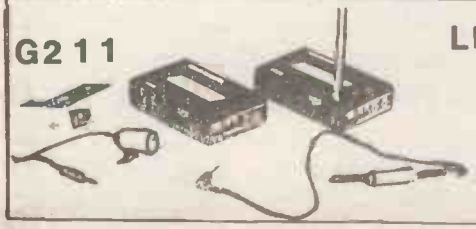
£120-75

ATTENTION RETAILERS.....
WHOLESALE/QTY PRICES ARE
AVAILABLE ON THESE AMPS.

EQUALIZER/BOOSTER

Slimline 7-band equalizer/booster with 60W total output power into 4 speakers. Built-in 3.5mm stereo headphone socket. Twin 5 LED power level indicators. Front/rear fader control. Mounting hardware included.

Output power	30W per channel
Frequency response	20 - 20000Hz
Input impedance	23Ω
Control frequencies	60, 150, 400, 1k, 2.4k, 6kHz, 15kHz
Control range	12dB boost or cut
Output impedance	4 - 8Ω
Power	12 - 14Vdc negative earth
Dims	149 x 133 x 28mm



LIST PRICE: £49-50
SALE PRICE
£39-50

WIRELESS MICROPHONE

A 3-channel 2-part wireless microphone system designed for use with video cameras. The tie-clip mic has a remote belt clip transmitter with on/off switch. The receiver has a hot shoe for mounting on the video camera. The system allows greater mobility with a microphone than can be achieved with the camcorder mic.

12V CAR/CARAVAN ACCESSORIES

Hand held, HALOGEN spotlight with a **55Watt** bulb, producing more than 250,000 candle power, directed by a concave, electro-plated reflector.
Supplied complete with hanging loop and 3.6 Metres of coiled lead with a cigar plug fitted. These lights are a **must** for cars, vans, caravans, boats etc. The beam on these lights is VERY impressive.

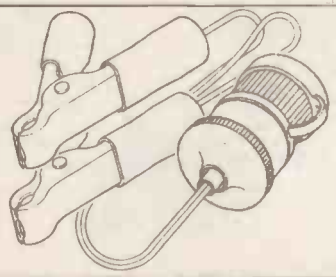
POWER.....12VDC 55Watts
DIMS.....125 X 125 X 140mm Approx.

	1+	4+	10+	100+
PRICE:	£5-75	£5-50	£5-00	£4-25

ORDER CODE: OPTO/QHS

CAR POWER LEAD
Very handy lead, fused 3A cigar plug connected to a moulded 2.1mm DC power plug. Lead length approx. 2 Metres.
Colour: Black

	1+	10+
ORDER CODE: CAR/P.LEAD	£1-50	£1-25



CAR EXTENSION CONNECTOR
Every car, van, caravan & motorhome should have one of these! It is a cigarette lighter socket connected to a pair of colour coded crocodile clips. This clever lead is INVALUABLE!!

	1+	4+
ORDER CODE: CAR/JL	£2-99	£2-50

PLUG-IN FLASHING LED
A flashing LED built into a car cigar plug to act as a visual warning/deterrent that alarm may be fitted. Simply plug the device into your cigar socket. Won't flatten your car battery and it may stop your vehicle being stolen! All for £1-95!!

ORDER CODE: CAR/B200Z **PRICE: £1-95**

CAR LITTER BAG **(LEATHERETTE)**
Not quite in our normal sphere of business but we were so impressed with this product. Simply attach the bag behind the headrest. If you have children you MUST buy at least one of these!!

ORDER CODE: CAR/LIT **£5-99ea** **2 for £10**

TRAVEL KETTLE - 12VDC
Supplied complete with mounting stand. Plugs directly into a car cigar lighter socket for power. A 'power-on' light is on the kettle base. Ideal for cars, caravans, motorhomes, camping etc etc.

Power.....12Vdc 9A Capacity.....0.5pints
Dimensions: 143 X 125 X 112mm (approx)

END OF SEASON SALE PRICE: £11-50 2 for £10

¼" JACK PLUGS AND SOCKETS - MONO AND STEREO

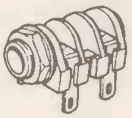
		1+	10+
C001	¼" Mono Plug Unscreened	26p	22p
C002	¼" Mono Plug Screened	58p	52p
C003	¼" Stereo Plug Unscreened	36p	32p
C004	¼" Stereo Plug Screened	88p	82p
C005	¼" Mono Chassis Socket 2 Tag	30p	26p
C006	¼" Mono Chassis Socket 4 Tag	38p	34p
C007	¼" Stereo Chassis Skt. 6 Tag	40p	35p
C008	¼" Mono Line SKt. Unscreened	33p	29p
C009	¼" Mono Plug Right Angle Unscreened	40p	36p
C010	¼ Mono Plug Right Angle Screened	46p	42p
C011	¼" Mono Unswitched Open Chassis socket	44p	38p
C012	¼" Mono Switched Open Chassis socket	52p	48p


C001


C002

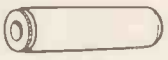

C003


C004


C005


C006


C007


C008

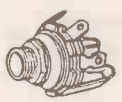

C009


C010

¼" JACK PLUGS MONO AND STERO - PROFESSIONAL

A range of top quality mono & stereo professional plugs and sockets. All metal, fully screened bodies with coiled spring flex outlet. Top part of cover is sleeved in coloured plastic for easy identification. Covers are knurled for firm grip.

	1+	10+
C012A ..MONO PLUG BLACK	85p	75p
C012B...MONO PLUG RED	85p	75p
C012C...MONO PLUG ORANGE	85p	75p
C012D...MONO PLUG YELLOW	85p	75p
C012E...MONO PLUG BLUE	85p	75p
C012F...MONO PLUG GREY	85p	75p
C012G...MONO LINE SOCKET RED	105p	95p
C012H...MONO LINE SOCKET BLACK	105p	95p
C012J...MONO LINE SOCKET BLUE	105p	95p
C012K...MONO LINE SOCKET YELLOW	105p	95p
C012L...STEREO PLUG BLACK	110p	99p
C012M...STEREO PLUG RED	110p	99p
C012N...STEREO	110p	99p


C011


C012


C012A C012F

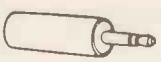

C012G C012K


J12L C012N

2.5mm JACK PLUGS AND SOCKETS-MONO AND STEREO

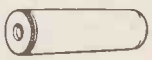
		1+	10+
C013	2.5mm Mono plug Unscreened	16p	12p
C014	2.5mm Mono Plug Screened	38p	34p
C015	2.5mm Stero Plug Unscreened	55p	50p
C016	2.5mm Mono Chassis Socket	24p	21p
C017	2.5mm Mono Line Socket Unscreened	21p	18p


C013


C014


C015


C016


C017

3.5mm JACK PLUGS AND SOCKETS-MONO AND STEREO

		1+	10+
C018	3.5mm Mono plug Unscreened	16p	13p
C019	3.5mm Mono Plug Screened	35p	30p
C020	3.5mm Stereo Plug Unscreened	25p	20p
C021	3.5mm Stereo Unscreened Right Angle	28p	24p
C022	3.5mm Stereo Plug Screened	58p	52p
C023	3.5mm Mono Chassis Socket	24p	22p
C024	3.5mm Mono Line Socket Unscreened	24p	22p
C025	3.5mm Stereo Line socket Unscreened	25p	23p
C026	3.5mm Stereo PCB Socket Switched	22p	19p
C027	3.5mm skeletal chassis Stereo socket. Plastic unswitched	42p	38p
C028	3.5mm skeletal chassis Stereo socket. Plastic switched	49p	44p


C018


C019


C020


C021


C022


C023


C024


C025

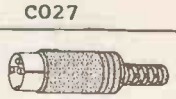

C026

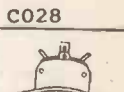

C027


C028

DIN PLUGS AND SOCKETS

PLUGS - All with grey plastic covers and cable grips. 7 & 8 pin are BLACK
CHASSIS SOCKETS - All metal except for 2 pin which is moulded plastic.
IN-LINE SOCKETS - All with GREY covers except for 7 & 8 pin which are BLACK





PLUGS	CODE		1+	10+
2 pin	C100		14p	12p
3 pin	C104		20p	18p
4 pin	C107		26p	24p
5 pin	C110	180°	22p	20p
5 pin	C113	240°	26p	24p
5 pin	C116	360°	26p	24p
6 pin	C119		26p	24p
7 pin	C122		28p	26p
8 pin	C125		38p	35p

CHASSIS SOCKETS	CODE	1+	10+
2 pin	C102	12p	10p
3 pin	C105	29p	27p
4 pin	C108	30p	28p
5 pin 180°	C111	32p	29p
5 pin 240°	C114	32p	29p
5 pin 360°	C117	30p	28p
6 pin	C120	33p	30p
7 pin	C123	33p	30p
8 pin	C126	42p	39p

LINE SOCKETS	CODE	1+	10+
2 pin	C103	14p	12p
3 pin	C106	30p	28p
4 pin	C109	30p	28p
5 pin 180°	C112	32p	29p
5 pin 240°	C115	32p	29p
5 pin 360°	C118	32p	29p
6 pin	C121	33p	30p
7 pin	C124	33p	30p
8 pin	C127	40p	36p

CONNECTORS

2mm CONNECTORS

C250	Plastic Plug Red	14p	11p
C251	Plastic Plug Black	14p	11p
C252	Plastic Plug Green	14p	11p
C253	Plastic Plug White	14p	11p
C254	Plastic Plug Blue	14p	11p
C255	Plastic Plug Yellow	14p	11p
C256	Socket Red	16p	14p
C257	Socket Black	16p	14p
C258	Socket Green	16p	14p
C259	Socket White	16p	14p
C260	Socket Blue	16p	14p
C261	Socket Yellow	16p	14p

2mm BINDING POST - 10A

High quality nickel brass terminal.
2mm socket in top of terminal.

C262	Binding post 2mm Red	45p	40p
C263	Binding post 2mm Black	45p	40p

PHONO PLUGS

Plastic covers, solder terminals.

C290	Red	15p	12p
C291	Black	15p	12p
C292	White	15p	12p
C293	Blue	15p	12p
C294	Yellow	15p	12p
C295	Green	15p	12p
C296	Grey	15p	12p

High quality, soft plastic covers, solder terminals, cable protector.

C296	Red	18p	15p
C297	Black	18p	15p

C298	Metal Phono plug (Screened)	28p	26p

High grade, metal phono plugs with coloured plastic ID band on cover with matching cable protector.

C299	Red	28p	25p
C300	Black	28p	25p
C301	Green	28p	25p
C302	Blue	28p	25p
C303	Yellow	28p	25p

PHONO SOCKETS

High grade, metal phono line socket with coloured ID band on cover with matching cable protector

C325	Red	28p	25p
C326	Black	28p	25p
C327	Greeen	28p	25p
C328	Blue	28p	25p
C329	Yellow	28p	25p

Plastic in-line, plastic with solder terminals.

C310	Red	14p	12p
C311	Black	14p	12p
C312	White	14p	12p
C313	Blue	14p	12p
C314	Yellow	14p	12p
C315	Green	14p	12p
C316	Grey	14p	12p

Single phono socket on paxolin. Dia 25mm.

C317		12p	10p

Single chrome chassis socket with colour coded insulator.

C318	Red	20p	18p
C319	Black	20p	18p
C320	White	20p	18p
C321	Blue	20p	18p
C322	Yellow	20p	18p
C323	Brown	20p	18p
C324	Green	20p	18p

CO-AXIAL SOCKET - PANEL MOUNTING

Push-in Needs 18 x 18mm mounting hole.

C356		22p	20p

CO-AX PLUG - Metal

C357		25p	22p

CO-AXIAL CHASSIS SOCKET.

C358		20p	18p

CO-AXIAL LINE SOCKET - Metal

C359		44p	40p

CO-AXIAL LINE CONNECTOR - Joins two coax plug

C360		20p	18p

4mm CONNECTORS

SOLDERLESS - Hard plastic, screw terminals

C270	4mm Plug Red	15p	12p
C271	4mm Plug Black	15p	12p

SOCKETS - Single nut fixing.

C272	Socket Red	18p	16p
C273	Socket Black	18p	16p
C274	Socket Green	18p	16p
C275	Socket Yellow	18p	16p
C276	Socket + Tag Red	12p	10p
C277	Socket + Tag Black	12p	10p

4mm BINDING POST - High quality

C280	4mm Binding post Red	42p	38p
C281	4mm Binding post Black	42p	38p
C282	4mm Binding post Blue	42p	38p
C283	4mm Binding post Green	42p	38p
C284	4mm Binding post Yellow	42p	38p

PHONO PLUG - GOLD PLATED

Gold plated, knurled body, coiled spring cable outlet. Coloured ID marker bands on body.

C340	Red	85p	75p
C341	Black	85p	75p
C342	White	85p	75p

PHONO LINE SOCKET - GOLD PLATED

Gold plated line sockets with coloured ID bands on body. Knurled body coiled spring cable protector. Solder terminals. Matches above plugs.

C343	Red	90p	80p
C344	Black	90p	80p
C345	White	90p	80p

PHONO CHASSIS SOCKETS - GOLD PLATED

Gold plated, chassis sockets with coloured insulators. Single hole fixing.

C346	Red	60p	55p
C347	Black	60p	55p
C348	White	60p	55p

C350

C351

C352

C353

C354 C355

CAR AERIAL CONNECTORS

Skeleton Plug.

C350		24p	22p

Plastic Plug - Solderless, & screw on cap. Colour: Black

C351		42p	38p

LINE SOCKET - Plastic body, solderless.

C352		48p	44p

CHASSIS SOCKET - Panel cut out 12.7mm

C353		33p	30p

CIGAR PLUG - Fused with 5A fuse. Solder term

C354		£1-15	£1-05

CIGAR PLUG - Non fused.

C355		25p	22p

CO-AXIAL PLUG - Turned Brass

Very high quality.

C361		55p	50p

C356

C357

C358

C359

C360

C361

COMPONENT KIT SALE

SALE PRICES ANY QUANTITY

Resistor Kit – 0.25W (5 off)

A pack containing 305 resistors. Values as listed below. Each value individually packed and each bag marked with the values enclosed.

Contents: 5 off each value:

10R, 12R, 15R, 18R, 22R. 27R, 33R, 39R, 47R, 56R, 68R, 82R, 100R, 120R, 150R, 180R, 220R, 270R, 330R, 470R, 560R, 680R, 820R, 1K, 1K2, 1K5, 1K8, 2K2, 2K7, 3K3, 3K9, 4K7, 5K6, 6K8, 8K2, 10K, 12K, 15K, 18K, 22K, 27K, 33K, 39K, 47K, 56K, 68K, 82K, 100K, 120K, 150K, 180K, 220K, 270K, 330K, 390K, 470K, 560K, 680K, 820K, 1M.

Order Code:	1+	5+
KIT/RES/25/5	~~£3.75~~	~~£3.25~~

SALE PRICE £2-99

Resistor Kit – 0.25W (10 off)

A pack containing 610 resistors. Values as listed below. Each value individually packed and each bag marked with the value enclosed.

Contents: 10 off each value:

10R, 12R, 15R, 18R, 22R, 27R, 39R, 47R, 56R, 68R, 82R, 100R, 120R, 150R, 180R, 220R, 270R, 330R, 390R, 470R, 560R, 680R, 820R, 1K, 1K2, 1K5, 1K8, 2K2, 2K7, 3K3, 3K9, 4K7, 5K6, 6K8, 8K2, 10K, 12K, 15K, 18K, 22K, 27K, 33K, 39K, 47K, 56K, 68K, 82K, 100K, 120K, 150K, 180K, 220K, 270K, 330K, 390K, 470K, 560K, 680K, 820K, 1M.

Order Code:	1+	5+
KIT/RES/25/10	~~£5.10~~	~~£4.60~~

SALE PRICE £4-00

Resistor Kit – 0.25W POPULAR

A pack containing a total of 1,000 of 1,000¼W 5% carbon film resistors ranging in value from 10R to 10M.

