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JULY 1981 60p

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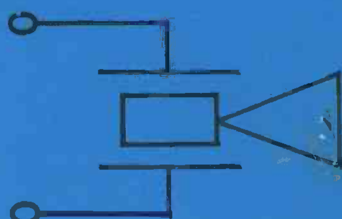

DESIGN IDEAS – USING PIEZO ACOUSTIC RESONATORS

STARTING IN THIS ISSUE

COMPULINK – *LINKING MPU'S TO THE REAL WORLD*

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- IR REMOTE CONTROL
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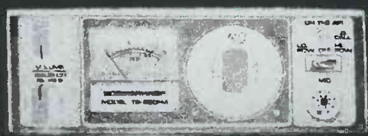
73



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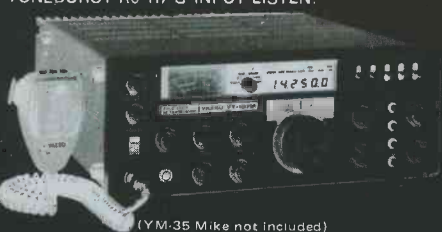

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FT107 Yaesu Basic set £690.00
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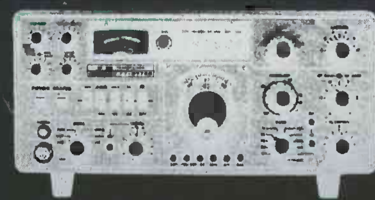

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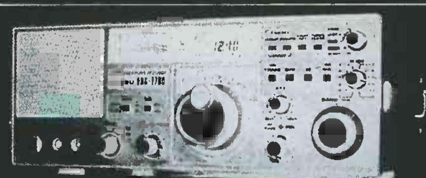

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Technical Queries. We regret that we are unable to answer queries other than those arising from articles appearing in this magazine nor can we advise on modifications to equipment described. We regret that queries cannot be answered over the telephone, they must be submitted in writing and accompanied by a stamped addressed envelope for reply.

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OUR NEXT ISSUE WILL BE PUBLISHED 15th JULY

RADIO & ELECTRONIC WORLD BOOK SERVICE

Radio & Electronics World

The R&EW Book Service

By way of an introduction to part of the philosophy behind the forthcoming *Radio and Electronics World*, we are introducing some of the vastly expanded range of titles on electronics, radio and computing that we are now able to offer in conjunction with *International Book Distributors*.

Unlike many magazine book services, *R&EW* is actually stocking the titles for direct despatch, and thus we are basically offering only those titles which we feel are really worthwhile. The editorial eye has been cast over the titles listed here, and we have weeded out those which we feel are not particularly appropriate or apposite.

In case you think this must be the same range as you have seen elsewhere - wait a moment, since IBC has *not* previously engaged in such an excercise with a monthly magazine, you will find a plethora of new material herein.

New titles are introduced at the rate of 3-4 a month, and we will be reviewing and stocking all those which have a contribution to make to the prime *R&EW* aim, which is to improve both the quantity and quality of the information that is available to the electronics enthusiast - be he/she an 'amateur' or 'professional'.

You will see that we have introduced a couple of title from the famous *Howard Sams* series. The *Sams'* photofact series are widely appreciated in the USA as being the standard service engineer's 'bible' on subjects ranging from washing machines to CB. In view of the nature of the equipment and the varying standards that apply both sides of the Atlantic - we will probably only be stocking the CB and scanner-monitor series for UK consumption.

Books BOOKS Books

Z-80 Microcomputer Design Projects
by William Barden, Jr.
208 pages; 8½ x 11; softbound. © 1980
(ISBN: 0-672-21682-5) £8.40

Even a beginner in electronics will enjoy constructing and operating the EZ-80 microcomputer, a project that requires surprisingly little time and money. The book is a solid introduction to the Z-80 microcomputer and the remarkable chip, EZ-80. Several EZ-80 applications programs are included.

One Evening Electronic Projects
by Calvin R. Graf
128 pages; 5½ x 8½; softbound. © 1980
(ISBN: 0-672-21699-X) £3.20

Even beginners will discover the pleasure of building their own electronic projects with this book as a guide. Simple tools found in the home workshop and readily available components can result in an evening of fun and a useful project for the house, garage, workshop, or office.

Microcomputer Interfacing With the 8255 PPI Chip
by Paul F. Goldsbrough
224 pages; 5½ x 8½; softbound. © 1979
(ISBN: 0-672-21614-0) £5.80

This self-instructional text is designed to introduce the reader to the Intel 8255 Programmable Peripheral Interface (PPI) through discussion and experiments. Much of the material is applicable to PPIs in general and tells what the 8255 is, where it fits in a microcomputer system, why it is used, and how it is used.

Programming & Interfacing the 6502, With Experiments
by Marvin L. De Jong
416 pages; 5½ x 8½; softbound. © 1980
(ISBN: 0-672-21651-5) £10.35

Dr. De Jong has compiled 14 interesting chapters of information and programs that will be useful to anyone interested in using 6502-based microcomputer systems. Experiments and examples are written so that a KIM, AIM or SYM system may be used to reinforce the material presented in each chapter.

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6502 Software Design

by Leo Scanlon

272 pages; 5½ x 8½; softbound. © 1980

(ISBN: 0-672-21656-6) £7.50

The 6502 integrated circuit is a very popular microprocessor that is currently being used in general-purpose microcomputers, video games, and personal computers. This material is presented to increase the reader's understanding of the 6502 integrated circuit. Fundamentals are first explained then more complex topics are gradually introduced in the nine information-packed chapters.

Active Filter Cookbook

by Don Lancaster

240 pages; 5½ x 8½; softbound. © 1975

(ISBN: 0-672-21168-8) £9.70

A practical, user-oriented treatment of active filters. Explains what active filters are and how they work, and gives detailed information on design, analysis, and synthesis techniques. Explores some interesting applications for active filters in brainwave research, electronic music, quadrature art, and psychedelic lighting.

Design of Op-Amp Circuits, With Experiments

by Howard M. Berlin

224 pages; 5½ x 8½; softbound. © 1977

(ISBN: 0-672-21537-3) £5.80

Covers the fundamentals of operational amplifier devices in linear amplifiers, differentiators, filters, and nonlinear amplifiers. Use of the readily available 741 and 3900 devices is stressed with many practical circuits and 35 experiments.

Practical Low-Cost IC Projects (2nd Edition)

by Herbert Friedman

96 pages; 5½ x 8½; softbound. © 1979

(ISBN: 0-672-21599-3) £2.95

Presents complete parts lists and schematic diagrams for 38 different integrated-circuit projects, most of which can be inexpensively built in a few hours by either the inexperienced or the experienced project builder. Projects include a walkie-talkie power pack, hi level mixer, scope calibrater, headphone amplifier, LED power blinker, and fuzzer for electric guitars.

555 Timer Applications Sourcebook, With Experiments

by Howard M. Berlin

160 pages; 5½ x 8½; softbound. © 1976

(ISBN: 0-672-21538-1) £4.50

Deals with the many applications of the popular 555 timer "chip." Uses for voltage regulation, control, sequencing are covered as well as the more usual timing and signal generating functions. With many useful circuits and 15 detailed experiments.

Computer Language Reference Guide with Keyword Dictionary.

by Harry L. Helms, Jr.

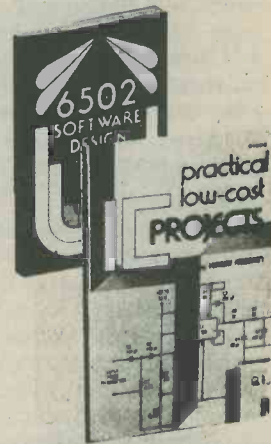
112 pages; 5½ x 8½; softbound © 1980

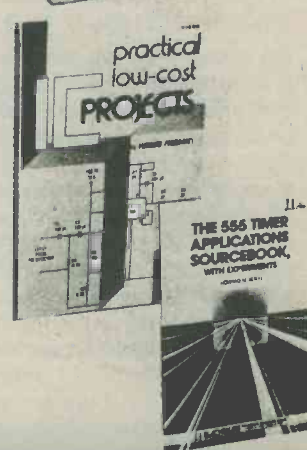
(ISBN: 0-672-21786-4) £4.50

If you're working with computers and find yourself confronted with programs written in languages you normally don't use or even know, then this new book is exactly what you need.

Seven chapters explain the computer languages—BASIC, ALGOL, LISP, Pascal, PL/1, COBOL and FORTRAN. Each chapter follows the same pattern—introduction, program format, variables and constants, etc.—to give you a clear distinction of the differences in each language. A helpful Resource work list is included in most chapters, while Chapter 8 contains a complete keyword dictionary.

You can depend on this quick, easy-to-follow reference for a better understanding of today's computer languages.





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TRS-80 Interfacing — Book I
by Jonathan A. Titus
192 pages; 5½ x 8½; softbound. © 1979
(ISBN: 0-672-21633-7) £5.80

If you have a fairly good understanding of the commands in Level II BASIC, this book will appeal to you. The book introduces you to the signals available within the TRS-80 computer and to show you how they can be used to control external devices. You will have an opportunity to construct and test a number of interesting interface circuits that will be used in the experiments.

TRS-80 Interfacing — Book 2
bu Jonathan A. Titus, Christopher A. Titus, and David G. Larsen
256 pages; 5½ x 8½; softbound. © 1980
(ISBN: 0-672-21739-2) £7.10

Introduces you to more advanced interfacing techniques that allow you to do real things with your TRS-80 computer. You learn how to drive high current and high voltage loads, how to generate voltage and current signals used in a variety of control applications, how to measure unknown voltages and currents with your computer, and how to use remote control circuits that allow you to control Universal Asynchronous Receiver/Transmitter Chips, analog-to-digital and digital-to-analog converters, and other devices located some distance from your computer. Contains complete software examples.