In this pack we have included larger quantities of the more popular values.

Each value individually packed.

Contents:

No.	VALUE	NO.	VALUE	NO.	VALUE
10 x	10R	10 x	82R	10 x	390R
10 x	12R	20 x	100R	30 x	470R
10 x	18R	10 x	120R	20 x	560R
10 x	22R	10 x	150R	20 x	680R
10 x	33R	10 x	180R	10 x	820R
20 x	47R	20 x	220R	40 x	1K
10 x	56R	20 x	270R	15 x	1K2
10 x	68R	20 x	330R	15 x	1K5
10 x	1K8	10 x	8K2	10 x	39K
25 x	2K2	30 x	10K	30 x	47K
20 x	2K7	15 x	12K	20 x	56K
20 x	3K3	15 x	15K	15 x	68K
15 x	3K9	15 x	18K	10 x	82K
25 x	3K7	20 x	22K	30 x	100K
20 x	5K6	15 x	27K	20 x	120K
15 x	6K8	20 x	33K	15 x	150K
15 x	180K	5 x	820K		
20 x	220K	20 x	1M		
15 x	270K	10 x	2M2		
15 x	330K	5 x	3M3		
10 x	390K	10 x	4M7		
20 x	470K	5 x	6M8		
10 x	560K	20 x	10M		
10 x	680K.				

SALE PRICE £5-50

Order Code	1+	5+
KIT/RES/25/POP	~~£6.99~~	~~£5.99~~

Resistor Kit – 0.5 POPULAR

A pack containing a total of 1,000 ½W 5% carbon film resistors ranging in value from 2R2 to 10M.

In this pack we have included larger quantities of the more popular values. Each value individually packed.

Contents:

NO.	VALUE	NO.	VALUE	NO.	VALUE
5 x	2R2	10 x	12R	10 x	120R
5 x	2R7	10 x	18R	10 x	150R
5 x	3R3	10 x	22R	10 x	180R
5 x	3R9	10 x	33R	20 x	220R
10 x	4R7	20 x	47R	20 x	270R
5 x	5R6	10 x	56R	20 x	330R
5 x	6R8	10 x	68R	10 x	390R
5 x	8R2	10 x	82R	30 x	470R
10 x	10R	20 x	100R	20 x	560R
20 x	680R	10 x	3K9	20 x	22K
10 x	820R	25 x	4K7	10 x	27K
40 x	1K	20 x	5K6	20 x	33K
10 x	1K2	10 x	6K8	10 x	39K
10 x	1K5	10 x	8K2	30 x	47K
10 x	1K8	30 x	10K	20 x	56K
25 x	2K2	15 x	12K	10 x	68K
20 x	2K7	15 x	15K	10 x	82K
20 x	3K3	30 x	18K	30 x	100K
20 x	120K	10 x	680K		
10 x	150K	5 x	820K		
10 x	180K	20 x	1M		
20 x	220K	10 x	2M2		
15 x	270K	5 x	3M3		
15 x	330K	10 x	4M7		
10 x	390K	5 x	6M8		
20 x	470K	20 x	10M		
10 x	560K				

SALE PRICE £9-00

Order Code:	1+	5+
KIT/RES/5/POP	~~£10.75~~	~~£9.75~~

Resistor Kit – 0.5W (5 off)

A pack containing 365 resistors. Values as listed below. Each value individually packed and each bag marked with the value enclosed.

Contents: 5 off each value:

2K2, 2R7, 3R9, 4R7, 5R6, 6R8, 8R2, 10R, 12R, 15R, 18R, 22R, 27R, 33R, 39R, 47R, 56R, 68R, 82R, 100R, 120R, 150R, 180R, 220R, 270R, 330R, 390R, 470R, 560R, 680R, 820R, 1K, 1K2, 1K5, 1K8, 2K2, 2K7, 3K3, 3K9, 4K7, 5K6, 6K8, 8K2, 10K, 12K, 15K, 18K, 22K, 27K, 33K, 39K, 47K, 56K, 68K, 82K, 100K, 120K, 150K, 180K, 220K, 270K, 330K, 390K, 470K, 560K, 680K, 820K, 1M, 1M2, 1M8, 2M2.

Oder Code:	1+	5+
KIT/RES/5/5	~~£5.40~~	~~£5.00~~

£4-50

Resistor Kit – 0.5W (10 Off)

A pack containing 730 Resistors. Values as listed below. Each value individually packed and each bag marked with the value enclosed.

Contents: 10 off each value:

2R2, 2R7, 3R3, 3R9, 4R7, 5R6, 6R8, 8R2, 10R, 12R, 15R, 18R, 22R, 27R, 33R, 39R, 47R, 56R, 68R, 82R, 100R, 120R, 150R, 180R, 220R, 270R, 330R, 390R, 470R, 560R, 680R, 820R, 1K, 1K2, 1K5, 1K8, 2K2, 2K7, 3K3, 3K9, 4K7, 5K6, 6K8, 8K2, 10K, 12K, 15K, 18K, 22K, 27K, 33K, 39K, 47K, 56K, 68K, 82K, 100K, 120K, 150K, 180K, 220K, 270K, 330K, 390K, 470K, 560K, 680K, 820K, 1M, 1M2, 1M5, 1M8, 2M2.

Order Code:	1+	5+
KIT/RES/5/10	~~£8.75~~	~~£7.75~~

£7-00

ALL PRICES INCLUDE V.A.T.

ADD £3.00 P & P PER ORDER

COMPONENT KIT SALE

SALE PRICES ANY QUANTITY

Resistor Kit - 1W (5 off)

A pack containing 365 1W resistors. Values as listed below. Each value individually packed and each bag marked with the value enclosed.

Contents: 5 off each value:

10R, 12R, 15R, 18R, 22R, 27R, 33R, 39R, 47R, 56R, 68R, 82R, 100R, 120R, 150R, 180R, 220R, 270R, 330R, 390R, 470R, 560R, 680R, 820R, 1K, 1K2, 1K5, 1K8, 2K2, 2K7, 3K3, 3K9, 4K7, 5K6, 6K8, 8K2, 10K, 12K, 15K, 22K, 27K, 33K, 39K, 47K, 56K, 82K, 100K, 120K, 150K, 180K, 220K, 270K, 330K, 390K, 470K, 560K, 680K, 820K, 1M, 1M2, 1M5, 1M8, 2M2, 2M7, 3M3, 3M9, 4N7, 5M6, 6M8, 8M2, 10M.

Order Code:	1+	5+
KIT/RES/1/5	~~£15.25~~	~~£14.00~~

SALE PRICE £13-00

Ceramic Kit - 50V - Over £9.70 worth at catalogue prices -

A pack containing 125 50V disc and plate ceramics - ranging in value from 1pF to 10nF (0.01mF).

Each value individually packed and each bag markes with the value enclosed.

Contents: 5 off each value:

1.0pF, 1.8pF, 2.7pF, 3.3pF, 4.7pF, 5.6pF, 6.8pF, 8.2pF, 10pF, 12pF, 22pF, 27pF, 47pF, 68pF, 82pF, 100pF, 150pF, 180pF, 270pF, 470pF, 560pF, 1000pF, 2200pF, 4700pF, 10nF.

Order Code:	1+	5+	
KIT/CER/50V	~~3.99~~	~~£3.50~~	**£3-00**

Electrolytic Kit - Radial - Over £11.00 worth at calalogue prices -

A pack containing 100 miniature radial lead electrolytic capacitors. 12 different values. Each value individually packed.

Contents:

No.	VALUE	VOLTAGE	NO.	VALUE	VOLTAGE
10	1mF	63V	15	10mF	25V
10	2.2mF	63V	10	22mF	25V
10	4.7mF	63V	10	47mF	25V
15	100mF	16V	5	1000mF	16V
5	220mF	16V	2	1000mF	25V
5	470mF	16V	3	2200mF	16V

Oder Code	1+	5+
KIT/ELECT/RAD	£8.50	£7.50

SALE PRICE £7-00

Fuse Kit - 20mm Quick Blow

A pack containing 80 Quick-Blow 20mm Fuses.

Each value individually packed.

Contents:

No.	VALUE	NO.	VALUE	NO.	VALUE
5	x 100mA	10	x 500mA	10	x 3.15A
5	x 250mA	20	x 1A	5	x 5A
5	x 315mA	5	x 1.6A	5	x 6.3A
		10	x 2A		

Order Code:	1+	5+	
KIT/FUSE/QB2	~~£4.75~~	~~£4.25~~	**£3-50**

Fuse Kit - 20mm Anti-Surge

A pack containing 80 Anti-Surge 20mm Fuses.

Each value individually packed.

Contents:

No.	VALUE	NO.	VALUE	NO.	VALUE
5	x 100mA	10	x 500mA	10	x 3.15A
5	x 250mA	20	x 1A	5	x 5A
5	x 315mA	5	x 1.6A	5	x 6.3A
		10	x 2A		

Oder Code:	1+	5+	
KIT/FUSE/AS2	~~£8.50~~	~~£7.50~~	**£7-00**

A pack containing a total of 120 miniature horizontal mounting pre-set potentiometers. A total of 13 different values. Each value individually packed.

Contents:

No.	VALUE	No.	VALUE	No.	VALUE
5	x 100R	5	x 2K2	10	x 47K
5	x 220R	15	x 2K7	20	x 100K
5	x 470R	20	x 10K	5	x 220K
15	x 1K	5	x 22K	5	x 470K
		5	x 1M		

Order Code:	1+	5+	
KIT/POT/HORIZ	~~£7.75~~	~~£7.25~~	**£6-50**

A pack containing a total of 120 miniature vertical mounting pre-set potentiometers. A total of 13 different values. Each value individually packed.

Contents:

No.	VALUE	No.	VALUE	No.	VALUE
5	x 100R	5	x 2K2	10	x 47K
5	x 220R	15	x 4K7	20	x 100K
5	x 470R	20	x 10K	5	x 220K
15	x 1K	5	x 22K	5	x 470K
		5	x 1M		

Order Code:	1+	5+	
KIT/POT/VERT	~~£7.75~~	~~£7.25~~	**£6-50**

Zener Diode Kit - 400 M/W

A pack containing 55 zener diodes. 400m/w. Ranging from 3V6 to 30V. Each value individually packed and each bag marked with the value enclosed.

Contents: 5 off each value:

3V3, 4V7, 7V5, 8V2, 11V, 12V, 13V, 15V, 16V, 20V, 24V.

Order Code:	1+	5+	
KIT/ZEN/400	~~£3.99~~	~~£3.50~~	**£3-00**

Polyester Capacitor Kit

ITT PMT type 100V miniature or similar. Pack contains 110 capacitors. Each value individually packed and each bag marked with the value.

Contents: 10 off each value:

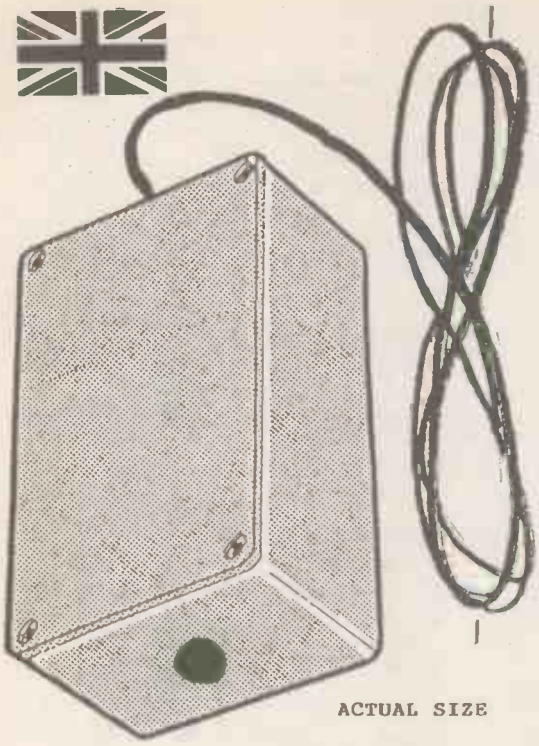
0.01uF, 0.015uF, 0.022uF, 0.033uF, 0.047uF, 0.068uF, 0.1uF, 0.15uF, 0.22uF, 0.33uF, 0.47uF.

Order Code:		
KIT/POLY	Price ~~£5.00~~	**£4-00**

ALL PRICES INCLUDE V.A.T.

ADD £3.00 P & P PER ORDER

F.M. TRANSMITTER



ACTUAL SIZE

Very high quality Mini-Bug, ideal for baby alarms etc etc!!

These units are well tried & tested and may be the best on the market.

Range will depend on terrain, siting of the mini-bug and also the quality of your receiver, but under normal conditions any FM radio will suffice. We have acheived over half a mile!

Simply remove box cover, insert AA battery and tune radio to mini-bug & away you go. Happy listening!! One AA battery lasted over 5 days in continuous with us!. Frequency is adjustable.

Frequency Range.....85-110MHz
Power.....AA 1.5V Battery
Dimensions.....72 X 46 X 22mm

	1+	10+
ORDER CODE: SEC/FMB1	£9-99	£7-50

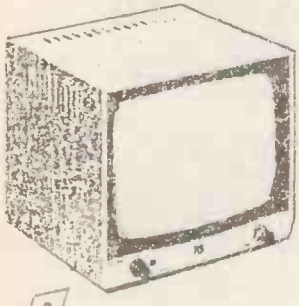
ALSO AVAILABLE IN KIT FORM SEE OUR RANGE OF COMDEK KITS. UK DESIGNED & PACKED!!

C.C.T.V. EQUIPMENT

C.C.T.V. CAMERA (USED)

A steel cased, closed-circuit monochrome camera. Ideal for internal or external(using a weatherproof housing) security for domestic or commercial property surveillance. All camera's are supplied complete with 16mm lens. Wide angle lens(8mm) are available at extra cost. These units are secondhand & the style & design may differ to the illustration as stock changes. All camera's are thoroughly tested before despatch and should give very long trouble free service. Never mount the camera facing a window or bright light as this will burn the camera tube. Voltage generally 240Vac, if lower, we will supply a power supply.

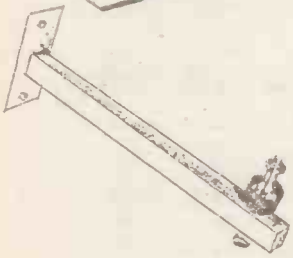
ORDER CODE: SEC/CAM/USED PRICE: **£120**



C.C.T.V. MONITOR (USED)

Steel cased, good quality black & white monitors. Depending on availability we can normaly offer sizes from 9" up to 17". State your size preference & we will supply nearest size available. All monitors: 240Vac.

ORDER CODE: SEC/MON/USED PRICE: **£70**



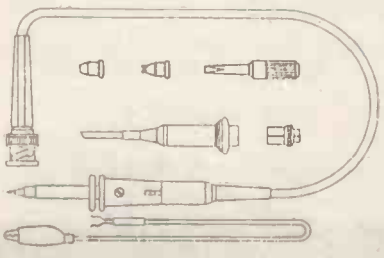
C.C.T.V. CAMERA BRACKET (NEW)

High quality, British made mounting bracket to suit not only our camera's above but any CCTV camera. White, plastic coated steel with standard ¼"-20 mount. Locking swivel allows camera to be adjusted and fixed in almost any position.

ORDER CODE: SEC/CB PRICE: **£7-75**

BUY THE COMPLETE PACKAGE ABOVE I.E.:
1 X Camera, 1 X Monitor, 1 X Bracket **£185**
ORDER CODE: SEC/PACK (EXTRA CARRIAGE ON THE PACKAGE IS £10-00)

OSCILLOSCOPE LEADS (MADE IN UK)



A set of very high quality 'scope' probes. Switched: **X1 and X10**
Supplied in neat storage pack & full instructions. **MADE IN UK**

TEST/BS110 PRICE: £15-50

SECURITY SYSTEMS

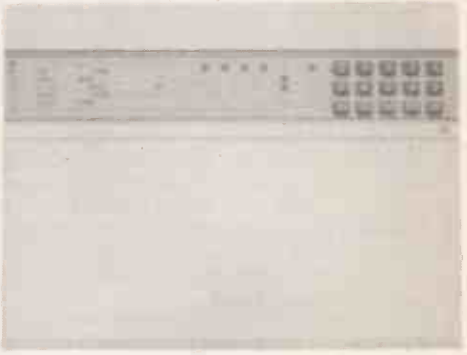
LOGIC 4
3 zones each with its own individual function, built in bell timer and keyswitch operation provide effective security with absolute ease of operation. Simple to install & full fitting instructions supplied. Available on its own or as complete Home Alarm Package, see below for special package price.

FEATURES
* Keyswitch operated security control unit
* Selectable part guard zone
* Selectable PA and tamper loops.
* Adjustable entry-exit timers.
* Integral 20 minute bell timer & auto set
* Latching strobe output.
* Simple 4 terminal wiring to each zone

ORDER CODE - SEC/LGC4 £39-99

OPTIMA XM
Latest updated version of the leading UK selling 'Optima' panel. Rubber keypad, fully selectable 4 digit customer code allows the system to be switched on or off, with the option of omitting zones, quick setting at night and performing simple tests.
Very simple to install supplied complete with full fitting instructions etc. Ideal for either office or home. This panel is also available below as a complete Alarm Package saving even more money.
We have sold hundreds of this truly versatile alarm panel. Our number 1 seller

FEATURES
* Keypad operated
* 4 zones & PA & tamper
* Built in internal sounder
* User may omit any zone.
* Memory recall for last alarm
* Programmable timers including bell cut off.
* Quick set feature.
* Intelligent auto reset and re-arm.

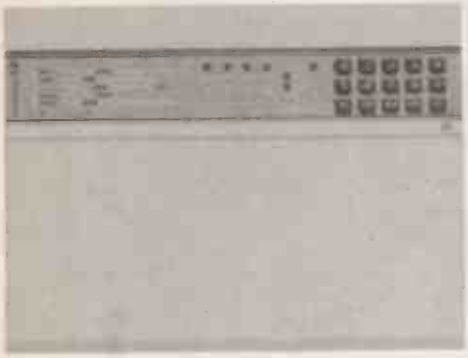


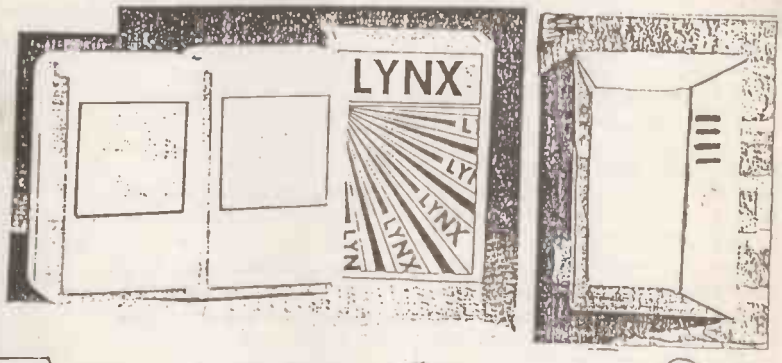
ORDER CODE: SEC/OPT/XM £49-00

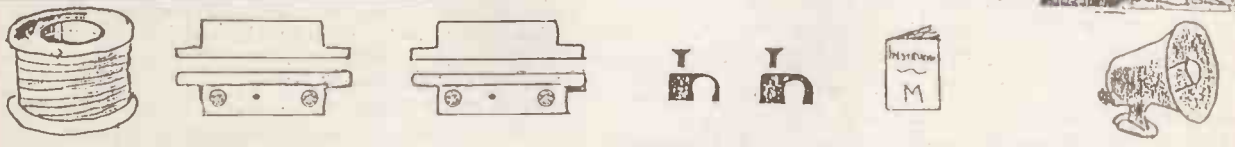
OPTIMA PLUS
As per the Optima XM but also has two communicator outputs thus enabling connection to a British Telecom telephone line. Further technical information is available.

ORDER CODE SEC/OPT/PLUS £75-00

PROTECT YOUR HOME NOW!







We have sold hundreds of these Home Alarm Packages. They represent truly excellent value for money. It is becoming, sadly, a necessity to protect your home and office with a security system and most important of all, one that can be relied upon!
OK, and now for the contents of your package:

* OPTIMA XM or LOGIC 4 Panel
* External Bell Box
* Siren for Bell Box
* 2 X Lynx Internal P.I.R.'s
* 2 X Sets Door Contacts
* 100mts Cable & Clips

**********FULL FITTING INSTRUCTIONS**********

SEC/PACK/LOG £115-00 **SEC/PACK/OPT £130-00**

* Should you require extra P.I.R.'s for your installation they are available : ORDER CODE: SEC/LYNX PRICE: £29-00 each

ALL PRICES INCLUDE V.A.T.

ADD £3.00 P & P PER ORDER

BOOKS

50 SIMPLE LED CIRCUITS - BOOK 1 (R.N. Soar)
Contains 50 interesting, useful circuits & applications, covering many different area of electronics using one of the most inexpensive & freely available components - The Light-Emitting Diode (L.E.D.) This book also includes circuits for the 707 common anode display.
This book is ideal for the beginner. (1977 64 pages)
ORDER CODE: BP42 **PRICE: £1-95**

50 SIMPLE LED CIRCUITS - BOOK 2 (R.N. Soar)
A further range of uses for the simple L.E.D. which compliments those shown in Book BP42 (1981 64 pages)
ORDER CODE: BP87 **PRICE: £1-95**

MODEL RAILWAY PROJECTS (R.A. Penfold)
Provides a number of useful but fairly simple projects for the model railway enthusiast to build, based on inexpensive and easy to obtain components!
The projects covered include controllers, signal & sound effects units and to help construction, stripboard layouts are provided for each project! (1981 112 pages)
ORDER CODE: BP95 **PRICE: £1-95**

IC 555 PROJECTS (E.A. Parr)
Every so often a device appears that is so useful that one wonders how life went on before we had it! The 555 timer is such a device. Included in this book are basic & general circuits, motorcar & railway circuits, alarms & noise makers as well as a section on the 556, 558 & 559 timers. This really is a super book! (1982 176 pages)
ORDER CODE: BP44 **PRICE: £2-95**

POPULAR ELECTRONIC CIRCUITS - BOOK 1 (R.A.Penfold
This book contains a wide range of circuits which are accompanied by a short text giving a brief introduction, circuit description & any special notes on construction & setting up that may be necessary. (1980 160 pages)
ORDER CODE: BP80 **PRICE: £2-95**

POPULAR ELECTRONIC CIRCUITS - BOOK 2 R.A.Penfold
Again, this book provides a wide range of designs for electronic enthusiasts who are capable of producing working projects from just a circuit diagram without the aid of detailed constructional information. However, where relevant, any special setting up procedures are described. (1982 160 pages)
ORDER CODE: BP98 **PRICE: £2-95**

ELECTRONIC PROJECTS FOR BEGINNERS (F.G. Rayer)
Contains a wide range of easily constructed projects (including some that require NO Soldering) for the newcomer to electronics.
Includes many actual component & wiring layouts to aid easy & successful construction. (1978 128 pages)
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IC PROJECTS FOR BEGINNERS (F.G. Rayer)
Offers a range of simple projects based around a number of popular & inexpensive linear & digital I.C's. With most projects, complete layout and/or point to point wiring diagrams are included to help simplify construction. (1982 112 pages)
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ELECTRONIC PROJECTS FOR CARS & BOATS R.Penfold
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Provides a collection of the most popular types of circuits & projects covering a wide range of interests, including Radio, Audio, Household & Test Equipment projects. (1978 144 pages)
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POWER SUPPLY PROJECTS (R.A. Penfold)
Mains power supplies are an essential part of many electronic projects.
This book gives a number of power supply designs, including simple unstabilised types, fixed-voltage regulated types, and variable-voltage stabilised designs, the latter being primarily intended for use as bench supplies for the electronics workshop!. The designs provided are all low-voltage types for semi-conductor circuits.
This book should help the reader design their own power supplies.
Included in the last chapter are a number of other types of power supplies including: a cassette power supply, ni-cad battery charger, voltage step up circuit and a simple inverter.
A super book! (1980 96 pages)
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HOW TO USE OP-AMPS (E.A. Parr)
This book has been written as a designers guide covering many operational amplifiers, serving both as a source of circuits and a reference book for design calculations. The approach has been made as non-mathmatical as possible and it is hoped, easily understandable by most readers, be they engineers or hobbyists! (1982 160 pages)
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HOW TO DESIGN & MAKE YOUR OWN PCB's R.PENFOLD
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Chapter 2: covers photographic methods of producing PCB's.
Chapter 3: deals with most aspects of designing your own PCB layouts. (1980 80 pages)
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HOW TO GET YOUR ELECTRONIC PROJECTS WORKING
R.A. Penfold
We have all built circuits from magazines & books only to find that they did not work correctly, or at all when first switched on! The aim of this book is to help the reader overcome just these problems by indicating how & where to start looking for many of the common faults that can occur during building projects.
Chapter 1: deals with mechanical faults i.e. tracing dry joints, short circuits, broken pcb tracks, etc. The construction and use of a tristate continuity tester, to help in the above, is also covered.
Chapter 2: deals with linear analogue circuits & also covers the use & construction of a signal injector/tracer which can be used to locate & isolate the faulty areas in a project.
Chapter 3: considers ways of testing the more common components such as resistors, capacitors, op-amps, diodes, transistors, SCR's, unijunctions etc. with the aid of only a limited amount of equipment.
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R.A. Penfold

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Covers; Opto alarms incl. pyro-sensor, infra-red & fibre optic loop types. A computer based system showing how a home micro fitted with a user port can form the basis of a most sophisticated alarm & monitoring system. Also included are various alarms using; mercury tilt switches, magnetic switches, doppler shift & capacity effect on an RF oscillator etc. (1988 112 pages)

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C.E. Miller

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W. Simmister

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How directories and sub-directories can be employed. How to write your batch files. How to manage your systems environment. The guide covers versions 3.0, 3.1 and 3.2 of both PC-DOS and MS-DOS as implemented by IBM and IBM compatibles. It covers both floppy & hard disc based systems. (1987 64 pages)

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R.A. Penfold

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This really is a must for all. (1990 178 pages)
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Used properly, it should enable the reader to trace most common faults quite quickly. Across the top of the chart will be found four rectangles containing brief descriptions of these faults, i.e. sound weak but distorted, set dead, sound low or distorted and background noise etc. One then selects the most appropiate of these following the arrows, carries out the suggested checks in sequence until the fault is cleared.
A most useful book! (1980 chart)
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R.A. Penfold
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Each project, which is designed to be built on a 'Protobloc' or less common now 'Verobloc', is presented in a familiar fashion with a brief circuit description, circuit diagram, component layout diagram, component list & notes on construction & use where necessary. Wherever possible, the components used are common to several projects hence only a modest number of components required with a budget to match! This book has been recommended by BICC-VERO! (1982 160 pages)
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MORE ADVANCED ELECTRONIC MUSIC PROJECTS
R.A. Penfold
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This range of loudspeaker is a versatile range for guitar and bass instrument sound production. The linen edge gives a smooth sound and excellent bass response; particularly suited to bass guitars, keyboards and bass driving in multi-way enclosures and P.A. systems.

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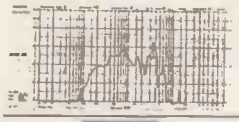

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Nominal Chassis Diameter:	8", 203.2mm
Impedance:	8Ω or 16Ω
Power Rating:	100W$_{RMS}$
Resonance:	72Hz
Usable Freq Range ±6dB:	72Hz to 4kHz
Average Sensitivity 1W@1m:	97dB
Magnet Weight:	38oz
Magnet Gap Depth:	0.312", 8mm
Voice Coil Diameter:	2.0", 50.8mm

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~~£62-00 pair~~
ANY QTY

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EM10-100

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Power Rating:	100W$_{RMS}$
Resonance:	71Hz
Usable Freq Range ±6dB:	70Hz to 7kHz
Average Sensitivity 1W@1m:	97dB
Magnet Weight:	38oz
Magnet Gap Depth:	0.312", 8mm
Voice Coil Diameter:	2", 50.8mm

Performance optimised for lead guitar. Also suitable for bass guitar, vocal P.A., keyboards, discotheques, club music systems and stage monitors.

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ANY QTY

EM12-100PE

EM12-100PE

Nominal Chassis Diameter:	12", 304.8mm
Impedance:	8Ω or 16Ω
Power Rating:	100W$_{RMS}$
Resonance:	94Hz
Usable Freq Range ±6dB:	95Hz to 6kHz
Average Sensitivity 1W@1m:	99dB
Magnet Weight:	38oz
Magnet Gap Depth:	0.312", 8mm
Voice Coil Diameter:	2", 50.8mm

SUGGESTED APPLICATIONS

Performance optimised for lead guitar.

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~~£75-00 pair~~
ANY QTY

EM12-300

Nominal Chassis Diameter:	12", 304.8mm
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Power Rating:	300W$_{RMS}$
Resonance:	47Hz
Usable Freq Range ±6dB:	46Hz to 5kHz
Average Sensitivity 1W@1m:	103dB
Magnet Weight:	95oz
Magnet Gap Depth:	0.375", 9.53mm
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£59-99 ANY QTY

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EM15-200

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Power Rating:	200W$_{RMS}$
Resonance:	46Hz
Usable Freq Range ±6dB:	45Hz to 5kHz
Average Sensitivity 1W@1m:	99dB
Magnet Weight:	56oz
Magnet Gap Depth:	0.375", 9.53mm
Voice Coil Diameter:	2.5", 63.5mm

SUGGESTED APPLICATIONS

All bass applications, including bass guitar.

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~~£125-00 pair~~
ANY QTY

EP18-400

Nominal Chassis Diameter:	18", 457.2mm
Impedance:	8Ω or 16Ω
Power Rating:	400W$_{RMS}$
Resonance:	33Hz
Usable Freq Range ±6dB:	30Hz to 800Hz
Average Sensitivity 1W@1m:	98dB
Magnet Weight:	95oz
Magnet Gap Depth:	0.375", 9.53mm
Voice Coil Diameter:	3", 76.2mm

~~£142-00 each~~
~~£255-00 pair~~
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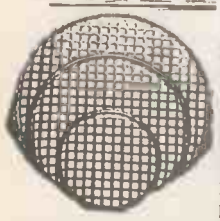
ANY QTY



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L004	10"	£2-20	£2-00
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Self fixing nuts
Steel clamping plates

ORDER CODE: LSP/CKIT

1+	10+	100+
£1-25	£1-12	88p

ALL PRICES INCLUDE V.A.T.

ADD £3.00 P & P PER ORDER

COMDEK HOBBY KITS

For those of you who are not yet familiar with the COMDEK range of Kits, we would advise you that ALL of these Kits are designed & packed in the UK. All PCB's are Silk-Screened and not only designed in the UK but also UK made!

THE GOLDEN RULE FOR KIT ASSEMBLY IS SIMPLE.....READ THE INSTRUCTIONS BEFORE YOU START!!

TWIN ALTERNATE LED FLASHING UNIT - RED (PCB SIZE: 45 X 30mm)

Two Red LED's which flash alternately at a fully adjustable rate operating on a voltage from 3V up to 15V, at approx. 25mA depending on voltage it is run at.
Ideal for battery use using either AA, C, D or PP3 size battery. Can also be used 'In-Car' at 12V and can also be used with the Comdek Anti-theft unit listed below.

Applications include: Burglar & Car Thief deterrent, model construction, name badge sign, jewellery etc etc.