How to Program and Interface the 6800
by Andrew C. Staugaard, Jr.
416 pages; 5½ x 8½; softbound. © 1980
(ISBN: 0-672-21684-1) £10.35

An in-depth introduction to microprocessors and microcomputers in general and the Motorola 6800 microprocessor family in particular. Covers 6800-based microcomputers-learning systems. Over 30 "real-world" experiments demonstrate applications as the concepts are being explained. Includes detailed discussions of the internal structure, instruction set, and programming techniques for the 6800. Input/output techniques, memory interfacing, the 6820/6821 peripheral interface adapter, and system interfacing are all covered.

Design of VMOS Circuits, With Experiments
by Robert T. Stone & Howard M. Berlin
176 pages; 5½ x 8½; softbound. © 1980
(ISBN: 0-672-21686-8) £7.10

The vertical metal oxide semiconductor, or VMOS, is a new and exciting device that may be a giant step towards the ideal active circuit element. This book written to whet your appetite, features 11 chapters on the VMOS and its characteristics. Chapter 11 presents a series of experiments that demonstrate a number of the concepts discussed in earlier chapters.

DBUG: An 8080 Interpretive Debugger
by Jonathan A. Titus and Christopher A. Titus
112 pages; 5½ x 8½; softbound. © 1977
(ISBN: 0-672-21536-5) £3.20

This text describes DBUG, a software debugging package for 8080-based microcomputers. It describes the operation of the program and how it can be applied to program development and testing. Complete with documentated hexadecimal and octal listings of programs.

TV Antennas and Signal Distribution Systems
by M. J. Salvati
256 pages; 5½ x 8½; softbound. © 1979
(ISBN: 0-672-21584-5) £6.45

An invaluable guide to selecting and installing tv antennas and signal distribution systems, this book is packed with easy-to-understand information on using these systems to produce high quality tv reception. Many of the antennas described have been personally tested by the author.

Design of Phase-Locked Loop Circuits, With Experiments
by Howard M. Berlin
256 pages; 5½ x 8½; softbound. © 1978
(ISBN: 0-672-21545-4) £6.45

The design of the basic PLL circuits is described; detector, phase comparator, and voltage-controlled oscillator circuits are detailed. Contains many practical circuits using the 560-series devices and the CMOS 4046 chip. With over 15 experiments.

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The Howard W. Sams Crash Course in Microcomputers

by Louis E. Frenzel, Jr.

264 pages; 8½ x 11; wirebound. © 1980
(ISBN: 0-672-21634-5) £11.40

Because of its content and unique form of presentation, the reader is provided with a solid background in microcomputers quickly and effectively. This course, arranged as a series of lessons in a self-teaching format, features 14 units and 2 appendices that will teach the average consumer as effectively as the scientist with a PhD to deal with complete microcomputer systems. Each unit includes self-test review questions and answers.

Practical RF Communications Data for Engineers and Technicians

by M. F. "Doug" DeMaw

256 pages; 5½ x 8½; softbound. © 1978
(ISBN: 0-672-21557-8) £5.80

Communications engineers and technicians who need a practical reference of rf circuit design data will find that these five chapters of vital information have been compiled specifically for them. Subjects include ferromagnetic devices, networks for semiconductor circuits, transistor design basics, receiver design basics, and practical communications antennas. Each chapter contains an extensive bibliography.

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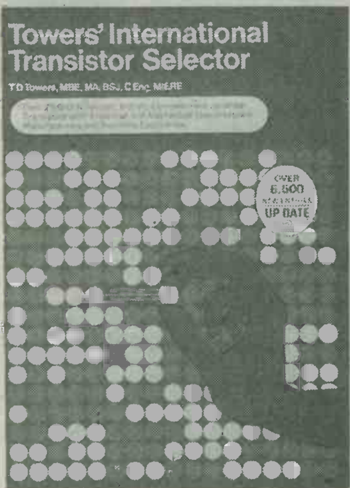

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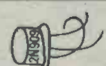

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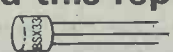

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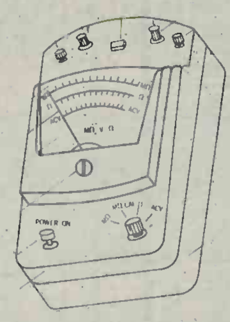

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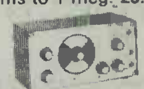

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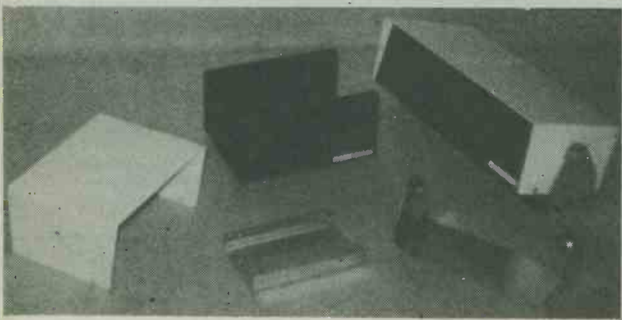

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2N4039 MOSFET 54p
•2N4285 17p
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2N4891 FET 30p
•2N4898 40v 25w 37p
•2N4900 80v 25w 37p
•2N4918 40v 30w 15p
2N5037 70v 83w 52p
2N5058 300v .5w 11p
•2N5147 100v 7w 15p
2N5163 Fet 25v 21p

2N5191 60v 40w 40p
2N5293 80v 36w 30p
2N5294 80v 36w 30p
2N5295 60v 36w 30p
2N5296 60v 36w 30p
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2N6178 100v 25w 30p
•2N6180 100v 25wt 30p
•2N6181 75v 25w 30p
2N6288 30v 40w 36p
2N6290 60v 40w 30p
2N6292 80v 40w 30p
•2N6385 80v 100wt Darlington 55p
2N6387 60v 40w 36p
2N6486 40v 75w 36p
2N6488 90v 75w 36p
2S701 30v .5w 18p
•2SA12 16v .1w 42p
•2SA50 18v .1w 36p
•2SA80 20v .1w 36p
•2SA83 25v .1w 36p
•2SA141 15v .1w 36p
•2SA142 15v .1w 36p
•2SA234 20v .1w 50p
•2SA236 18v .1w 50p
•2SA354 25v .1w 38p
•2SA360 20v .1w 34p
•2SA367 20v .1w 56p
•2SA518 18v .1w 38p
•2SA634 50v 10w 80p
•2SB75 25v .15w 25p
•2SB77 25v .15w 25p
•2SB135 30v .1w 25p
•2SB136 25v .15w 25p
•2SB156 16v .15w 60p
•2SB175 30v .15w 20p
•2SB176 32v .15w 20p
•2SB457 20v .15w 25p
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1034 Plast. 10wt 15p
•16120 (MPSU55/BD238) 19p
40235 45v .2w 50p
40250 50v 30w 36p
40250VI (2N3054 + Ht. sink) 40p
40316 40v .50w 36p
40372 (2N3054 + Ht. sink) 40p
40349v2 160v 1w 30p
•40394 60v 1w 30p
40409 90v 3w 32p
40633 40w 36p
•40874 80v 40w 38p
40911 (2N6261 + Ht. sink) 40p

TRIACS

Amp	Volt		
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1	400	21061650	32p
2.5	600	2N5757	44p
3.5	400	T2710D	58p
4	400	T2716D/40730	74p
6	200	T2500B/41014	54p
6	400	T2700D	65p
8	400	T2850D	72p
8	500	BT137-500	72p
8	500	T2801E	72p
10	600	T4101M	80p
12	500	BT138-500	90p
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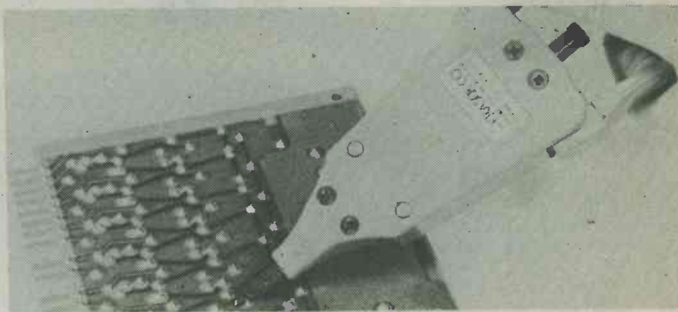
NEWS . . . AND

Improved cutting and bending tool



Eraser International of Unit M, Portway Industrial Estate, Andover, Hants., have announced the availability of a new improved tool, the Model TP3, for component lead cutting and bending in Printed Circuit Board Assembly.

The TP3 is designed to cut the legs of electronic components subsequent to their insertion in a Printed Circuit Board. In addition to the cutting legs, it also bends them over at a right angle thus retaining the component firmly in the Printed Circuit Board for subsequent manual or automatic soldering operations. This method of cutting and bending the component lead legs after insertion into a P.C.B. eliminates the possibility of components being dislodged during wave soldering.

The TP3 incorporates a new fixed and moving blade system giving extended blade life and ease of operator use where the angle of the tool relative to the Printed Circuit Board is not critical.

The TP3 is suitable for cutting and bending all electronic components with lead diameters of between 0.3mm and 1.5mm. The hand tool is self-adjusting to compensate for different lead diameters.

The TP3 employs hardened steel cutting blades which are both regrindable and replaceable.

The tool is constructed from rugged dyecast aluminium and is suitable for both production and prototype work.

Further information is available from Eraser International Limited.

International Year of Disabled People

The International Year of Disabled People is to be acknowledged by the Amateur Radio fraternity with an "International Weekend on the Air" for the disabled. The weekend selected is 1st – 3rd August, to coincide with the opening of the International Meeting of the Devon Sports Association for Disabled Persons at St. Loyes College, Exeter.