	1+	4+	10+
ORDER CODE: COM/KIT/004	PRICE: £5-75	£5-25	£4-75

TWIN ALTERNATE LED FLASHING UNIT - RED and GREEN (PCB SIZE: 45 X 30mm)

Two LED's, one Red and one Green which flash alternately at a fully adjustable rate operating on a voltage from 3V up to 15V, at approx. 25mA depending on voltage used.
Ideal for battery use using either AA, C, D or PP3 size battery. Can also be used 'In-Car' at 12V and can also be used with the Comdek Anti-Theft unit listed below.

Applications include: Burglar & Car Thief deterrent, model construction, name badge sign, jewellery etc etc.

	1+	4+	10+
ORDER CODE: COM/KIT/001	PRICE: £5-99	£5-50	£5-00

CABLE AND METAL DETECTOR (PCB SIZE: 60 X 40mm)

A super kit, using a ferrite antenna. The 'Detection' range is up to approx. 6cm. Complete with LED for visual indication. Operates at 3Volts using 2 X AA batteries.

Applications include: Detecting cables in walls, under floors, detecting hidden pipes, nails in wood.

	1+	4+	10+
ORDER CODE: COM/KIT/002	PRICE: £5-95	£5-45	£4-95

F.M. MINI-TRANSMITTER (PCB SIZE: 40 X 25mm)

A super quality, very small mini-bug, ideal for baby alarms etc!! Simply runs off 1 X AA (1.5V) battery! We had a unit running for over a week none stop! Whilst range is always difficult to quote because it depends on location & conditions, we have achieved over half a mile! A well tried & tested unit, excellent value for money.

	1+	4+	10+
ORDER CODE: COM/KIT/003	PRICE: £7-50	£6-85	£5-99

ELECTRONIC ACUPUNCTURE

A new kit to our range, but we think you will love it. Based on the ancient practise of Acupunture but instead of using needles we use electronics! And very effective it is too. This kit operates, as they say, in accordance with the electronical acupunture method. A fully illustrated leaflet is included for the treatment of many ailments. Come on, give it a go!
Operates on between 3v and 12V.

* arthritic pain or a sprain.
* Lumbago or back aches
* Stimulates blood circulation
* strained shoulders
* muscle pain
* arm & leg neuralgia
* neuralgia
* and lots more!!!

	1+	4+	10+
ORDER CODE: COM/KIT/005	PRICE: £8-95	£8-00	£6-75

CAR, MOTORHOME, VAN ANTI-THEFT UNIT - AT1 (PCB SIZE: 80 X 60mm)

A brand new design and indeed a very clever device which gives 100% peace of mind to the vehicle owner and causes the would be car thief 100% frustration! This unit may also be used 'alongside' an existing car alarm. So, what's so special about this device?

Most alarms require the owner to activate them when you exit the vehicle, which can easily be overlooked or simply forgotten. The AT1 circuit overcomes this by activating the moment the ignition is switched on or the vehicle is 'Hot wired' making it impossible to forget. From the moment the ignition is first switched on the AT1 circuit starts timing. When the engine has started the unit must be 'de-activated' otherwise, and this is the clever bit, the engine will cut out.
The method of de-activating the unit is set by the installer. We recommend wiring up to one or more switches i.e. rear window de-mist, wipers, interior light, etc etc, the choice is yours! You can of course wire up to a concealed switch.
Therefore, until the chosen switche/switches are 'switched' ON/OFF, the AT1 will NOT De-activate and the engine will stop after the pre-set time.
Every AT1 is pre-set at approx. 20 seconds but this may be shortened or lengthened to suit your requirements up to 130 seconds. This time of course, governs how far your vehicle will travel before the engine cuts out!
The car thief will then be faced with the problem of not only the engine cutting out but then failing to re-start! The thief will not hang around to 'repair' the vehicle. Simple!
A Red LED is supplied with kit which may be fitted to the dashboard and will remain lit all the time acting as a deterrent to any would be car thief.
Suitable for both Electronic & Non-Electronic Ignition cars. Full fitting instructions are supplied with the assembly instructions.
Such a success has this kit been that we can now offer a ready built unit. See below for prices.

	1+	4+
ORDER CODE: COM/KIT/AT1	PRICE: £15-00	£12-50

READY BUILT CAR, MOTORHOME, VAN ANTI-THEFT UNIT

Supplied ready built and housed, simply follow the installation instructions and fit to your vehicle.

	1+	4+
ORDER CODE: COMDEK/BUILT/AT1	PRICE: £25-99	£24-00

SUPER SOLDER SALE

High grade 60/40 tin/lead alloy solder available in both 18swg & 22swg, in a choice of reel sizes from 18gms to 500gms (½Kg). Manufactured to BS219. Contains 5 cores of type 362 non-corrosive flux. Melting temperature is 188°C. **NOW JUST LOOK AT OUR AMAZING PRICES**

18swg (1.2mm)

Reel Size	Approx. Length	ORDER CODE	1+	10+	100+
18gms	3 Metres	SOLD/18/3Y	65P	50P	40P
200gms	21 Metres	SOLD/18/200	£2-25	£2-00	£1-60
500gms (½Kg)	52 Metres	SOLD/18/500	£4-75	£4-25	£3-50
22swg (0.71mm)					
200gms	62 Metres	SOLD/22/200	£2-35	£2-10	£1-75
500gms (½Kg)	153 Metres	SOLD/22/500	£4-79	£4-30	£3-60

REMEMBER: BUY 100 REELS OF 18swg 500gms & PAY ONLY £2-98 + VAT PER REEL!

SOLDERING IRON STAND - Heavy Duty

Suitable for use with **ANTEX** and most other leading makes of soldering irons. The heavy base makes it very stable. Supplied complete with sponge

ORDER CODE: SOLD/814 PRICE: **£2-99**

WHOLESALE PRICES AND EX-STOCK NOW!!

EXTERNAL HALOGEN FLOODLIGHT & P.I.R.

A high power security floodlight with built-in PIR detector which reacts to body heat switching on the floodlight whenever somebody approaches within the detection zone. The PIR is adjustable for horizontal and vertical angle and contains a photo detector to prevent daylight operation.
Power: 220-240Vac.

* **Choice of 200W, 300W or 500W lamp.**
* **Adjustable range up to 15 Metres.**
* **Adjustable 'Time On' 9 secs to 10 mins.**
* **Twilight setting is adjustable.**

If you don't state a lamp wattage preference 500Watt will be sent.

SALE PRICE £29-99 (Incl. Lamp)

PROTECT YOUR HOME NOW!

ALL PRICES INCLUDE V.A.T.

ADD £3.00 P & P PER ORDER

POTENTIOMETERS and P.C.B.'s

ROTARY POTENTIOMETERS - Single

A range of British Made, carbon track, potentiometers with ¼" dia. plastic spindle and PCB mounting terminals.

Fixing Hole.....10.5mm
Spindle Dia..... 6.35mm(¼")
Spindle Length.....55mm
Power rating.....0.4W LIN, 0.2W LOG
Max Volts.....500Vdc
Tolerance.....±20%

Supplied complete with fixing nut and locking washer. Available in Lin and LOG.

LIN: 470R, 1K, 2K2, 4K7, 10K, 22K, 47K, 100K, 220K, 470K, 1MO, 2M2, 4M7.

LOG: 4K7, 10K, 22K, 47K, 100K, 220K, 470K, 1MO, 2M2.

ORDER CODE: POT/LIN or LOG + Value Required

	1+	10+	100+
PRICE:	64p	56p	48p

ROTARY POTENTIOMETERS - Stereo

Same technical spec. as above single pots. Supplied complete with fixing nuts etc.
Values same as above Single pots.

ORDER CODE: POT/DUAL/ LIN or LOG + Value required.

	1+	10+	100+
PRICE:	£1-70	£1-55	£1-25

ROTARY POTENTIOMETERS - Switched - DPST 4Amp

Same technical spec. as above single & dual pots. Supplied complete with fixing nuts etc.
Values as above.

ORDER CODE: POT/SW/LOG or LIN + Value required

	1+	10+	100+
PRICE:	£1-60	£1-50	£1-35

STRIPBOARD

STRIPBOARD - Copper Clad

A good quality stripboard with 0.1" spaced holes.

CODE	SIZE	Tracks	Holes	PRICE
PCB/500	25X64	9	25	22p
PCB/505	64X95	24	37	69p
PCB/515	95X127	36	50	£1-15
PCB/535	95X432	36	170	£4-50
PCB/540	119X455	46	179	£5-50

MATRIX BOARD - Plain

Plain board with no copper strips. Holes also on a 0.1" grid.

PCB/0585	95X127	36X50 Holes	£1-15
PCB/0595	119X455	46X179 Holes	£5-00

STRIPBOARD CUTTER

Simply insert tool at the point where break is required and twist clockwise!

ORDER CODE: PCB/TOOL PRICE: £2-50

TERMINAL PINS

Press fit terminal pins for use with stripboard. Single sided pins are NOT suitable for the above Matrix board. Pack Qty: 100 pins

ORDER CODE: PCB/SINGLE 85p per pack
ORDER CODE: PCB/DOUBLE £1-50 per pack

PROTOBLOC PROTOTYPING BOARDS Protobloc 2

Protobloc 2 has a total of 840 tie points consisting of two sets of 64 rows of 5 interconnected sockets plus 4 rows of 50 interconnected sockets running alongside, suitable for use as power supply rails. All contact positions are clearly defined on an alphanumeric grid. ABS polymer board mounted on an adhesive foam base. Will accommodate up to seven 16 pin devices.

ORDER CODE: PCB/PB2 PRICE: £6-50

PROTOBLOC BOARD TYPE: YO35G

2420 contacts arranged in six blocks of 64 rows of 5 interconnected sockets on a standard 0.1" pitch. Supplied mounted on a baseboard with 4 X 4mm sockets.
Dimensions: 243 X 195 X 20mm.

ORDER CODE: PCB/YO35G PRICE: £19-99

PHOTO-ETCH PCB - Economy

Good quality board, manufactured in FRG-50 laminate with positive working UV sensitive resist. Boards are protected by a black sensitive film.

SIZE (mm)	ORDER CODE	1+	10+
100 X 160	PCB/PB/SS1	£1-75	£1-60
100 X 220	PCB/PB/SS2	£2-25	£2-00
114 X 203	PCB/PB/SS3	£2-30	£2-05
12" X 18"	PCB/PB/SS4	£12-95	£11-75

Double sided available in above sizes, please telephone for prices.

PHOTO-ETCH PCB - Professional

Photo resist boards in FR4 Epoxy Glass coated with positive working UV sensitive resist. Boards are supplied with protective black plastic film.

SIZE (mm)	ORDER CODE	1+	10+
100 X 160	PCB/FR4/SS1	£2-60	£2-34
100 X 220	PCB/FR4/SS2	£3-25	£2-95
203 X 114	PCB/FR4/SS3	£3-10	£2-80

ULTRAVIOLET EXPOSURE UNIT WITH TIMER

An ultraviolet unit for preparing photo-resist boards as per above. 1:1 artwork using Alfac type transfers on translucent drafting film. Simply place on the glass screen with the photo-board on top. Complete with built-in 6 minute timer. 2 X 8Watt UV tubes (replaceable) and full instructions! Comes with 13A plug fitted!

ORDER CODE: PCB/UV1 PRICE: £79-50

FERRIC CHLORIDE Crystals

Ferric chloride etchant in crystalline form. Pack weight: 500gm to produce approx 1 litre of concentrated solution.

ORDER CODE: PCB/ETCH PRICE: £3-50

DEVELOPER

Developer crystals for use with our photo-resist board above. Contains enough to make approx. 500ml of solution.

ORDER CODE: PCB/DEV PRICE: £1-00

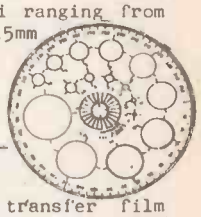
POLISHING BLOCK

Super quality, after use simply wipe away traces of the abrasive.
Dims: 30 X 40 X 20mm

ORDER CODE: PCB/BLCK PRICE: £1-65

RADIUS AID - CIRCULAR PROTRACTOR - With Bevel

Contains 16 circles with radii ranging from 1mm up to 15mm. Overall dia: 115mm
Material: Glass-clear Dunilon



PCB/71F

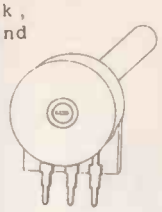
PRICE: £1-85

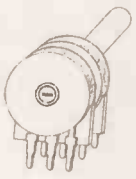
ARTWORK DRAFTING FILM

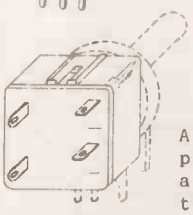
Used with drafting tapes & transfer film master artwork for the layout of PCB's. Pack contains 5 sheets 0.003in single matt polyester fim & one sheet 0.005in film printed with 0.1in grid for accurate layout of pads/symbols.

Size: 248 X 148mm

ORDER CODE: PCB/ART £3-99 per pack

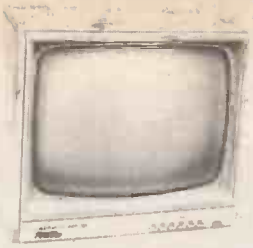






MONITOR SALE

£10-00 EACH !!



We have a large quantity of Black & White monitors, intended for CCTV application, that are faulty, or picture quality is not up to scratch. These monitors HAVE NOT been checked by our engineers! It simply costs us too much money. Therefore we are selling them off at a silly price to make space. First come first served, No Guarantees and NO RETURNS for any reason!

ORDER CODE: SO/MON/CC PRICE: £10-00

STERNICE HIGH WATTAGE WIREWOUND RESISTORS
BRAND NEW! Very very large!!
Marked as follows:
STERNICE RWST 50.373 180ohm 5% X 9
Dimensions: 370mm length. 50mm Dia.
Weight: 2¼Kg. Complete with fixing bracket.
Two values available: 100ohm & 180ohm.

Value	ORDER CODE	1+	10+
100ohm	SO/661A	£4-99	£3-50
180ohm	SO/662	£4-99	£3-50

CONTROLLED BRIDGE RECTIFIER 'SPECIAL'
PACE-Pak (Brand New)International Rectifier
Pace-pak modules give single phase bridge configurations of thyristors & diodes, mounted on an aluminium substrate to provide a completely isolated assembly.
Farnell current price £23-30 each plus VAT!

25A 1200V (Type P135)
ORDER CODE: SO/663 PRICE: £9-99

TRANSFORMER (Brand New)
Super quality transformer. Limited quantity.
Primary: 0-10-220-240-380-415V
Secondary: 0-17V 250mA
0-17V 250mA
Fixing Centres 75mm. Height: 50mm
Top dims: 60 X 70mm.

ORDER CODE: SO/664 PRICE: £3-50

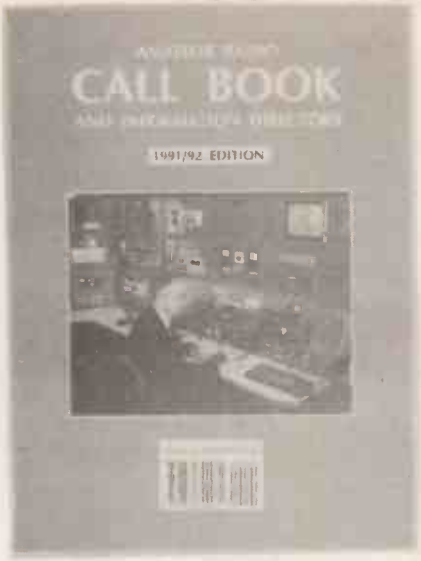
CAPACITOR ARCOTRONICS
No info, only whats on the capacitor:
VISCONOL 8uF ±20% 1000VDC WKG at 70°C
650VDC WKG at 100°C

DIMS: H 120mm W 85mm D 65mm
2 contacts on top of capacitor.
ORDER CODE: SO/665 PRICE: £2-50

HEATSINK (USED)
Still has a couple of SEMIKRON SKT 24/12C fitted. (Bolted On). Maybe SCR's. Not all checked so if you get one with a different component fitted DON'T ask to send it back!!
ORDER CODE: SO/666 PRICE: £1-50

WE BUY SURPLUS STOCK

RSGB CALL BOOK 1991-1992



LESS THAN HALF PRICE!!

£2-99

The Official RSGB (Radio Society of Great Britain) Call Book & Information directory. This publication is a must for anyone with an interest in Amateur Radio. 430 pages! Lists all UK & EIRE Call signs with names & addresses and is packed with information including:
Abbreviations, Awards, Band Plans, Beacons, Clubs, Contests, EMC, Licensing Info., Locators, Morse Info, News, Packet nodes, Propagation, QSL, Planning Permission, RAE, Raynet, Repeaters, RSGB Info., Safety, Satellites, Special Event Stations ETC ETC.
DIMS: 200 X 270mm.
NORMAL PRICE IS OVER £7-00 !!!!!

SALE PRICE £2-99

BROADBAND RADIO RECEIVER
A handheld radio with a range covering: CB, FM,TV, AIR Band & PB Band. Built in telescopic aerial Squelch, volume & tuning controls & Band selector switch.
FREQUENCY RANGE:

AIR	108-145MHz
PB	145-176MHz
WB	162.5MHz
TV	54-87MHz
FM	88-108MHz
CB	1-80 Channels

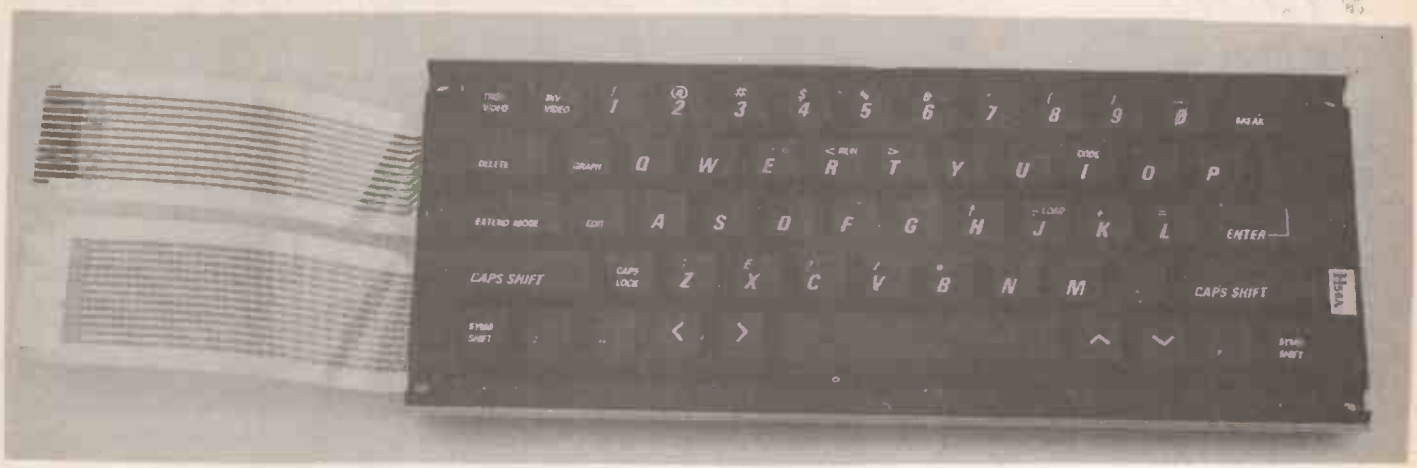
Power: 4 X AA (Batts Not Incl)
DIMS: 93X198X50

£17-50

WIREWOUND POTENTIOMETERS 10K Tol ±20% 3 WATTS. AB
Very high quality, Made in UK.
Current Trade price: £4-76 each plus VAT!!!!
Dia: 45mm Shaft Length: 40mm
LIMITED QUANTITY...Hurry Hurry.
ORDER CODE: SO/667 PRICE: £2-50 each!

SINCLAIR KEYBOARD OFFER

ZX SPECTRUM +2A/+3/+3A



Those of you who service/repair Sinclair computers will know what a real bargain these are. However, only limited stocks so hurry, hurry! These keyboards are made by Amstrad!

ALL BRAND NEW!!

Marked as follows: 40060/B ESU2456A .

At time of printing, the Trade price for this keyboard is £26-06 + VAT!!

ORDER CODE: SO/668

SALE PRICE: £6-50 2 FOR £11-50

PACKING TAPE CLEARANCE!!

Such a success was our Summer Sale of Parcel tape that we sold out!! However, we have just taken delivery of 6,000 reels of packing tape but not brown in colour but clear. Very high quality and a **tremendous** saving on the normal price. Hurry, hurry, this well sell out quickly!

REMEMBER.....ALL OUR PRICES INCLUDE V.A.T.!!!

Length: 66 Metres

NORMAL PRICE IS £1-15 per REEL!!

WIDTH: 50mm

Colour: Clear

	1+	10+	100+
SUPER SALE PRICE:	**65P**	**55P**	**48P**

RECHARGEABLE BATTERIES - NI-CADS

At time of printing our Ni-Cads are **Hitachi** with the exception of the PP3. Should the Hitachi be unavailable we will supply a suitable alternative brand.
We guarantee our batteries may be charges 1000 times!

Type	Volt	Ah	Order Code	1+	10+
AAA	1.2V	180mAh	**BAT/AAA**	**£1-50**	**£1-30**
AA	1.2V	500mAh	**BAT/AA**	**95p**	**85p**
C	1.2V	1.2Ah	**BAT/C**	**£1-95**	**£1-80**
C	1.2V	2.0Ah	**BAT/CI**	**£3-40**	**£3-20**
D	1.2V	1.2Ah	**BAT/D**	**£2-00**	**£1-85**
D	1.2V	4.0Ah	**BAT/DI**	**£4-75**	**£4-50**
PP3	9V	110mAh	**BAT/PP3**	**£3-90**	**£3-75**

NI-CAD BATTERY CHARGER

Capable of charging all the above sizes i.e.

4 X AAA, AA, C or D sizes
2 X PP3

White in colour, free-standing unit with LED 'charging' indicators. A built in tester is provided for 1.5V batteries.
Power: 240Vac
Dims: 180 X 85 X 50mm

	1+	10+
BAT/CHARGE/UNIB	**£4-99**	**£4-75**

ALL PRICES INCLUDE V.A.T.

ADD £3.00 P & P PER ORDER

SUPER PACK SALE

Our Component Packs were such a success when introduced in our Summer Supplement that we have increased the range. We have added approx. 17 more packs to our range and we will be adding even more over the next few months. For those of you who have already purchased some of our packs 'Thank You' for making them a success and for those who have not yet purchased any do so now and save money!

KNOB PACK
A pack containing an assortment of knobs, both rotary and slider. Some push On and some are screw fixing.
Total Pack Qty: 50 Assorted
ORDER CODE: PACK/018 **SALE PRICE: £4-50**

SEVEN SEGMENT DISPLAY PACK
A most useful pack of assorted displays, may contain Red, Green, Single digit, double digit large & small. A very mixed pack.
Total Pack Qty: 20 Assorted
ORDER CODE: PACK/019 **SALE PRICE: £3-00**

0.5W Resistor Pack
A good assortment of good quality 0.5W Carbon Film resistors mainly 5% tolerance. Many preferred values included. A super buy.
Total Pack Qty: 1000 assorted
ORDER CODE: PACK/020 **SALE PRICE: £2-00**

ZENER DIODE PACK
A good selection of assorted voltages, from 3.0v to 180v and wattages 250mW to 5Watt.
Total Pack Qty: 100 Assorted
ORDER CODE: PACK/024 **SALE PRICE: £2-75**

VOLTAGE REGULATOR PACK
A most useful pack containing a good selection of assorted fixed and maybe variable regulators. Both +ve and -ve, from 100mA to 5A. Plastic and metal. Excellent value foe money.
Total Pack Qty: 25 Assorted.
ORDER CODE: PACK/025 **SALE PRICE: £5-00**

PLUG TOP MAINS FUSE PACK
A pack of assorted 1" mains fuses. Anything from 3A to 13A. Super value for money.
Total Pack Qty: 40 assorted
ORDER CODE: PACK/029 **SALE PRICE: £4-25**

SLIDER POT PACK
A pack of metal and plastic mono and stereo sliders, Log and Lin.
Values may range from 250 ohms to 1Meg
Total Pack Qty: 25pcs
ORDER CODE: PACK/030 **SALE PRICE: £2-50**

TUBULAR CERAMIC PACK
A good mixture of capacitors, anything from 1pF up to 10,000 pf. Radial leads ideal for PCB mounting.
Total Pack Qty: 100pcs
ORDER CODE: PACK/031 **SALE PRICE: £1-50**

TUNGSTEN DRILL BIT PACK
A mixed pack of metric solid tungsten carbide drill bits suitable for drilling glass fibre based pcb's and general hobby use.
Original price was £4-20 each bit!!
Mixed sizes, anything from 0.4mm up to 3.0mm.
Total Pack Qty: 10 pcs
ORDER CODE: PACK/033 **SALE PRICE: £3-50**

ELECTROLYTIC PACK
A good assortment of both axial & radial capacitors. Some radial's are already pre-cropped for PCB mounting. These packs contain a good selection of voltages from 10V to 1000V and values anything from 1.0uF to 1000uF.
This pack is excellent value for money.
Total Pack Qty: 100 Assorted
ORDER CODE: PACK/021 **SALE PRICE: £2-50**

DISC CERAMIC PACK
A super selection of assorted values and voltages. Many popular values are included.
Voltages, anything from 5 to 1KV, Values, anything from 1.0pF to 0.1uF.
Great value for money.
Total Pack Qty: 100 assorted
ORDER CODE: PACK/022 **SALE PRICE: £1-50**

POLYSTYRENE PACK
A very useful range of assorted values and voltages of polystyrene capacitors. Many preferred values included.
Values range from 10pF to 0.01uF, and voltages up to 400V.
Total Pack Qty: 100 assorted
ORDER CODE: PACK/023 **SALE PRICE: £1-50**

BRIDGE RECTIFIER PACK
A very mixed pack, excellent value for money. May contain voltages from 50 to 1000v and up to 10 Amps.
Total Pack Qty: 25pcs
ORDER CODE: PACK/026 **SALE PRICE: £5-50**

CABLE TIE PACK
A mixed pack of assorted length cable ties and maybe black ones.
Total Pack Qty: 100pcs
ORDER CODE: PACK/027 **SALE PRICE: £2-00**

HEATSHRINK PACK
A super pack, very high quality heatshrink sleeving. Much of it is British made.
A very good assortment of both colours and sizes.
Total Pack Qty: 10 Lengths approx 12" in length.
ORDER CODE: PACK/028 **SALE PRICE: £1-25**

500V SINGLE LAYER-CERAMIC PACK
A useful assorted pack of these very high quality capacitors. Very small, 8-16mm dia. Normal price over 50p each! Super value.
Total Pack Qty: 50pcs
ORDER CODE: PACK/032 **SALE PRICE: £2-00**

CALCULATOR PACK
A mixed pack of calculators! Hand held, mains desk type, printers, non-printers, cased, uncased, damaged cases, bits missing! You name it - this pack has it! Lots of useful bits. Sold by weight. Total Pack Weight: 10Kg
ORDER CODE: PACK/034 **SALE PRICE: £5-00**

ALL PRICES INCLUDE V.A.T.

ADD £3.00 P & P PER ORDER

SUPER PACK SALE

PRE-SET PACK

A mixed pack of various pre-sets. Miniature, standard, 0.1W, 0.25W, vertical, horizontal.

Assorted values from 100R to 1Meg.

Total Pack Qty: 100 pcs

ORDER CODE: PACK/001 SALE PRICE: £3-00

POTENTIOMETER PACK

A mixed pack of pots single, dual, slider, convergance - in fact almost every kind of pot. Assorted values ranging from 10R to 1Meg. These really are super value.

Total Pack Qty: 100 Assorted

ORDER CODE: PACK/002 SALE PRICE: £4-50

VOLTAGE DEPENDANT RESISTOR PACK

A good mix of different types of V.D.R's 50-500V Super Value

Total Pack Qty: 50 Assorted

ORDER CODE: PACK/003 SALE PRICE: £3-00

WIREWOUND RESISTOR KIT

A very mixed pack of assorted wirewound resistors. Mixed wattages and values, many popular values. A really good value pack.

Total Pack Qty: 100 assorted

ORDER CODE: PACK/004 SALE PRICE: £2-50

DIL SOCKET PACK

A good assortment of various IC sockets which may range from 8 pin to 64 pin! Generally low profile. May also include gold plated, turned pin, wirewrap etc.

Total Pack Qty: 100 pcs

ORDER CODE: PACK/009 SALE PRICE: £8-00

SUPADRIV. Self Tapping Pack HARDWARE

A super pack of a mixture of No4 X ⅜ and No6 X ⅜. All Pan head hardened steel type AB bright zinc.

Total Pack Qty: 100 assorted

ORDER CODE: PACK/010 SALE PRICE: £1-00

MIXED SELF-TAPPING SCREW PACK HARDWARE

A good mixture of various self-tapping screws of assorted types, lengths etc. All top quality. Length's 5-10mm

Total Pack Qty: 200 assorted

ORDER CODE: PACK/011 SALE PRICE: £1-50

PRE-SET PACK 0.25W

A super selection of 0.25W Pre-sets mainly Piher enclosed, AB etc. Both vertical & horizontal and many popular values. Values may range from 100R to 10Meg!

Total Pack Qty: 100 pcs Assorted

ORDER CODE: PACK/016 SALE PRICE: £2-50

POLYESTER PACK

A good assortment of various polyester capacitors. Both Radial and Axial styles, values ranging from 0.01uF up to 2.2uF and voltages from 63V to anything up to 1000V! This pack is very good value for money.

Total Pack Qty: 100 Assorted

ORDER CODE: PACK/017 SALE PRICE: £2-50

TANTALUM BEAD CAPACITOR PACK

A random selection of tantalum bead capacitors of assorted voltages and values. Many popular values.

Total Pack Qty: 50 pcs

ORDER CODE: PACK/005 SALE PRICE: £2-50

TRANSISTOR PACK

A mixed pack of various transistors, many popular types including:
AC169, BC107, BC125, BC147, BC148, BC158, BC182A, BC237, BC328, BC558, BCY72, 2N2907A, TIP126, TIP141, TIS90, 2N2222A, etc etc.

Over £17-00 value at current catalogue prices!!

Total Pack Qty: 100 pcs

ORDER CODE: PACK/006 SALE PRICE: £4-99

INTEGRATED CIRCUIT PACK

A super value pack containing all types of I.C's many popular types included. All are new and full spec..

Total Pack Qty: 100 pcs

ORDER CODE: PACK/007 SALE PRICE: £5-00

TRIMMER KIT

A useful kit containing a selection of 'ceramic' trimmers.
Values include: 2-7pF, 4-15pF, 6-25pF, 8-30pF.
Working voltage: 250Vac

Total Pack Qty: 50 Assorted

ORDER CODE: PACK/008 SALE PRICE: £2-99

M5 & M6 Pack

A mixed pack of steel screws, a mixture of Pan Head Supadriv and Allen type. Length's 20-30mm All super quality and a real bargain!

Total Pack Qty: 50 Assorted

ORDER CODE: PACK/012 SALE PRICE: £1-00

M4 Mixed Pack

A mixed pack of small M4 bolts - various lengths and types, pan, cross etc. All the highest quality. Length's 5-20mm

Total Pack Qty: 100 Assorted

ORDER CODE: PACK/013 SALE PRICE: £1-50

MIXED HARDWARE JUMBO PACK

A super Jumbo pack containing all types of bolts, screws, washers. All mainly small types and high quality. Also nuts etc. Length's 10-45mm
This pack is really super value for money.
We are selling this pack by weight: 1Kg.
This is up to 1000 pcs depending on sizes.