The Exeter Amateur Radio Society will operate stations from St. Loyes on all amateur frequencies from 80m to 10m, VHF and UHF between the hours of 0900z and 2000z using the callsigns GB21YD and GB6IYD. It is hoped that disabled operators all over the world will contact each other and exchange greetings and QSL cards. It is suggested that stations should call "CQ IYDP from . . . . (c/s). Further details from: G. Draper, 1 Carlyon Close, Exeter EX1 3AZ. Tel: 37170.

Marconi International Fellowship Award

Dr. Seymour A. Papert, Professor of Mathematics and Education at the Massachusetts Institute of Technology has been awarded the Seventh Marconi International Fellowship which takes the form of a $25,000 grant which the recipient can use to originate or complete a project of his choice.

Dr Papert was honoured for his work in computer education and in particular the development of the LOGO language which he designed especially for children. A computer education system based on the LOGO language encourages a child to take an active role in the learning process. To do this the LOGO system reverses the usual computer-pupil relationship, instead of the computer teaching the pupil, the student is required to teach the computer. The system has shown itself to be particularly useful in the education of children suffering from cerebral palsy, a disability which imposes a passive role on its victims.

Low priced DFMs especially imported

Due to the difficulty of obtaining a low priced high quality digital frequency meter in the UK, Messrs. Holdings of Mincing Lane, Darwen Street, Blackburn, Lancs., have arranged to import DFMs from Japan.

A DFM is, of course, invaluable to the electronic enthusiast and the unit being imported can be used to check many types of equipment.

The basic price of the unit is £39.99, including V.A.T., and the total price including batteries, input lead, carriage and insurance is £43.58.

. . . COMMENT

The customer is always right

The completed survey forms (supplied in last month's issue) look like providing a very useful and comprehensive insight into the attitudes and opinions of our readers.

As far as we can tell, most respondants want more to do with radio and communication topics. And as we had guessed, there is distinct evidence of a broadening in the market for 'personal computing', and we are pleased to say that the thoughts offered by readers tend to align with those that we have put forward as our own 'platform' - namely less of the 'space invaders', and more practical examples of microprocessors at work.

Test equipment features seem to have emerged as another favourite. We have a number of articles 'booked' that both describe test equipment (including a 500MHz 8 digit multigarious frequency counter and capacitance meter) from the users viewpoint, and also approach the subject from a practical and constructional viewpoint.

The section covering the buying habits of 'electronic man' has obviously provided a vent for feelings ranging from satisfied to the vitriolic, so this is perhaps an opportune time to point out the advantages of careful cooperation between publishers and suppliers to ensure that featured items use parts selected from a 'standard range'. A surprisingly small number of 'standards' can be used in an extremely broad range of circuits, thereby benefitting the reader (who gets a better price due to the increased volume of the 'standards' forcing down the price), the supplier (who is not faced with an unnecessarily vast range of stock items) and the publisher, who can rest in the knowledge that he won't get endless letters and 'phone calls asking where a BC923 can be run to ground.

Next month's *Constructor* will contain the opening shot in our crusade to try and constrain 'components' into some sort of order, and we look forward to useful dialogue with suppliers and readers alike until we can produce the definitive 'selection'.

Smaller Video Recorder maintenance Kit

A smaller version of the Bib Video Recorder Maintenance Kit has been marketed by Bib Hi-Fi for inclusion in their Videophile Edition range, making it particularly suitable as a gift item.

Available in blister form, this smaller Video Recorder Maintenance Kit is completely disposable, since it is recommended that it should only be used for 5 machine cleanings. Bib suggest that with the average use of video recorders, this Kit should last for about 2 years.

The Kit comprises 5 Video Tape Head Cleaning Tools, Dust-Away Air-Blast and Head Cleaning Fluid. Full instructions for use with both VHS or BETAMAX are provided and the Kit is packed in a clear container, the same size as a VHS cassette, enabling it to be stored conveniently with video tapes.

The recommended retail price is £5.47.

The Bib Video Recorder Maintenance Kit is marketed by Bib Hi-Fi Accessories Limited, Kelsey House, Wood Lane End, Hemel Hempstead, Herts.

Computer wakes the guests

In the old days of gracious hotel living, a guest used to smile at the receptionist or maid, and ask to be woken at a particular time with one's morning tea and a paper.

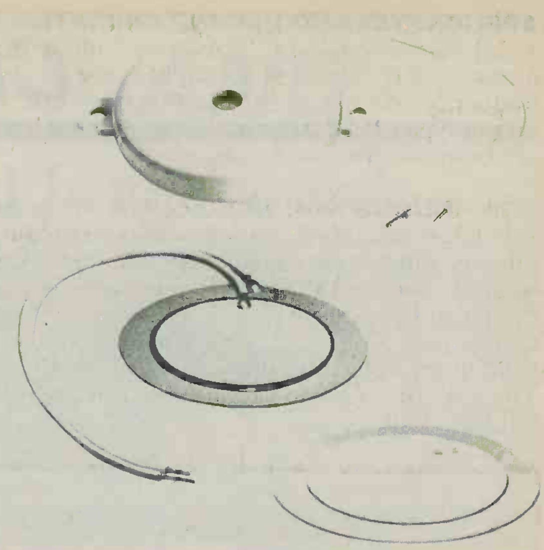
Now though, thanks to a computer, graciousness and human contact can be restored, but at a fraction of the cost of maintaining the old human-operated system. Millbank Electronics have worked out this new technological marvel, and integrated it with their existing hotel sound system which gives a choice of radio programmes, controls the TV, tells you whether there's a message waiting for you, and switches the lights on and off, all from a neat aluminium panel beside the bed.

When you smile at the receptionist – yes, it's that human – and ask for your call, all she does is tap out your room number and the time you request on a little calculator-like keyboard on her desk. Your room number and time are displayed on the panel, so she can check that she's got the details right. When she confirms that she has, the call is printed on a paper roll, just as a record. Then, at just the right time, an electronic 'bleeper' raises you from your slumbers. Sadly it can't deliver tea and your choice of paper – yet – but no doubt the Millbank people are working on that. But the machine doesn't end there. If you are one of those people who seem capable of switching the alarm clock off without waking, the system catches you – for it prints out, as well as the initial call request, what time it bleeped you, and what time you cancelled the bleep. And if you're capable of sleeping through earthquakes even, then after a preset time, the system warns the receptionist so she can despatch someone to wake you.

Now all we need is a computer that cleans the boots and changes the towels as well as making morning tea and delivering newspapers – so long as it isn't programmed to ask for tips!

DESIGN IDEAS: No. 1

Piezo Acoustic Transducers



Jonathan Charles Burchell

Introduction

Next time your project needs some kind of built-in tone or alarm signalling device consider using a Piezo-electric buzzer. This output device complete in its plastic encapsulation is comparable in size and cost to a 50 pence piece, yet at resonance the device is capable of producing sound levels of over 95db some 10 cm away, a volume level in excess of that obtainable from most 4 inch loudspeakers.

Because of the extremely high efficiency of the piezo-buzzer even at this high output level–the input power is only 30 milliwatts.

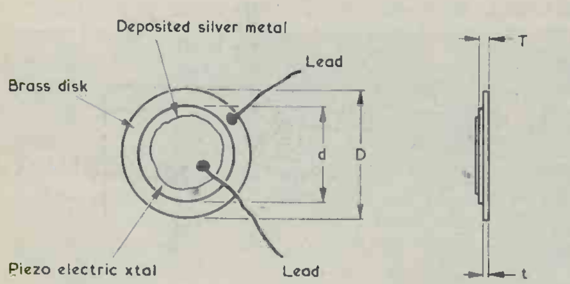
THE PIEZO-ELECTRIC BUZZER

The piezo-electric effect is well known and exploited in objects as diverse as Gas lighters, Record cartridges, Crystal filters, and of course Quartz crystals.

Piezo-electricity is caused by certain crystals which produce a voltage across their faces when subjected to mechanical stress. The effect is reversible, the crystal undergoing mechanical contraction when subjected to a suitably applied voltage, it is this effect which is used in the piezo-electric buzzer.

Fig. 1. illustrates the method of construction used in a piezo-sounder. A circular disc of suitable crystals (often Titanate-Zirconate) is deposited onto a slightly larger disc of thin metal, which forms one electrode, a second electrode is produced by depositing a lyer of metal onto the surface of the crystals.

When a voltage is applied, the mechanical contractions of the crystals are converted into vertical flexing of the plate. If the unit is driven by an oscillating voltage, then mechanical oscillations of the same frequency will be set up in the plate as shown in Fig. 2.



Dimensions mm			
D	d	T	t
27	20	0·55	0·25

Fig. 1.

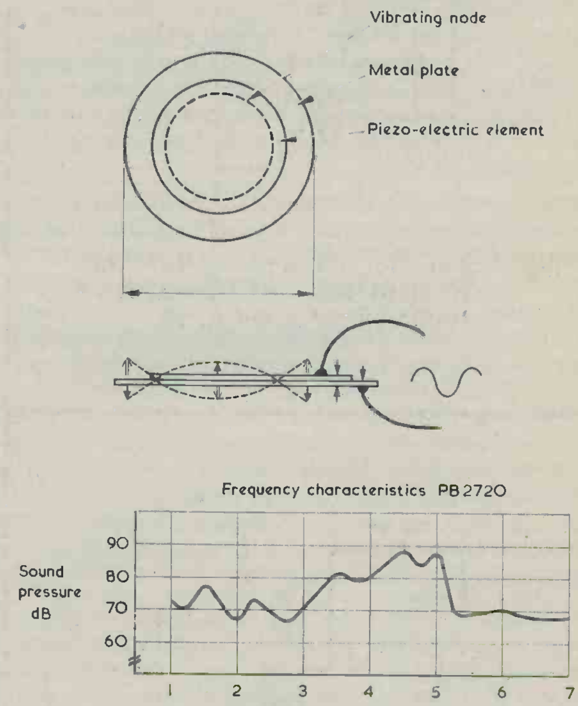


Fig. 2.