Pack Size: 1Kg

ORDER CODE: PACK/014 SALE PRICE:

FUSE PACK

A super pack containing an assortment of fuses which could include 20mm 32mm 1", fast blow, slow blow, in fact any type of fuse. Man popular sizes and values.

Total Pack Qty: 100 pcs

ORDER CODE: PACK/015 SALE PRICE: £2-50

SURPLUS STOCK WANTED

ALL PRICES INCLUDE V.A.T.

ADD £3.00 P & P PER ORDER

SUPER PACK SALE

TRANSFORMER PACK

A super pack containing various small transformers, all being 220/240V primary. The secondary outputs will vary anything from 4.5V up to 12V.
Mainly chassis type but maybe some PCB types included. Current ratings anything from 200mA to 1Amp.

Total Pack Qty: 20pcs

ORDER CODE: PACK/035 PRICE: £15-00

WALKMAN PACK

Yes, you read it right! A very mixed pack of walkmans which may be complete, bits nissing, working, non-working, cased or uncased. A very mixed pack at a very cheap price.
Feeling lucky? NO GUARANTEES!

Makes may include: AIWA, SANYO, SONY, JVC, MURPHY, etc.

Total Pack Qty: 4 pcs approx.

ORDER CODE: PACK/036 PRICE: £10-00

WATCH PACK

Another very mixed pack which may include LCD, LED, gents, boys, ladies, girls watches.
Watches may or maynot have straps, bracelets fitted. Having just seen a bracelet for sale for over £7-00 this pack is a winner!
Sold by weight, but you should get 6-10 watches.

Total Pack Weight: ½Kg

ORDER CODE: PACK/037 PRICE: £5-00

MOTOR PACK

A good mixture of mainly 3-12Vdc motors but maybe a couple of 110V or 220v/240v included for good measure.

Total Pack Qty: 10pcs

ORDER CODE: PACK/038 PRICE: £5-00

SWITCH PACK

An assortment of switches which may include: rocker, illuminated, rotary, toggle, micro, push, slide, etc.

Total Pack Qty: 20 pcs

ORDER CODE: PACK/039 PRICE: £2-25

POWER SUPPLY PACK

An assortment of mainly 220/240V 2 pin low voltage power supplies useful for running calculators, radio's, walkman's etc. Most fit the standard UK shaver socket.

Total Pack Qty: 10pcs

ORDER CODE: PACK/040 PRICE: £5-99

BATTERY HOLDER PACK

A useful pack of assorted battery holders, ranging from maybe AAA up to D size. Some solder, some PP3/PP9 and some wire ended!

Total Pack Qty: 20 pcs

ORDER CODE: PACK/041 PRICE: £3-50

RUSSIAN TEST/CHART RECORDER PART PACK

We have just found in one of our warehouses a very large qty. of complete, part complete and spares for, chart recorders and some multimeters, from a large parcel that we purchased several years ago. Some of you may remember Z & I Aero Services Ltd ???
The chart recorders were mainly the H3020 series and the multimeters were the U4324 type. No promises but ALL IS MADE IN THE USSR!!!!
(As it was called)
Although sold by weight, if you find an item enclosed of partic. interest we may be able to quote you for it but only for quantity please.

Total Pack Weight: 10Kg

ORDER CODE: PACK/042 PRICE: £10-00

SOLDER PACK

A mixed pack of both 18swg & 22swg solder. Each pack contains 10 assorted 12" length of solder.

ORDER CODE: PACK/043 PRICE: £1-50

CONNECTOR PACK

A useful pack containg a wide & varied selection of assorted connectors. Typical types may include: D type, IDC, Edge, Audio, Chassis, Line etc. In fact almost any type including popular ones.

Total Pack Qty: 25pcs

ORDER CODE: PACK/044 PRICE: £5-99

DIN CONNECTOR PACK

An assorted pack of DIN plugs, sockets chassis & line.

Total Pack Qty: 25pcs

ORDER CODE: PACK/045 PRICE: £4-50

PVC SLEEVING PACK

Assorted diameters & colours of PVC sleeving. Diameters may range from 2mm up to 19mm.
These packs are super value.

Total Pack Qty: 10 lengths each approx 12" long

ORDER CODE: PACK/046 PRICE: £1-25

TV DROPPER PACK

This pack contains a random selection of very assorted values of TV Replacement Droppers.
Packs may include droppers for Philips, Thorn, Pye, Decca etc etc.

Total Pack Qty: 15pcs

ORDER CODE: PACK/047 PRICE: £6-50

MULTI-SECTION ELECTROLYTIC PACK

A super mixed pack of multisection electrolytics. Widely used in TV sets etc.
The original prices of some of these capacitors was over £5-00 each!!
These really are good value.

Total Pack Qty: 10pcs

ORDER CODE: PACK/048 PRICE: £5-50

0.25W RESISTOR PACK

Assorted values, some popular because we are overstocked, others simply values we don't stock. Either way, these really are a bargain.
A minimum of 10 different values.
All 0.25W carbon film, 5% tolerance.

Total Pack Qty: 1000pcs

ORDER CODE: PACK/049 PRICE: £1-99

GOODY PACK

This pack contains a random selection of very assorted components including:
Resistors, Capacitors, Connectors, IC's, Diodes, Potentiometers and much much more.
Many of the items are to a much higher spec. than those usually available to the hobby market. These packs really are a bargain.
These packs are sold by weight.

Total Pack Weight: 1Kg

ORDER CODE: PACK/050 PRICE: £2-50

MAGAZINE PACK

A random selection of Electronic Magazines!
Some maybe old, some maybe new but whatever you get it will be interesting reading. Ideal for those winter nights!

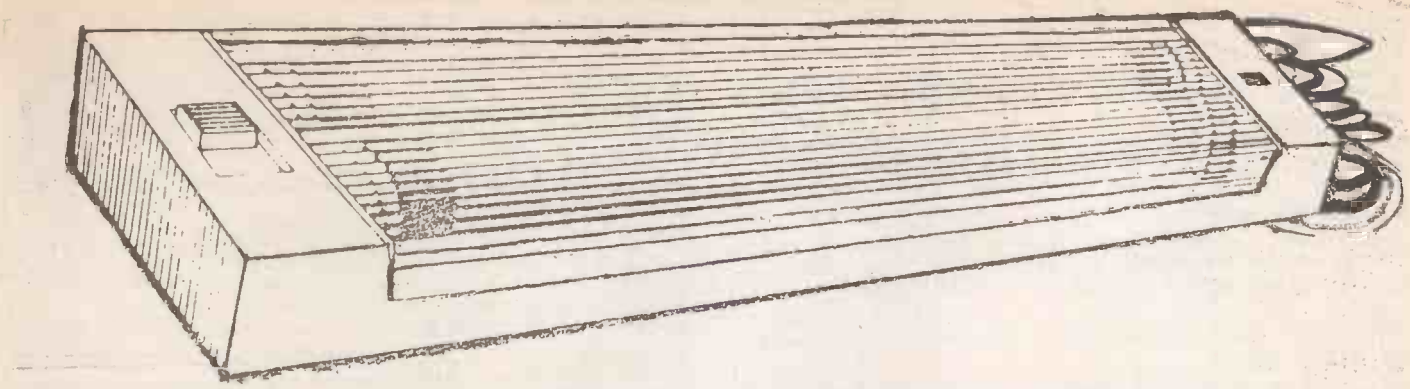
Total Pack Qty: 10 Magazines

ORDER CODE: PACK/051 PRICE: £4-50

REMEMBER: UNLESS STATED OTHERWISE, ALL OF OUR PACKS CONTAIN NEW & UNUSED COMPONENTS!!

DON'T DELAY.....ORDER YOUR MONEY SAVING PACK TODAY!!

12VOLT FLUORESCENT LIGHTS



A very attractive **twin** tube fluorescent light complete with two 12Volt 8Watt fluorescent standard type & size tubes.
White plastic case with clear plastic ribbed diffuser **and** ON/OFF switch.
The light is fitted with approx. 90cms. of twin flex for connection to 12V battery or other 12V power supply. Cable is colour coded for polarity identification.
These lights are ideal for **Caravans, Boats, Vans, Camping** etc etc.

Overall dimensions: 370 X 65 X 41mm

	1+	10+	50+	100+
ORDER CODE: **OPTO/TFL12**	**£6-50**	**£5-75**	**£5-25**	**£4-95**

SINGLE 12Volt Fluorescent Light

Identical to the above unit but **SINGLE** tube fitting.

ORDER CODE: OPTO/SFL12	**£6-00**	**£5-25**	**£4-75**	**£4-50**

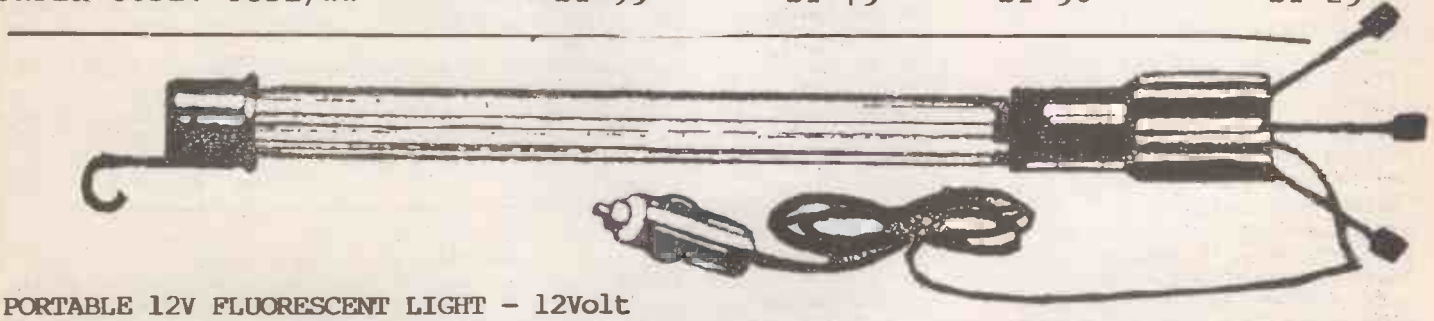
SPARE TUBES

Standard 12V fluorescent tube suitable not only for our lights above but for most other makes. Tube length is approx: 300mm incl. pins.
Colour: White.

	1+	10+	50+	100+
ORDER CODE: **OPTO/TUBE**	**£1-50**	**£1-25**	**£1-00**	**85p**

SPARE TUBE - 'WARM' WHITE
Identical to the above tube but more suited for the caravan/camping application. This tube gives a 'warmer' light.

	1+	10+	50+	100+
ORDER CODE: TUBE/WW	£1-95	£1-75	£1-50	£1-25



PORTABLE 12V FLUORESCENT LIGHT - 12Volt
Free-standind or hanging (Hanging hook supplied), with approx. 5 Metres lead terminating in standard car type cigar plug. Ideal for use in Car, Boat, Caravan, Van, Camping etc.
Sealed unit therefor completely weatherproof, they even float on water!!
The fluorescent light is 12Volt & 10Watts.

Overall dimensions: 430 X 30MM dia.

	1+	10+	50+	100+
ORDER CODE: OPTO/PEL12	**£5-99**	**£5-50**	**£5-00**	**£4-75**

WE ARE THE IMPORTERS OF THESE ITEMS. LARGER QTY. PRICES AVAIL.

HOBBY KITS

ELECTRIFYING APPARATUS

...generates a weak adjustable high tension of approx. 80-300V out of 3-6V(Max 9V). May be used by anglers to catch worms etc.
Max. current 50-250mA

KIT/B007 PRICE: £8-35

FOG HORN 5Watts

...generates a deep, noisy sound similar to the fog horns of ships! Operating voltage 4.5-12V, Max 5Watts depending on the voltage. Suitable for 8ohm speakers.

KIT/B015 PRICE: £5-99

TEST OSCILLATOR

This is a close range test only transmitter, which can be tuned between 88-108MHz and used to service radio receivers by using the unmodulated carrier. This kit must not be used to transmit over any distance!

KIT/B018 PRICE: £6-85

12V to 240VAC INVERTER

Transforms voltage from 12V car battery to 240VAC voltage approx. (adjustable) 50Hz. The required transformer & cooling unit are NOT included in this Kit. Precise information on standard transformers are given in the Kit assembly instructions. Max. 120Watts.

KIT/B038 PRICE: £9-25

LIGHT BARRIER 12V

A light barrier kit which uses an LDR (Light Dependant Resistor) to trigger the relay on. Can be used to switch on an alarm, open a door, or simply used as a security twilight switch. A light source is required which shines onto the LDR of the kit, if this light source/beam is broken the relay will pull on.
Max relay current is 5A. Requires 12V supply.

KIT/B045 PRICE: £9-75

THERMO SWITCH

Turns the relay on or off at a pre-fixed temperature. This instrument may be used as a thermostat, ice warning system, frost detector etc etc. Temperature range is approx: -30 to +150°C. Operating Voltage: 12V
Relay switching capacity: 5A.

KIT/B048 PRICE: £9-85

ULTRASONIC DOG WHISTLE

The ultrasonic dog whistle emits high powered sounds which although audible to dogs mostly undetectable to the human ear. The output frequency is through a special piezo loudspeaker and is adjustable between 8000 & 25,000Hz. Requires a PP3 9V battery.

KIT/B179 PRICE: £7-50

12V-24V SPEED CONTROL

Suitable for the operation of miniature DC drills. A rectifier is fitted in the circuit and only requires a transformer of 12-24V secondary depending on the required voltage. Suitable for use up to 3A current input.

KIT/B180 PRICE: £6-45

ION GENERATOR

Regenerates negatively loaded air particles (air-ions) & helps to produce a healthy climate which can reduce troubled sleep, aggressiveness, headache's etc.
Input: 6-18Vdc. Output 2-7Kv Current limit protection 200uA.

KIT/B137 PRICE: £9-95

CAR ANTENNA AMPLIFIER

This amplifier is connected between the antenna and the radio using co-ax cable, 60-75ohm. Gain Max. 22dB. Frequency range: 0.5-150MHz (Approx)

KIT/B068 PRICE: £5-99

SPY STETHOSCOPE

Using an earpiece the spy stethoscope allows you to listen through thin walls, doors, windows etc, due to a highly sensitive pre-amplifier & microphone. Suitable for monitoring animals etc!

KIT/B069 PRICE: £20-50

MW & SW DIODE RECEIVER

'Detector-receiver' for approx. 2-9MHz. This radio works on the same principle as the very first radio receivers! It does NOT require an operating voltage. Super educational kit for beginners.

KIT/B076 PRICE: £10-75

PARABOLIC MICROPHONE

Highly sensitive microphone. If mounted into a semi-circular reflector (half a plastic ball) noise & voices several hundred metres away may be heard & recorded! Ideal for animal observance, detectives etc.
Headphone connection: 8ohm. Requires 9V supply/battery.

KIT/B085 PRICE: £10-35

ROBOT VOICE

This kit modulates the human voice with an adjustable frequency to produce robot like sounds. This sound then requires amplification i.e. by an amplifier or tape recorder.
Requires 9-12V supply.

KIT/B107 PRICE: £9-60

DOG BARKING - ELECTRONIC

Generates a dog barking sound. Suitable for use with an 8ohm speaker. Operating voltage: 9-12V. The barking is stored on a special speech-synthesizer IC.

KIT/B155 PRICE: £19-50

MW TESTING TRANSMITTER

A close range test only oscillator which can be used as an unmodulated carrier to test radio receivers in the MW band. This kit must NOT be used to transmit over any distance!

KIT/B144 PRICE: £4-99

HI-FI AMPLIFIER 200W

KIT/B125 PRICE: £26-99

METRONOME

Anelectronic metronome which has an adjustable time signature between 30-300 beats per minute. The sound of each beat is clearly indicated by the loudspeaker. Requires 4.5-6V supply.

KIT/B082 PRICE: £8-50

VHF RECEIVER

Frequency approx. 79-110MHz. Sensitive FET input circuit based on the shuttle principle. Operating voltage: 9V. At the output use either a high impedance ear-piece or an amplifier. Output approx. 10mV, 50K.

KIT/B100 PRICE: £10-95

MODULES

MOTORBIKE ALARM

This waterproof & shakeproof module will automatically switch on a horn or siren if the motorbike is moved. Can also be used to protect other items. Additional items required: power supply (Bikes battery), SPST switch, horn or siren. Max current: 1Amp.

KIT/M073 PRICE: £4-50

MICROWAVE LEAKAGE INDICATOR

This module is used as an microwave oven leakage tester, and will light up the LED if any radiation escapes through defective door hinges, rubber seals or shieldings.
Requires a 9V battery.

KIT/M058 PRICE: £6-00

VOLTAGE TRANSFORMER

Suitable for driving cassette decks, portable radio's etc. requiring 6V, 7.5V, or 9VDC from a 12V car battery or other 12V supply. Max load 800mA.

KIT/M015 PRICE: £5-65

INTERFERENCE FILTER-MAX 20Amp

High capacity mains filter has a ring core choke & must be connected within the mains supply that requires filtering.

KIT/M041 PRICE: £8-00

SPECIAL OFFERS

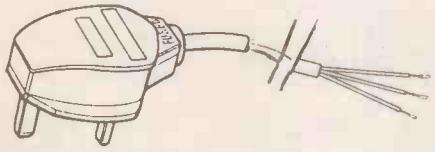
SELLOTAPE SALE

Standard Reels of Sellotape, made by 3M.
WIDTH: 3/4" Length: 66 Metres
Normal Price: 60p per reel!!!
ORDER CODE: SO/SELL
SALE PRICE: 50P 10 FOR £4-00

BT 4 Way plug to 25 way 'D' Socket Lead
A short lead, BT 4 way plug to 25 way 'D' socket using BT flat style cable. 4 core, pins 2,3,5 & 7 connected on the 25 way 'D'.
Lead Length: Approx 175mm

ORDER CODE: SO/625 PRICE: 50p

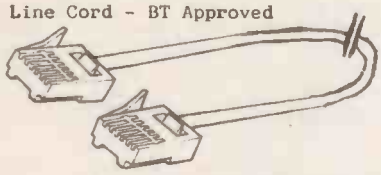
MOULDEO 13A PLUG & LEAD



A non-rewireable standard VOLEX 13A plug fused with 3A fuse, moulded to a 2 Metre length of 3 core 0.5mm cable. The free cable end has stripped conductors ready for fiting to your equipment.
COLOUR: BLACK

		1+	10+
ORDER CODE: SO/612	PRICE:	£2-00	£1-75

BT Type Line Cord - BT Approved

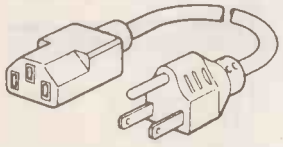


50P ANY QTY

Line Cord, Plug to Plug. BT standard cord set used when modifying existing equipment. Plugs each end are 4 way.
LENGTH: 3 Metres

	1+	10+	100+
SO/613 PRICE:	~~£1-25~~	~~£1-00~~	~~88p~~

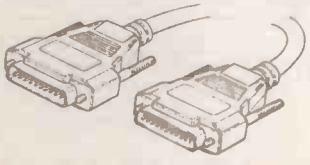
IEC MAINS LEAD Belling Lee UK 6A 250V



A non-rewireable IEC socket moulded to a 2M length of 3 core 0.75mm cable terminating with a USA plug. For UK use simply cut off USA plug and fit UK 13A plug.
Rating: 10A @ 115V. 6A @ 250V. Colour: GREY

		1+	10+	25+
ORDER CODE: SO/614	PRICE:	£1-50	£1-25	£1-10

COMPUTER MODEM LEAD



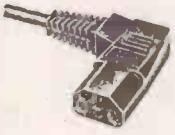
RS232 - RS232 25 way 'D' plug to 25 way 'D' plug.
9 pins connected.
Snap-fit covers allowing you to open and re-wire the pin configuration if required.
Length: 1.5 Metres (Approx)
ORDER CODE: SO/615 PRICE: £2-75

MOTOR RUN CAPACITORS - 440V 5% TOL.

Stud mounting capacitors suitable for motor start/run and other similar applications. Connections via double 6.35mm tabs. Manufactured to BS5267.
Curent list price is over £6 each plus VAT!
15uF 440V DIMS: 115mm X 45mm Dia.
20uF 440V DIMS: 135mm X 45mm Dia.

15uF 440V ORDER CODE: SO/631 PRICE: £3-50 each
20uF 440V ORDER CODE: SO/632 PRICE: £4-00 each

IEC MAINS LEAD - Right Angle - Belling Lee 6A 250V



SO/618
A non-rewireable right angle socket moulded to approx. 2 metres of 3 core 0.75mm cable terminating in prepared ends ready for wiring to your equipment.
Length: 2 Metres PRICE: £1-00 each COLOUR: BLACK

AVO PANEL METERS Type T60/2481

Marked 50-0-50uA
Internal Resistance 400 ohm.
Dims: 70 X 60mm (Approx)
Zero adjustment on front of meter.
As you would expect from AVO, made to the highest quality. Limited qty. available.

ORDER CODE: SO/628 **£5-00** PRICE: ~~£6-50~~

COMPUTER CURLY LEAD

A 15 way 'D' plug fitted to approx. 1 metre of black 4 core curly lead with prepared ends on the other end.
Lead stretches to approx. 3-4 metres.
ORDER CODE: SO/620 PRICE: £1-00 each

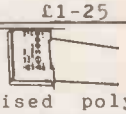
CAPACITOR SALE
2200uF 35Volt Ideal for power supplies. Super quality, made by Matsushita (Panasonic) in Japan. Only available while stocks last. **RADIAL LEAD**
Dims: Length 30mm, Dia. 16mm. Lead length approx. 30mm.

		1+	10+	100+
ORDER CODE: SO/621	PRICE:	50p	45p	35p

L293B SGS Bridge Driver 16 pin DIL
Only a few hundred available at this once only price. 25 pcs to a tube.

	1+	25+	100+
ORDER CODE: SO/622	£1-50	£1-25	£1-00

MAINS SUPPRESSION CAPACITOR



ISKRA 0.1uF 250Vac X2
A radial lead boxed metallised polypropylene mains suppression capacitor. Approved to VDE-0565 Class 2. Epoxy resin encapsulated in flam retardent plastic case. Iskra Type: KNB1532
Dims: W 18mm. H 7mm. D 13mm Pitch: 15mm
Tolerance: ±20%

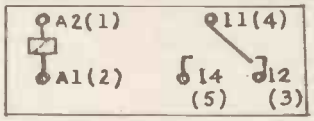
		1+	10+	100+
ORDER CODE: SO/627	PRICE:	20p	18p	15p

SPECIAL OFFERS

PHOTO-TRANSISTOR Siemens Type: SFH309-5
Case: T1 (3mm)
Sensitivity: 1.0-2.0 @ 0.5mW/cm²
Half Angle: 32°
Peak Response: 900nm
Response: 10 tr(US)
Short lead is connector.
Lead pitch: 2.54
We have large qty's in stock.

	1+	10+	100+	1000+
ORDER CODE: SO/601	38p	35p	25p	20p

SCHRACK RELAY TYPE: RP-03 1012



Internationally approved heavy duty PCB mounting relay in industry standard dimensions with 1 form C contact rated at 8Amps. Mounted on 0.1" grid.

Switching voltage: 380Vac max.
8A 250Vac Dims: 28 X 25 X 11mm

Nominal V DC: 12V 270 ohm

ORDER CODE:	1+	10+	100+	1000+
SO/602	£1-00	90p	65p	55p

(We still have approx 3,000 in stock!)

EPROM LABELS 16.5mm X 5.08mm
OK INDUSTRIES TYPE CODE: 1/100A/10
A dual purpose label designed for use on Eproms or similar devices where the chip requires protection from the effects of light. These labels are also handy for marking devices or junction identification. Supplied on roll sheets which have pin-feed holes along the edge thus allowing them to be printed on a computer printer.
Total qty. per full rel: 3350 Labels (Approx)

	QTY	PRICE
ORDER CODE: SO/600	60 Labels	50p
	180 Labels	£1-40
(Full reel)	3350 Labels	£22-50

IEC LEAD - CURLY
6A 240Vac Right Angle IEC plug fitted to 3core 0.75mm black curly cable. Stretches to approx. 2.5Metres.

	1+	10+
ORDER CODE: SO/604	£1-00	90p

TERMINAL BOX - 12Vdc

Terminal junction box for powering d.c. accessories. Gives three pairs of pillar screw terminals, colour coded Red & Black. 90cm lead with cigar plug fitted.
Current.....3A max.
Dims: 84 x 55 x 32mm

ORDER CODE: SO/158	1+	10+
PRICE	£1-50	£1-25

TOROIDAL TRANSFORMER Made in UK
Manufacturer: St Ives Windings.

PRIMARY: 0-120V
0-120V

SECONDARIES: 9V at 4Amps
15-0-15v at 500mA

Dims: 75mm Dia 38mm Thick

Original Price in tens £24 each
ORDER CODE: SO/268 PRICE: £9-99

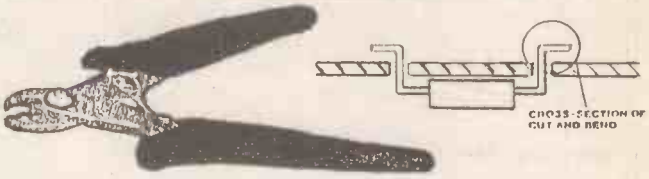
DIL SWITCH - 10 Way - Low Profile
Alco Type: ADP10
Very high quality. 0.1" pitch. Black with white switches. Length: 27mm. DIL package. 20 pin
At time of printing we have over 20,000 pcs in stock. 15pcs per tube.

	1+	15+	90+	900+
ORDER CODE: SO/608	50p	45p	39p	30p

HI RES MONITOR Made in UK GREEN SCREEN
Very high quality monitor, complete apart from the case.
Resolution at Centre is 900 lines therefore ideal for computer applications.
Simply input 12V @ 1.2A.
COMPOSITE VIDEO!
Supplied complete with full handbook and circuit diagram and full parts list.
(Manual available seperately £2-00 each)
SPEC:

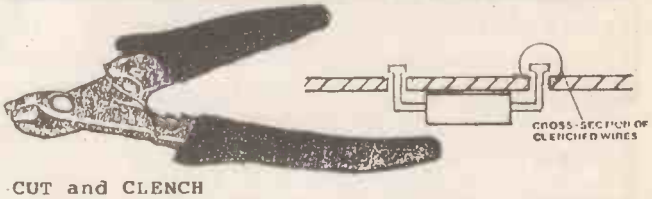
CRT Size	7" (178mm)
Power	12V/1.2A
Line Frequency	15-19KHz
Vertical Frequency	50-60Hz
Resolution at Centre	900 lines
Linearity	<2%
EHT Typical	12.0Kv
Line Blanking	12-7.5uS
Vertical Blanking	750uS
Video Input unterminated	12K
terminated	75R
Video Response	22MHz
Video Rise/Fall	17nS
Video in for 35V output	1Vp-p

ORDER CODE: SO/MONITOR PRICE: £19-99
2 for £35-00



CUT AND BEND
Cuts & bends component leads in one action (see drawing). A quick & easy method of retaining mounted components. Ideal for development work. Components can be removed & reused after desoldering at a later time. Cutting capacity 1mm dia. copper wire. Special cushion grip handles. Very high quality, manufactured in Italy.
Length: 128mm Weight: 70gms
Normal Catalogue Price: £4-95

ORDER CODE: TOOL/SC/TP30 SALE PRICE: £2-99



CUT and CLENCH
A stepped edge provides a cutting & clenching action which will cut & splay copper leads out to approx. twice the original diameter.(See drawing). Provides a permanent & secure method of retaining components, particularly useful in production. Cutting capacity 1mm dia. copper wire.

Length: 128mm Weight: 70gms

Special cushion grip handles . Made in Italy.
Normal catalogue Price: £4-99

ORDER CODE: TOOL/SC/TS30 SALE PRICE: £2-99

SIMILAR TO ABOVE KEYBOARD

KEYBOARD - Clare BRAND NEW
Uncased Brand new keyboards manufactured by Clare General Instrument Corp.
Alphanumeric - seperate numeric keypad.
Overall dims: 480 X 160mm.

ORDER CODE: SO/472 SALE PRICE: £4-50 each

SPECIAL OFFERS

MICROPROCESSOR BOARD

A very high quality PCB manufactured by Ferranti still in its original packaging.

All Microprocessors are 'plug-in'.

2 X Z0803006PSC (40pin) 1 X Z0801604PSC (48pin)

1 X Z8001B1 CPU (48pin) 4 X 27256-20 (28pin)

1 X AM8152ADC (48pin) 1 X AM27128A (28pin)

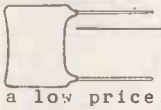
1 X AM8052-5LC (68pin PLCC) Dated 1984

Over 40 assorted IC's soldered plus numerous resistors, caps., crystals etc etc.

BOARD DIMS: 220 X 225mm

ORDER CODE: SO/648 **PRICE: £15-00**

SILVERED MICA 0.01uF 500V 1%
Type: RDM30FD103-F03 CDE



Super quality, good high voltage at a low price.

DIMS: Height 20mm Width 20mm Depth 7mm

Lead Pitch: 10mm (Lead length: 35mm)

The current distributor price for a 350V version is over £1-85 each plus VAT!!!

Several thousand avail.

ORDER CODE: SO/649	1+	10+	100+
PRICE:	50p	45p	35p

ANGLE SCREWDRIVER

USAG 340 Each end has flat blade 13mm tip.
Very high quality, marked Vanadium USAG Extra 2 X 13.

ORDER CODE: SO/650 **PRICE: £1-00 each**

POLYESTER 0.22uF 400V
ITT Made

Radial Lead. Lead Length: 15mm. Pitch: 22.5mm
Dims: H 19mm W25mm D 10mm

ORDER CODE: SO/651	1+	10+	100+
PRICE:	20p	18p	14p

COMMUNICATIONS INTERFACE PCB - Processor Board
Sorry, no further info. but board populated with several 6800, 6116, 2764, series chips (All plug-in).
Phono sockets, resistors, caps., etc etc.
Board Size: 465mm X 195mm

ORDER CODE: SO/652 **PRICE: £5-00**

MULLARD TRIMMER CAPACITOR

Mullard type: 808 series. 2-40pF 250V
Super quality at a very special price while stocks last!
Mullard Code: 808-11409. Value: 2-40pF 250Vac
Distributor price is 24p ea + VAT on 100's!!

ORDER CODE: SO/626	1+	10+	100+
PRICE:	25p	23p	20p

TANT BEAD SUPER SALE

We have just purchased over 150,000 tantalum bead capacitors and can offer very attractive prices while stocks last.

VALUE/Voltage	1+	10+	100+	1000+
1.0uF/35V	10p	8p	5p	3p
2.2uF/16V	11p	9p	6p	4p
4.7uF/35V	16p	12p	9p	7p
10uF/16V	20p	15p	10p	8p
10uF/35V	24p	18p	13p	10p

Lead Spacing: 5mm Approx Lead length: 5mm

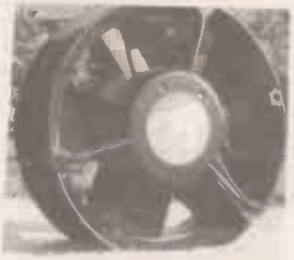
TELEFUNKEN - Selection guide Transistors & Diodes.
38 pages, packed with full specifications, drawings, pin-outs and cross-references.
Contents: BA204-2N4036
A super booklet full of useful data.
Dims: 270mm X 210mm

ORDER CODE: SO/654 **PRICE: £1-00**

BULGIN Panel Mounting AA Battery Holder
Takes 3 AA Batteries (Bulgin Type: B13/1)

Panel mounting battery holder. Flush fitting bayonet cap with coin slot for tightening. Mounting is from rear of panel, fixing by screws through front flange.