As the mechanical coupling from crystals to plate, and plate to media, is near perfect, combined with the high efficiency of the piezo-electric energy conversion process, the overall efficiency of the device is excellent making the device ideal for use in any application requiring high output combined with low power consumption. The metal disc provides both mechanical support for the crystals, and a lowering of the resonant frequency of the whole structure which would otherwise be in the ultrasonic region.

The designer of a digital watch would use the bare element and build it into his watch case, but to make the device easier to handle and mount (and to enable a serveralfold increase in output to be obtained), they are normally supplied in some form of plastic case which acts as a resonant cavity for the element.

Although maximum output from the buzzer is only obtained at resonance, the buzzer gives a useful output over much of the Audio-spectrum – as can be seen from the Graph of Fig.2.

APPLICATION AND DRIVING CIRCUITS

All that is needed to obtain an output from the piezo-electric buzzer is an input wave of the right frequency. All these circuits use the TOKO piezo buzzer type PB-2720 which has a resonant frequency of about 3.5 Khz.

CONTINUOUS SOUND CIRCUITS

Fig.3. is possibly the simplest way to obtain a continuous output of tremendous volume. A simple single transistor LC feedback oscillator is used and the piezo buzzer connected across the coil, at resonance some 30 + volts p-p are applied to the buzzer (due to the voltage multiplication of the LC circuit). The core of L1 should be trimmed to provide maximum output.

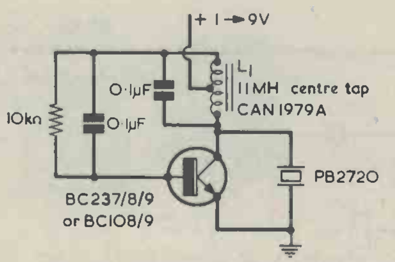


Fig. 3. Tune for resonance. Ultra high output/low consumption tuned transformer drive.

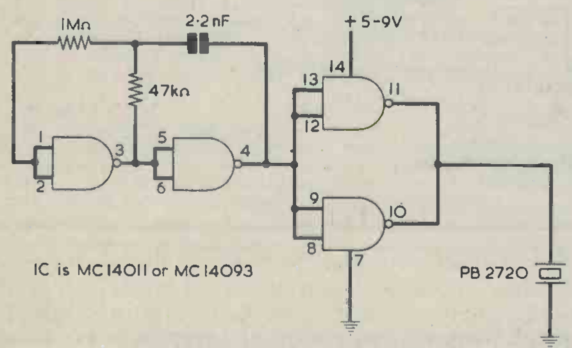


Fig. 4. Simple CMOS drive.

Fig.4: is also a continuous tone circuit but built this time from a single CMOS quad Nand gate.

Gates G1 and G2 form a simple cross coupled RC oscillator, whilst Gates G3 and G4 are coupled in parallel to increase the available output current. As the applied voltage is rather less than that of Fig.3. the output will be correspondingly less, but the output booster of Fig.6. may be added to further increase the output.

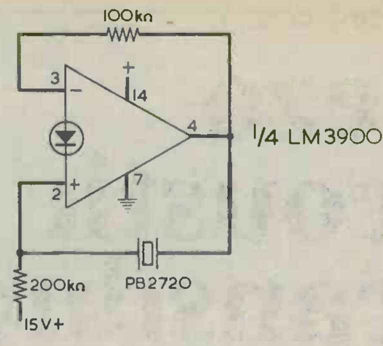


Fig. 5. Using a spare 'Op-amp' section.

Fig.5. The last circuit in this section shows a very simple oscillator built by using the piezo buzzer as the positive feedback element around a current input op-amp. The main advantage of this particular circuit is that the circuit inherently oscillates at the resonant frequency of the piezo-buzzer thus insuring maximum possible output from the device.

INTERFACE TO EXISTING OSCILLATORS

Fig.6. In many applications a suitable source of oscillations may already be available. The output of many LCD clock modules is a 1Khz or so square wave. In these applications all that is needed is some simple form of buffer/amplifier, and this circuit is just that.

The coil L2 forms the collector load of Tr2, the resulting back e.m.f. from switching Tr2 on and off is applied to the buzzer causing it to be driven from a voltage in excess of the rail voltage with a corresponding increase in output volume. A capacitor may be added as shown which creates a somewhat milder output tone, although causing a slight reduction in output volume.

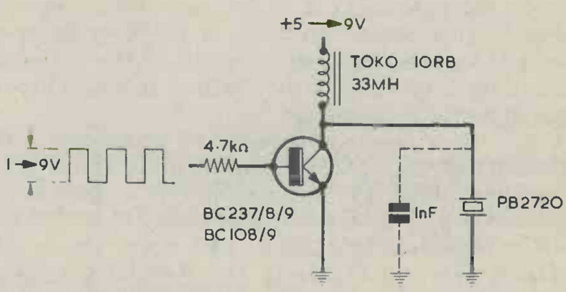


Fig. 6. An inductive voltage multiplier for increased output.

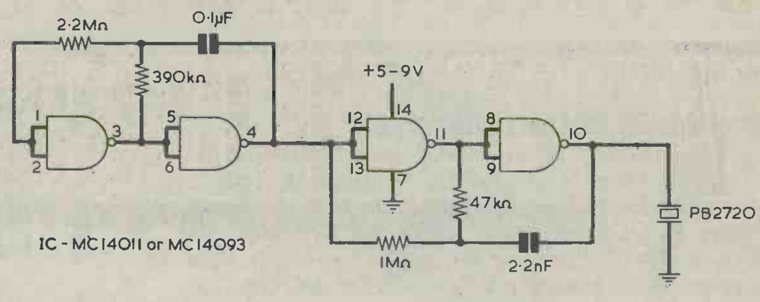
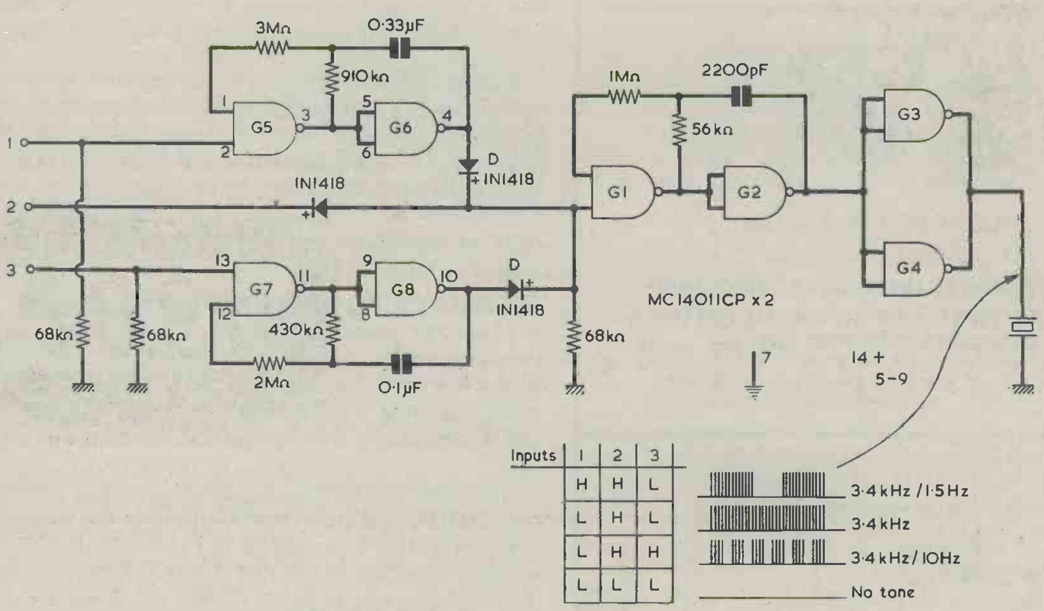


Fig. 7. Intermittent 'Bleeper'.



Inputs 1	2	3	
H	H	L	3·4 kHz /1·5 Hz
L	H	L	3·4 kHz
L	H	H	3·4 kHz/10Hz
L	L	L	No tone

Fig.8. 3 'State' audible annunciator.

MODULATED OUTPUTS

Fig.7. This circuit produces a pleasant bleeping sound at several hertz, and consists of the RC oscillator of fig.4. modulated by a second RC oscillator at a much lower frequency.

Fig.8. This circuit is capable of producing three different tone sequences according to the states of the three input lines. The three different sequences are continuous 3.4Khz, 3.4Khz modulated at 1.5Hz, and 3.4Khz modulated at 10Hz.

Gates G1 and G2 form the 3.4Khz Oscillator, Gates G5 and G6 form the 10hz oscillator and G7 and G8 the 1.5Hz Oscillator. The input lines and control diodes allow the 3.4Khz Oscillator to remain un-modulated or to be modulated by either the 10 or 1.5Hz oscillator.

Whilst the layout of the above circuits is non-critical, there exists a potential danger when connecting Piezo-buzzers onto CMOS devices.

Due to the piezo electric effect of the buzzer and the very high impedance between the input leads of the device, it is possible for a considerable potential to build up across the device when it is subjected to mechanical stress.

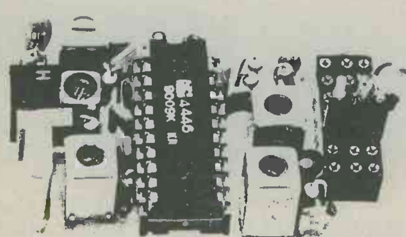
If an unconnected buzzer is tapped fairly sharply and the leads from the device then shorted together a click will be heard from the element as the built up charge is lost. So before connecting the buzzer into a circuit which already has CMOS gates plugged into it–the leads should be shorted together.