ORDER CODE: SO/635 **PRICE: £1-00 each**



PAPST FAN - TYPE 6124 (172 X 55mm) 206CfM
Aluminium fan, impeller of fibreglass reinforced plastic. Electronically commutated dc motor. Counterclockwise rotation viewed from rotor, air output over struts!! OK? (Supplied with FREE guard)
All brand new, still boxed, very high quality.
List price is over £85-00 each!!!

ORDER CODE: SO/256A **SALE PRICE: £10-00 each any qty.**

EBM FAN - Type W2G075-AE21
80mm X 80mm (Depth 38mm)
Super quality, latest model. Run at 12Vdc. (Will run on voltage between 8v and 16vdc.)
2.6Watts, 3450u/min. Made in Germany.
All aluminium construction. Trade price over £30 each!

ORDER CODE: SO/257 **SALE PRICE: £7-50 ea**

AUDIO CASSETTES **AUDIO CASSETTES**

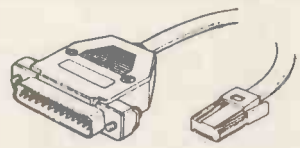
Used once and bulk erased. ALL FULLY GUARANTEED
Over the last 12 months we have sold over 55,000 of these tapes and demand is still growing.
At time of printing we have two makes available.
MAXELL UDI-90 & SKC GX90 Ferro Position
Both tapes are supplied complete with inlay cards.
Both tapes are 90 Minutes.

ORDER CODE	1+	10+	100+
SO/MAX	85p	75p	60p
SO/SKC	65p	55p	40p

SPECIAL OFFERS

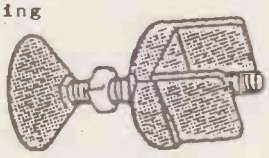
5¼" Computer Disks - 3M
Type: 744 D-O SS DD
Single sided double density soft sector.
Limited qty, only a few hundred boxes. First come first served!
ORDER CODE: SO/636 PRICE: £2-00 per box of 10

MODEM LEAD



25 Way 'D' Plug connected to a BT 4 way plug.
Length: Approx. 3 Metres.
ORDER CODE: SO/637 PRICE: £3-50

Adjustable Feet for Tube Fitting



High quality feet for fitting to most makes of 25mm square tube. Each pack contains:
4 X Threaded Feet. 4 X Metal Cap. 4 X Tightening Nut.Current Trade price is £4-70 plus VAT per pack! Remember, all our prices include VAT.
ORDER CODE: SO/638 PRICE: £3-00 per pack

CENTRONICS PLUG - MALE - 50 Way
Amphenol Type: 226 B-50-U

50 Way plug (Without strain relief) Very high quality. Only a couple of hundred available.

	1+	10+
ORDER CODE: SO/639	£1-10	£1-00

0.1uF 63V 5% Metallised Polyester Capacitor
Very small capacitors, ideal where space is restricted. Overall width is only 7.5mm.
Lead pitch is 5mm.
We have a substanial quantity of these capacitors so if you use large quantities contact us now.

ORDER CODE: SO/640	1+	10+	100+	1000+
PRICE:	5p	4p	3.5p	2.5p

FARNELL SWITCH MODE PSU - 240Watts G Series

Model: G12 20A
They seem unused but no promises. Copy of manual available with orders upon request. These units are in the curent Farnell catalogue at over £395 each!

INPUT: 115-120/240Vac

OUTPUT: 8 to 12.6V (Adjustable) 20 Amps

Dims: 88 X 160 X 194
SALE PRICE: £150-00 each

Multi-channel Photodarlington Optocoupler
Siemens Type: ILD32 8 pin DIL

2 input opto-coupler with darlington output

This device can be used to replace 4N32's or 4N33's in applications calling for several single-channel couplers on a board.

Continuous Forward Current.....80mA
Peak Reverse Voltage.....3V
Photodarlington Sensor (Load Circuit)
Power Dissipation @ 25°C Ambient.....150mW
Derate Linearly from 25°C.....2.0mW/°C
Collector (Load) Current.....125mA
Collector-Emitter Breakdown Voltage (BVceo)....30V
Emitter-collector Breakdown Voltage (BVeco).....5V
8 pin DIL package.

ORDER CODE: SO/643	1+	10+
PRICE:	45p	40p

INFRA-RED EMITTERS Type: OP161SLA
T1 (3mm) Package.

Gallium arsenide infrared emitting diodes moulded in clear plastic, mini-axial package. The lensing effect of the package allows a radiation half angle of 8° measured from the optical axis to the half power point. Lead spacing is 0.100" (2.54mm) to allow mounting in standard sockets.

Continuous Forward Current.....50mA
Peak Forward Current (pulse width=1usec 300pps).....3.0A
Reverse Voltage.....2.0V
Power Dissipation.....100mW

At time of printing we have several thousand pcs of this item if you require large quantity's.

	1+	10+	100+
ORDER CODE: SO/644	45p	40p	25p

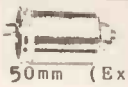
PAIR - INFRA-RED EMITTER & DETECTOR
T1 (3mm) Package.

No info on these pairs but we are fairly sure that the emitters are OP161SLA as detailed above with matching detector. But no promises!
Each pair is in a small holder.
ORDER CODE: SO/645 PRICE: £1-00 per pair

0.01uF 2000V Wima Type FKP-1
Tol: 5%

Width: 30mm Height: 20mm Depth: 11mm
Lead Pitch: 27.5mm
ORDER CODE: SO/646 PRICE: 50p each

2200uF 63V Electrolytic
PCB/Stud Fixing



Dimensions: Dia. 35mm Height. 50mm (Excluding thread)
Supplied complete with fixing nut and washer.

ORDER CODE: SO/647	1+	10+
PRICE:	50p	45p

2200uF 100V PCB Electrolytic
Miniaturized versions ensures a saving of space in compact power supply design.. PCB snap-in terminals on a 10mm pitch for direcr mounting into 2mm dia. holes. Super quality, super price!
ORDER CODE: SO/310
PRICE: £1-50 each

We may purchase your excess stock! Contact us now.

MARCO TRADING 1992 AUTUMN SALE ORDER FORM

INCORPORATING 'EAST CORNWALL COMPONENTS'

EE-TV

The Maltings, High Street,
WEM, Shrewsbury, SY4 5EN.

TEL: 0939-232763(3 lines)
0939-232689(2 lines)

FAX: 0939-233800

CUSTOMER NAME & ADDRESS _____

_____

_____

_____

DATE: _____

DESCRIPTION	QTY.	UNIT PRICE	TOTAL PRICE
ORDER YOUR 1993 CATALOGUE NOW TICK ☐			
SIMPLY TICK BOX & ADD £2(UK) £4(OVERSEAS)TO YOUR ORDER			
DELIVERY!!			
SIMPLY TICK 3 DAY OR NEXT DAY & CROSS			
OUT THE ONE YOU DO NOT REQUIRE			
(UK MAINLAND ONLY) **SUB.TOTAL FROM OVERLEAF**			

☐ **YES! MY ORDER IS OVER £30 PLEASE SEND MY RADIO FOR £17-50**

3 DAY	**£3-00**
NEXT DAY	**£9-00**
TOTAL	

IF PAYING BY CREDIT CARD, PLEASE STATE:
VISA ACCESS NO.:
EXPIRY DATE:
SIGNATURE:

PAYMENT ENCLOSED: VISA/ACCESS, CHEQUE, POSTAL ORDER, CASH, CREDIT NOTE.(Delete As Applicable.)

If any items are not available from stock, tick appropriate box for action required.

Send Order Balance To Follow A.S.A.P. ☐ Hold Order Until Complete ☐ Credit for Out of Stock Items ☐

DESCRIPTION	QTY.	UNIT PRICE	TOTAL PRICE
		SUB.TOTAL	

SPECIAL OFFERS

BUY A PAIR OF HAND HELD TRANCEIVERS FOR ONLY £27-50

2 Way Hand Held Crystal Control Tranceivers. Built in telecopic aerial, call button, transmit/receive key, on air indicator. Simply require PP3 battery!!

Operating Frequency.....49MHz
Transition Power.....100MHz
RANGE: Up to one mile depending upon conditions.
Oscillation.....Crystal control
Power.....9V(PP3)

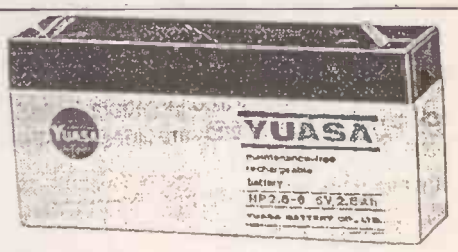
ORDER CODE: B123 **PRICE: £27-50**

OR PAY ONLY £17-50 WHEN SPENDING £30 OR MORE & USING THE ENCLOSED ORDER FORM

COMMODORE (CBM) Charger/Power Supply
A good quality power supply offering the electronics hobbyist/enthusiast the opportunity to purchase a quality unit that is fairly simple to alter the specfcation of, at a very attractive price. Plenty of room in the case to add zener's, voltage regulators etc.

Input: 220V-240V (Switcheable)
Output: 7.2Vdc @ 225mA
7.0Vac @ 45mA
DIMS: 100 X 55 X 60mm
Mains Lead: Approx. 400mm
Output Lead: Approx 2.25 Metres. Fitted with a moulded plug (Non-standard)
Several thousand of these units at time of printing.

ORDER CODE: SO/659	1+	10+	100+
PRICE:	£2-99	£2-50	£1-99



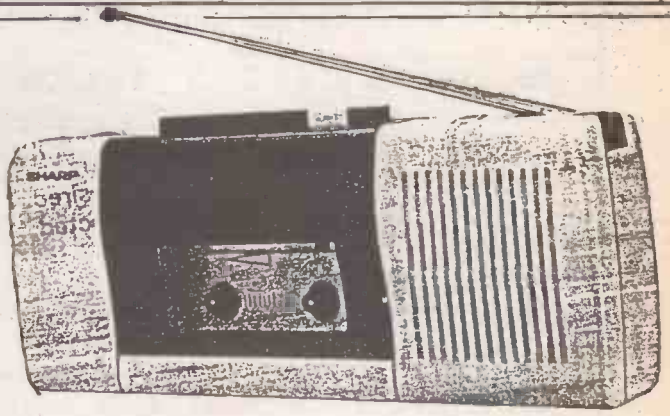
YUASA CODE: NP10-6 Dims: 101 X 151 X 50mm
Terminals: Spade Type.
Weight; 2.2Kg **6V 10Ah**

We have a limited stock of Yuasa Sealed Lead Acid batteries which when checked at random found are not accepting a full charge. On the few that we have found to be like this we have found with patience, most eventually came up to full specification.
However, time is money as they say and so we are selling off these batteries at a very reduced price. We are selling these batteries with NO WARRANTY WHATSOEVER and therefore it is a case of taking a chance!
NO RETURNS WILL BE ACCEPTED!
The normal price of these batteries is approx. £16-95 each.

	1+	5+	10+
SO/656	£5-00	£4-50	£3-50

SHARP RADIO CASSETTE - Model QT-F10E
A super radio cassette Recorder offered at a fraction of the normal price.
Although some are refurbished they are all guaranteed by us for 3 months from date of purchase. In the unlikely event of any problem we would repair or exchange at our discretion.
Features include:
* Auto Stop
* Battery Operated (5 X AA) NOT Included
* Recording from Radio using Built-In Mic. is posssible.
* Recording external sound is of course possible
* Earphone socket is fitted.
* FM Range: 87.6MHz - 108MHz
* AM Range: 526.5KHz - 1606.5KHz
* Some are complete with carrying case.

Limited quantity are available!
ORDER CODE: SO/658 PRICE: £12-50



SURFACE MOUNT SPECIAL

We have just taken delivery of more than 1 million pcs. of Surface Mount Components! If you are a manufacturer using Surface Mount Technology, you will find our prices just incredible....but hurry! At these prices we expect to sell out fast. For the hobbyist who perhaps has not tried Surface Mount components nows your chance at a fraction of the normal cost.

TANTALUM Bead Capacitor (Branded AVX) QTY: 150K
Value: 1.0uF 35V ORDER CODE: SO/670
PRICE: £1-00 per 50 £1-75 per 100 £15-00 per K

TRANSISTOR BCW31 (SOT-23) Philips
Bipolar, general purpose. NPN 32V 100mA 350mW
Total quantity available: 85,000 pcs.
ORDER CODE: SO/671
PRICE: £2-00 per 50 £3-50/100 £30-00 per K

MURATA CAPACITORS 50Volt

Value	TOL	ORDER CODE	per 100	per 1000
27pF	5%	SO/672	£1-75	£12-50
100pF	20%	SO/673	£1-75	£12-50
270pF	10%	SO/674	£1-75	£12-50
390pF	5%	SO/675	£1-75	£12-50
470pF	10%	SO/676	£1-75	£12-50
47nF	10%	SO/677	£2-00	£15-00
220nF	20%	SO/678	£2-50	£20-00

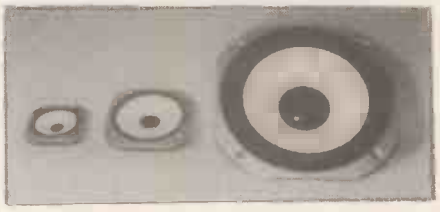
RESISTORS 0.125W (⅛W) 1206 Case Generally 1% & 2%
We have over 50,000 pcs of each value listed below.
100R, 180R, 220R, 820R, 1K8, 4K7, 10K 22K, 33K, 39K, 47K, 68K, 100K, 130K, 200K, 220K, 680K, 1MO, 1M5, 10MO.
ORDER CODE: SO/679/Value Required
PRICE: £1-00 per 100 £7-50 per 1000

LOW POWER ZENER 350mW PHILIPS
Only two values available but at very reduced prices:
BZX84C-4V7 32,000 pcs. ORDER CODE: SO/680
BZX84C-5V1 18,000 pcs ORDER CODE: SO/681
PRICE: £2-00 per 50 £3-00 per 100 £20 per 1000

SURFACE MOUNT JUMBO PACK
A random mixed pack including a selection of the above surface mount components. These packs are made up at random. NO CONTENTS LIST!!
Total Pack Qty: 100pcs
ORDER CODE: PACK/052 PRICE: £2-00

TELEX FOR SALE!! CHEETAH 87 BRITISH TELECOM
We don't use our Telex machine now, its all done by Fax. However, we paid nearly £3,000 for ours a few years ago and we understand that some industries still prefer Telex for overseas communication. Perhaps your company is one of those?? Or maybe you have always wanted to own a telex!! Ours is being offered at a very very cheap price to clear. Remember, one only!!
ORDER CODE: SO/TELEX PRICE: £350-00
(And we will throw in any spare paper rolls we may have!)

VALVE SPECIAL - TY4-400 MULLARD BRAND!
Only a few of these but yes, they are Genuine Mullard valves. A real bargain and of course, they are ALL BRAND NEW!!
ORDER CODE: SO/682 PRICE: £175-00



A super set of 3 speakers which are all mounted in Aluminium Bezels for front loading.
The set comprises of:
10" Woofer 8ohm 40Watts. Rubber Foam edge, White Paper Cone.
4½" Mid-Range 8ohm. White Cone, enclosed back
3" Tweeter 8ohms. White Cone. Enclosed back.
ORDER CODE: SO/683 PRICE: £15-00 per set

MARCO TRADING

********** INCORPORATING **********

EAST CORNWALL COMPONENTS

THE MALTINGS, HIGH ST. WEM, SHREWSBURY, SY4 5EN

TEL: 0939 232763 TEL:0939 232689 FAX: 0939 233800

BRANCHES

SUPERTRONICS,
65 HURST STREET,
BIRMINGHAM. B5 4TE
TEL & FAX: 021 666 6504

WALTONS,
55A WORCESTER STREET,
WOLVERHAMPTON.
WV2 4LL
TEL & FAX : 0902 22039