No trouble has been experienced in practice once the circuit has been connected up, but if the buzzer is going to be subjected to external shocks, a 1 to 10 Megohm resistor across the buzzer leads should prevent further problems. ■

IN NEXT MONTH'S

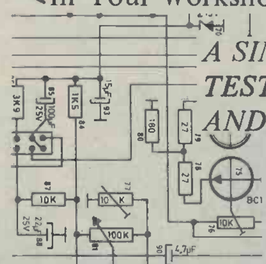
RADIO & ELECTRONICS CONSTRUCTOR

5 CHANNEL RADIO CONTROL SYSTEM

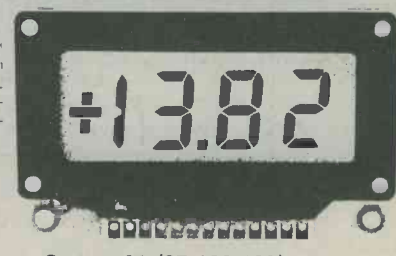


SIMPLE TO CONSTRUCT RELIABLE 5–CHANNEL RADIO CONTROL SYSTEM BASED ON A SINGLE CHIP SOLUTION FOR BOTH TRANSMITOR AND RECEIVER.

Dick and Smithy battle on; will Dick save the Galaxy for the third time that Summer's afternoon? Eavesdrop once again on the popular duo to discover what tips they have for you In Your Workshop...



A SIMPLE LOW–COST DIGITAL TEST METER FOR DC VOLTAGE AND CURRENT.



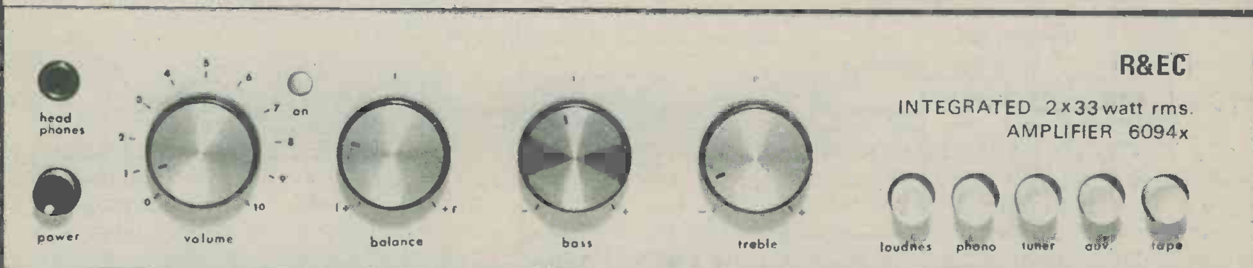
don't forget VHF scanner pt 2

```
380 N2$=STR$(N2)
390 IF LEN(F9$)=2 AND LEN(F0$)=7 THEN G4$="CANADA"
400 IF G3$<>"" THEN G8$="/"+G3$ ELSE G8$=""
410 PRINT #1, %7I, N2, "  ", F3$,
420 IF F4$<>"" THEN E
430 PRINT #1, TAB(11),
440 IF G2$="" THEN PRINT #1, TAB(73), G8$, ELSE PRINT #1, TAB(73), G2$,
450 PRINT #1, TAB(99), F8$, TAB(115), F9$, TAB(126), F0$, TAB(135), G4$,
460 IF G5$<>"" THEN PRINT #1, TAB(149), "("+G5$+")",
470 IF G6$<>"" THEN PRINT #1, TAB(155), G6
480 L=L+1
490 L0=0
500 IF F4$<>"" THEN 510 ELSE 530
510 IF G1$<>"" THEN PRINT #1, TAB(11), G1$
520 L0=1
530 IF G2$<>"" THEN 540 ELSE 560
540 IF G3$<>"" THEN PRINT #1, TAB(73), G3$
550 L0=1
```

Cast on 91 (97:103:109) sts.
Work 8cm k1 p1.
1st row k2 (k1.p1) to last stitch K1
2nd row k1 p1 to end.
Rib 3 (6:3:6) * inc.
7 (7;8:7) rep from* 11 times.
ib to end 104(110:116:122)
in stst until back measures
3:55)cm end p row.

COMPULINK

Programming and Program Languages—a cohesive approach to the black art of programming, beginning with such familiar items as ...... Knitting Patterns & Washing Instructions!



THE AUDIOMASTER–A Hi - Fi Amplifier of compact construction and design developed with the finest advanced electronic technology yet not too daunting in assembly. With 30 watts per channel and very good performance in all areas this project is a 'must' – especially as the amp will be available as a complete kit (down to the last nut & bolt!) for under £65.

PLUS MUCH MUCH MORE

Infra-Red Remote Control System Part 1

I. M. Attrill

This remote control system is of the sequential type where operating a push-button on the transmitter unit causes the controlled equipment to be switched on, and operating the push button switch again causes the equipment to be switched off, and so on. Although most short distance remote control systems use ultrasonics to provide the link between the transmitter and receiver, infra-red light now offers a practical alternative for the home-constructor, and is the medium used in this system.

The system has a maximum range of only about 6 or 7 metres, which is perfectly adequate for controlling equipment in the same room as the user. The equipment could, for example, be used to provide remote on/off switching for a T.V. set or light in a bedroom.

SYSTEM OPERATION

Fig.1. shows in block diagram form the various stages of the transmitter and receiver units. The transmitter is extremely simple, and is based on a pulse generator that has an operating frequency of about 10kHZ, with a mark space ratio of about 10 to 1. The brief output pulses are used to operate an infra-red L.E.D. via an amplifier which provides the high peak output currents that are required. The peak L.E.D. current is actually about 400mA; but due to the fairly high mark space ratio of the pulse generator the L.E.D. is only receiving power for about 10% of the time. It thus receives an average current of only about 40mA. This gives strong pulses of infra-red light, but ensures that the dissipation in the L.E.D. is not excessive.

The human eye is insensitive to infra-red radiation, and as infra-red L.E.Ds do not produce significant output in the visible light spectrum, no visual changes occur to the L.E.D. when the transmitter is switched on and off.

The reason for using a pulsed beam rather than a continuous one is simply that the steady-state output from an infra-red L.E.D. is not very strong, and a continuous beam would be swamped by the ambient infra-red level at more than a few inches from the L.E.D. Even if the pulses of infra-red from the transmitter are below the ambient infra-red level, they will produce small voltage pulses at the detector, and these pulses can then be amplified to give a suitable output to operate the control logic circuitry. The use of a pulsed signal also allows the receiver to be A. C. coupled, thus avoiding problems due to D.C. and thermal drift.

Therefore, the receiver has an infra-red detector diode which has its output fed to a two stage high gain amplifier. The output from the amplifier is fed to a Schmitt trigger circuit which ensures that the rise and fall times of the signal are fast enough to operate the subsequent stage of the circuit reliably. The Schmitt trigger also effectively removes any noise from the signal that might otherwise give erratic operation.

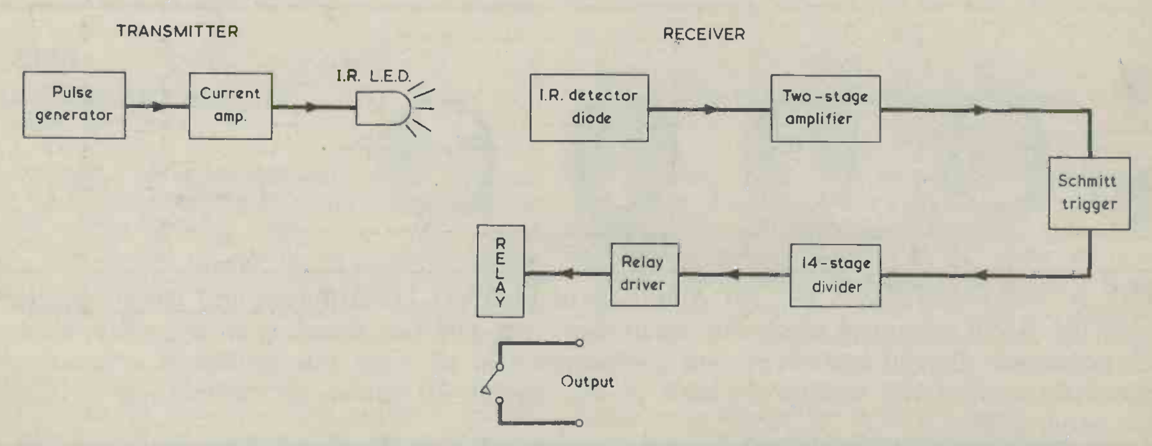
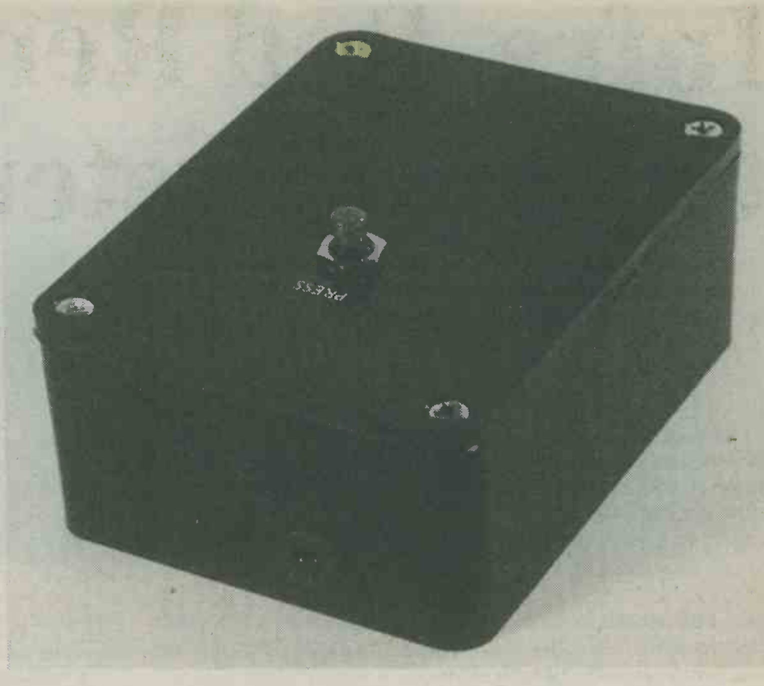


Fig. 1. Block diagram of the Sequential Infra-Red Remote Control System.



The transmitter in case.

The next stage of the circuit is a CMOS 14 stage binary divider, and this divides the input signal by 16,384. If the transmitter is run continuously, the output of the divider changes state slightly more frequently than once per second. A relay coil is driven from the output of the divider by way of an emitter follower buffer stage, and the load is controlled via a pair of normally open relay contacts. If the push button at the transmitter is depressed to make the transmitter operate non-stop, the controlled equipment will continuously switch on and off. In practice the transmitter is operated just long enough to switch the load on or off, as appropriate.

TRANSMITTER CIRCUIT

The circuit diagram of the transmitter is shown in Fig.2. This is based on a CMOS 4001 quad 2 input NOR gate I.C. In this application only two of the gates are used, and these both have their inputs connected together so that they give a simple inverter action. The two gates are connected in a CMOS astable multivibrator circuit, with the timing resistor formed by two resistors (R1 and R2), and two steering diodes (D1 and D2). In effect, the timing resistance is formed by R1 and D2 when the output is in the high state, and by R2 plus D1 when it is in the low state. This gives the required short positive output pulses, as R1 is much lower in value than R2, giving a shorter time constant when the output is 'high'.

The unused inputs of IC1 are tied to the negative supply rail so that they cannot be damaged by high static voltages, or spuriously operated by stray pick-up.

IC1 provides an output at a fairly high impedance, and it is not able to supply anything approaching the peak output current needed to power the L.E.D. Tr1 is therefore used as a common source amplifier which gives the necessary current amplification. Tr1 is a VMOS device which, unlike a bipolar transistor, is voltage rather than current operated. It is not like the f.e.t.s encountered in most designs, which are ***depletion*** mode types. These are normally switched hard

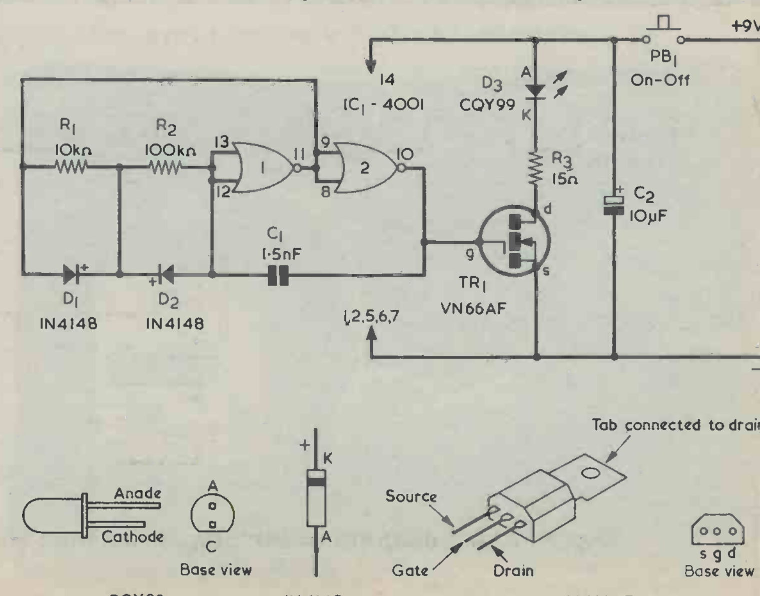
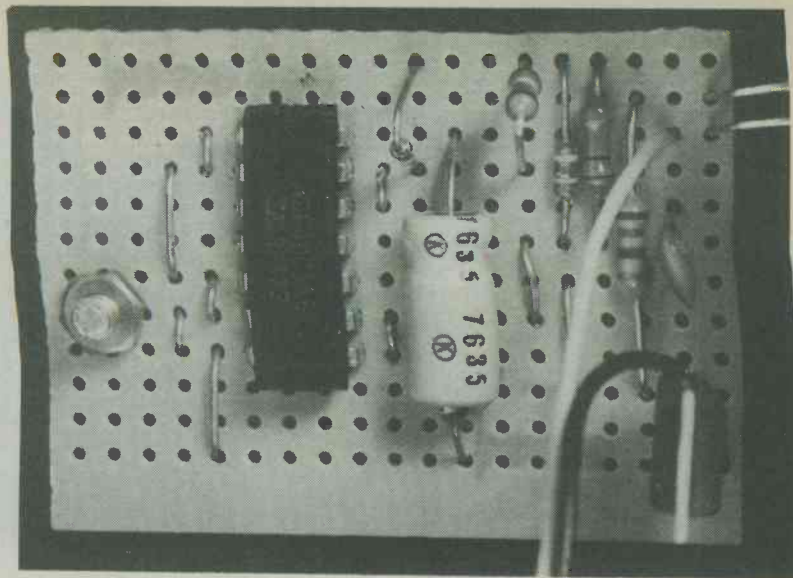


Fig. 2. The circuit diagram of the Infra-Red Transmitter.

Inside of the transmitter.



on, and must be reverse biased in order to switch them off. Tr1 is an ***enhancement*** mode device which, like an ordinary bipolar device, is normally in the off state and must be forward biased in order to switch it on. Thus, during the brief positive output pulses from IC1 Tr1 is biased into conduction and provides pulses of current L.E.D. D1 via current limiting "on" resistance and is capable of providing the high L.E.D. currents required.

On/off switching is provided by PB1, and C2 is a supply decoupling capacitor. The current consumption of the unit is a little over 40mA. Power is provided by a small (PP3 size) battery, and this has quite a long operational life despite the current consumption of the circuit, since the unit is only switched on very briefly each time it is used.

CONSTRUCTION

The prototype is housed in a small plastic box having approximate outside dimensions of 100 x 75 x 40mm, but it should be possible to accommodate all the components in virtually any small case, which is of a convenient size.

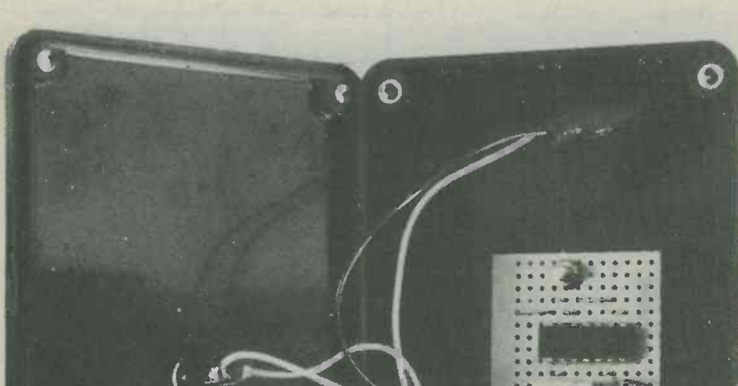
PB1 is mounted on the lid of the case, slightly forward of a central position. The holder for D3 is mounted on one of the end panels of the case. This simple layout can be seen in the accompanying photographs.

Most of the components, including D3, are assembled on a 0.1in. matrix stripboard, and details of this are provided in Fig.3. After cutting out a board having 12 strips by 19 holes, drill the single 3.3mm. diameter mounting hole and make the seven breaks in the copper strips. The components and link wires are then soldered into place, with the IC1 being left until last. As this is a CMOS device it should be handled as little as possible, and should be soldered into place using a soldering iron having an earthed bit.

With D3 fitted into its panel holder, the component panel can be used as a template to locate the position of the single mounting hole in the case. After wiring PB1 and the battery clip into circuit, the panel can be bolted in place using M3 or 6BA fixings.

TESTING

With a multimeter set to read 100mA. f.s.d. (or set to some similar high D.C. current range) connected in series with the positive battery lead, depressing PB1 should give a reading of about 40mA. or so. If a greatly different reading is obtained, re-check the



The transmitter electronics in case.

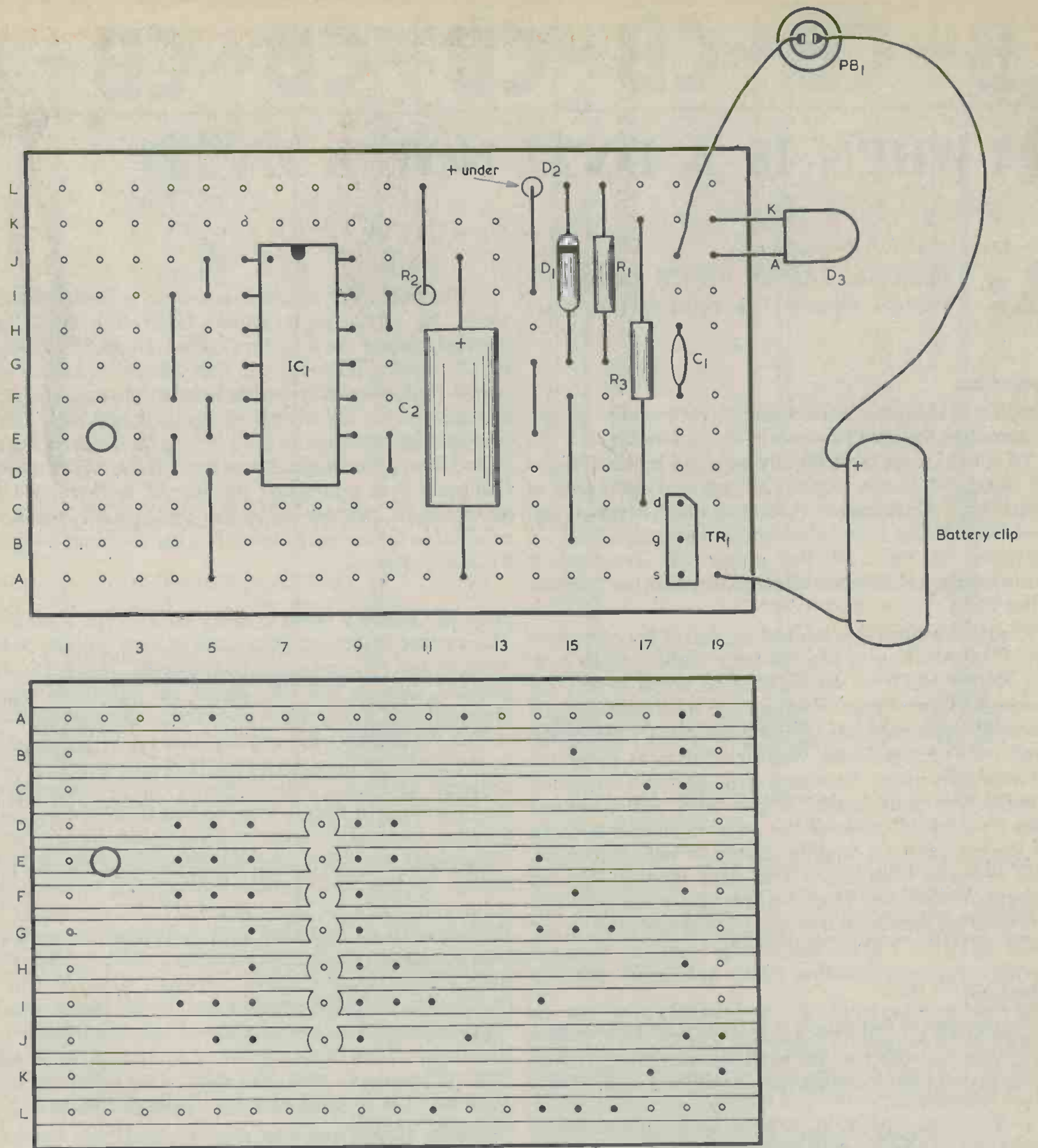


Fig. 3. The 0.1in. matrix stripboard layout for the Infra-Red Transmitter.

Transmitter Components

Resistors.
Miniature 1/3 watt 5%
R1 10K
R2 100K
R3 15 ohms

Capacitors.
C1 1.5nF ceramic plate
C2 10μF 10V

Switch
PB1 Push-to-make, non-locking type

Semiconductors
IC1 4001
Tr1 VN66AF
D1 1N4148
D2 1N4148
D3 CQY99

Miscellaneous
Small plastic case.
0.1in. matrix stripboard.
PP3 battery and connector to suit.
Wire, solder, etc.

wiring and check for accidental solder bridges between adjacent strips of the component panel. As a further check, a crystal earphone can be connected across D3, and a fairly loud, high pitched tone should be produced when PB1 is operated.

(To be Continued)

Q: WHEN IS A DV27 NOT A DV27?

A: Read on, JAMES FINCH helps you to choose the right antenna.....

Introduction

The author of this article has recently returned to the UK after spending the past 12 years living in Sweden. For the past 10 years I have been legally engaged in the Citizens Band Business, in the buying, selling and designing of Citizens Band Accessories, Antennas and Transceivers. During this period I had the unique opportunity as an Englishman to visit all the major CB Transceiver Manufacturers and Antenna Manufacturers in the Far East and the USA.

I find it therefore very interesting, and at the same time rather disappointing to see the poor taste, and in fact, direct NON-FACTUAL advertising in some of the CB Magazines. In some magazines one can read some serious discussions about antennas, giving facts, and data, written by well informed persons, while on the next page are advertisements about Antennas with, gain-performance that make the mind boggle. If this were not a serious subject I would call some of the advertisements nothing other than a joke: i.e. mobile antennas with 6dB gain. Mobile antenna with extra 1dB gain through special treatment of whip. etc. One can only hope that once the system does become legal then the market will start to get cleaned up (with, I hope, some help from the very CB magazines that are printing some extremely dubious information). . .

The purpose of this article is to try and help the would be purchaser of a mobile antenna as to how to get the right antenna for the right requirement, and also from the right Antenna manufacture, into this jungle of advertisements with Companies trying to out-bid each other, using antennas as a "VOGUE" with fantastic names, colours and ridiculous claims of Antenna gains.

To try and keep this simple (there are many serious articles written about antenna gains, and radiation patterns etc. Most of them are beyond the scope of most readers, as this is quite a difficult field to explain in simple terms), I shall start off with one antenna type. The antenna I have chosen is the most well known mobile CB antenna in the whole of Europe (also the most copied) the DV27 reduced 1/4 wave glass fibre antenna. *Fig. 1.*

The main reasons for the popularity of the DV27 are:

1. One of the first European made CB antennas, been around 16 years.
2. Extremely efficient (good radiation efficiency).
3. Simple to mount, easy to fold over. Due to unique toggle mount (the V in the DV means 'toggle-joint' in Danish).
4. Flexibility. i.e. Many types of whips are available, from short 30cm long to full 1/4 2.6m long. All can be used on basic toggle-mount.
5. High quality parts-finish. If, of course, you select right manufacturer . . .

The first DV27 antenna was made in Denmark around 1965, by a Company called HMP (the HMP is an abbreviation of the founders name), all other subsequent DV27s were offshoots from this design for better or for worse (unfortunately worse in most cases). The actual designer of the DV27 and all the different HMP CB and professional antennas up to 1979 was an Antenna Engineer called Bjarne Sorensen. It can be said that HMP were the Company that pioneered the use of reduced 1/4 type antennas in Europe, using the toggle joint mount, and adjustable tuning pin mounted on tip of antenna whip for SWR adjustment.

How to Choose a Good Quality DV27 Type Antenna

The answer to this question is not so easy unless you know what to look for, and also what to avoid. There are, at the present time in the UK, about ten different types of standard DV27s, varying in price from approximately £3.80 to £13. WHY? Well, the original HMP type DV27 from back in the 60s soon became a standard European CB mobile antenna, and many other antenna companies jumped on the Band Wagon. Before long we had DV27, being made in Sweden, Denmark, Germany, Italy, Spain, Japan, Taiwan, Hong-Kong etc. Most of them from the outside looking similar to the HMP types. Well seeing is not always believing, that's for sure! Some DV27s, especially from Taiwan, are so bad that it is a disgrace to call them Communications antennas, let alone antennas. I am certain that some readers have already experienced the frustrations of not being able to get the SWR any way near right, or mounting bases falling apart, paint cracking on whips, glass fibre cracking, hollow soft metal tubing which bends or breaks for ever. Never buy a set with a give away antenna, it is in most cases a 'nothing' antenna, of the cheapest quality.

If you are offered a DV27 type antenna, (not a HMP or a Procom type), then ask the salesman to bend the whip double. Do not do it yourself, as he might try and make you pay for a new whip. It should bend over and spring back into position again without any bends, cracks, etc.

Another very good quality type DV27 antenna to be found on the UK market comes under the Brand name PROCOM, these antennas are also made in Denmark, and all of their antennas are to be highly recommended. One of the main reasons they have made such advances on the UK market is that these antennas are just not a mirror copy of the HMP, as the person who has designed all the PROCOM antennas is none other than Mr Bjarne Sorensen who now works from Procom Antenna Company. There are a couple of points worth mentioning for the unknowing. The PROCOM antennas are once again very similar to the HMP types, but on closer inspection you will notice, that

1. The cable plug connecting cable to mount is a different size.
2. The HMP whip will not fit a PROCOM mount, but it will the other way around.

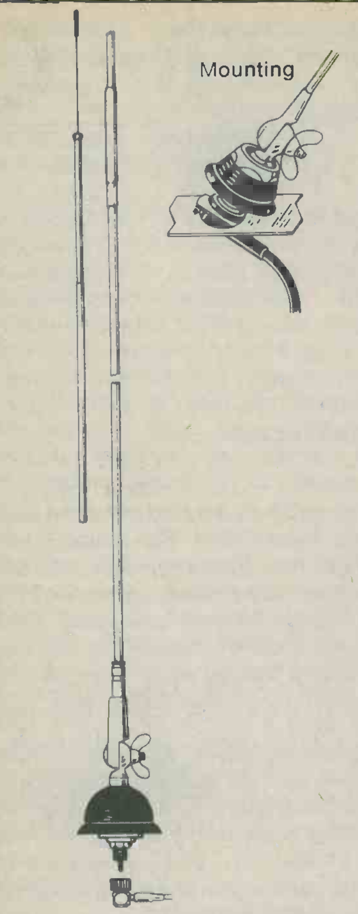


Fig.1. Standard DV27

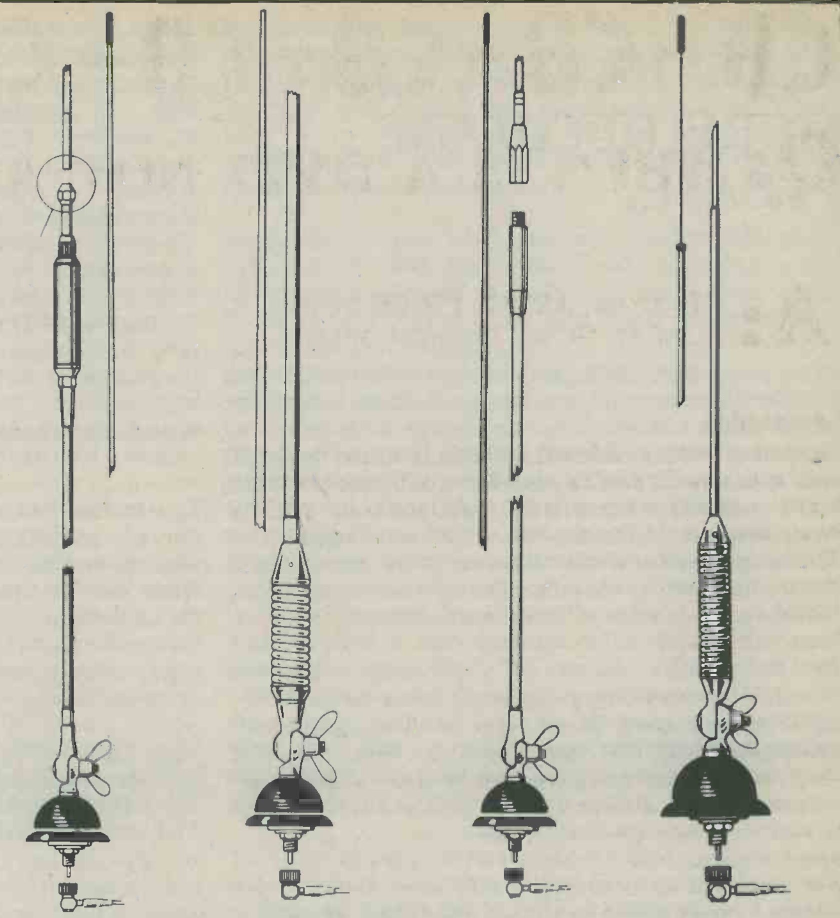


Fig.2. Groups of Whip Antennas

Both companies offer a very wide range of whips for these mounts. Both companies have tow different mounts.

1) Standard type with cable plug.
2) Low profile mount for roof mounting.

I have not tried to push any one brand antenna although I have mentioned the name of HMP many times. This is quite natural as they designed and made the first DV27, and that is what we are talking about. Having personally used many types of Citizens Band antennas in Sweden for the past years, in a climate which to say the least is pretty rough in winter, then I can only recommend the antennas that have proved, over a time, to be both mechanically and electrically of good quality, to the potential purchaser.

Most antennas from the following companies are to be highly recommended: PROCOM, HMP, ALGON, CARANT, UA, KATHREIN, HIRSCHMAN, WISI.

It is an interesting point, but a fact, that in Scandinavia approximately 99% of all the CB and professional mobile antennas, used by Police, Fire Brigades, Government Departments etc. are made in Europe. The same applies for West Germany and Holland, and the UK. It seems that in this field the Europeans can still compete successfully.

Which DV27 Model (Whip-Mounting Base) to Select?

The number of DV27 whips available is very considerable. I do not propose to list any directly, as I am not advertising for any Antenna manufacture. I suggest you obtain a catalogue from your local dealer of DV27 type antennas, from any of the companies listed above. Basically the whips fall into the following groups. (See *Fig. 2*).

1. Top loaded whip (long size) (short size)
2. Centre loaded whip (long size) (short size)
3. Full length 1/4 wave
4. Helical wound whip (long size) (short size)
5. Most of the above types with or without shock spring
6. Most of the above mentioned whips, with standard mount or Low Profile mount.

Depending on what type of vehicle, van, truck, sports car, saloon car, bus, etc. so you will have to decide what length of whip you want, and where to place it on the vehicle. Depending on where you place the antenna will of course effect the radiation pattern you obtain. Normally the higher the better, and the longer the whip the better. Do not fall into the trap many advertisements would have you believe, that their 60cm long super antenna is better than a standard 1.5m length. If you mount a shortish whip on the car roof, then you can always buy an extra whip which is longer and use it when you want to make contact when you are parked for instance, or in the countryside.

Good luck with your antenna, and remember that a good copy is not always due to the pounds your putting out. It's how well your antenna is putting them out!

LET'S HAVE A LITTLE MORE DECORUM, PLEASE.

Quite apart from the legality (or otherwise) of CB in its present illicit form, there is a very insiduous side effect, in the shape of the sudden increase in theft from, and tampering with, vehicles apparently fitted with CB radios. Mosty CB'ers don't know the difference between a CB radio and a perfectly legal piece of amateur equipment — but since these fellons imagine that anyone possessing a CB radio would not be willing to disclose its theft to the police (for obvious reasons) they feel they can indulge to their hearts content.

Not surprisingly, owners of legal radio equipment assailed by these characters are getting just a bit fed up. Very few users of amateur band equipment are willing to leave their gear in the car overnight — or even in a public car park any longer. Antennas get unscrewed (or simply hacked off), and the whole situation is very tiresome indeed.

The legalization of CB will tend to deter thefts from a couple of viewpoints — firstly the 'black market' in them will disappear overnight. In fact, after the experience of the US where the market was so saturated and overburdened — that one of the trade 'in' jokes suggested that there were dealers breaking into cars at night to fit CB radios! The second deterrent is the fact that the subject of the theft will not be illegally possessed, and thus the owner will be only too anxious to go and burden the crime statistics at his local police station.

Some observers have likened the present CB situation to that of the way in which drug takers are exploited by both the 'pushers' and any other shady elements who can use their illegal dependance to further criminal aims.

So R&EC is going to try and help to make life a little harder for these unfortunate characters, by offering rewards to anyone supplying information leading to the arrest and conviction of anyone found guilty of theft or criminal damage in connection with amateur radio and CB equipment. We are also offering free space in these pages to publicise the descriptions and serial numbers of stolen equipment.

The reward we offer is up to £100 (or 50% of the fine imposed on the guilty party, whichever is less) for any information that leads to a conviction for the theft of — or interference with — legally possessed CB and amateur radio equipment fitted to a car. If the owners of the rigs whose descriptions we give would care to add to this reward, then they are at liberty to do so.

So far, we have gathered a few names and numbers in conjunction with Arrow Electronics Ltd., but we expect to hear of many others:

Make	Type No.	Serial No.	Location
Kenwood/Trio	TR7800	1040911	Brentwood
Sommerkamp	TS280	8300025	Glasgow
FDK	Multi700E	02259	
Yaesu	FT7B	9H040405	Lincoln
Sommerkamp	TS240	9000180	Bolton
ICOM	IC255		Lincoln
Sommerkamp	TS280FM	8300212	Romford
Yaesu	FT101E	8H351814	Brentwood
Sommerkamp	Switched power linear		Brentwood
Yaesu	FT207RB	9M20204	Brentwood
Trio	TR2400		

We all need friends, good buddies . . . .

This feature has been at pains to try and point out that the only good CB'er is a legal CB'er. The moment you step across the threshold into illegality, then you are doing your bit towards the undermining of respect for the Law and all that is implied by such behaviour. Most CB'ers would certainly not consider themselves on a par with rioters throwing petrol bombs, but where do you draw the line between the law and an illegal act?

Mass disobedience seems to have aquired a very insidious respectability — and the unfortunate truth is that a lot of the responsibility must fall on governments who have been perennially too weak to uphold the rule of law, either by stubbornly and thoughtlessly maintaining totally unworkable laws, or failing to clamp down on offenders with adequate resolve.

Not surprisingly, perhaps, some of the more influential Home Office civil servants are very uncertain as to the benefits of the legalization of CB, which is seen as the criminal's answer to the use of radio by the police. If the police cannot do anything about the currently totally illegal CB situation, how on earth are they going to be able to sort out legal and illegal users — when the only visible difference on the set is very easily copied indeed?

It would be surprising if anyone was daft enough to use the legal CB allocation for criminal purposes, since the legal band will be used and monitored to such an extent as to make the idea laughable. The reservations lie in the continued use of illegal 120/280 channel AM/SSB equipment, covered by the cloak of respectability offered to legal users.

The rather unhopeful remarks make by CB lobbyists on their view of the legal situation indicate that acquiescence to the power of reasoned argument is still not one of their social graces, and that they will continue to use whatever frequencies and powers they like until the cows come home. Naturally enough, the Home Office feel that they have been more generous than any other European authority in the specification that they have offered — so the gloves are gradually coming off, and illegal users are being rounded up at the rate of over 100 a week in the London area alone. Courts have been told to get tough, since the once apparently reasonable arguments put forward by those collared about the 'unavoidability', the civil 'rights' aspects of CB, and the fact that the rest of the world has 'it' have crystalized into a very definite situation at last.

Furthermore, the Home Office now has a simple, cheap and 100% effective device to issue to police forces that will clearly show the difference between a legal and an illegal user — both as a general monitor, and as a specific test instrument once the suspect vehicle has been apprehended.

If UK CB had merely adopted the status quo, then CB would have been a worthless mess inside 6 months. As it is, we have a very good chance of maintaining a workable service indefinity — assuming those with pretentions to 'DXing' do the sensible thing and proceed to amateur radio — which as we have said before, is really very simple if you are at all keen. If CB'ers wish to gain the cooperation of police (and amateurs) in their emergency network groups, then it will only happen if the rules are observed and a degree of social responsibility is evident.

Finally, how you would like it if any 17 year old could pick up a set of keys and thrash down the M1 at 70 mph in a 32 ton truck? The closest parallel that actually seems to make some impact on the more hardened CBer is the very obvious one of the driving test. CB is a provisional licence if you like, or cruder still, the ability to ride a push bike on the air waves, without offering CB the potential to foul up essential emergency communications and navigational systems that is implied in the scope offered to the demonstrably more knowledgable radio amateur operator.

On yer bike . . . .

On the occasions that confessed CBers 'come out' and go to an amateur radio club to try and find out more about their new found fascination in communication via radio, rather too many clubs have simply 'asked' them to clear off . . . . or else. Rather than try to educate the breakers in the benefits of amateur radio, and the folly of risking their necks with an illegal rig, it seems that the reception afforded to CBers is going to create a big chasm betrween the two closely associated groups that is leading to some form of totally unnecessary conflict. Spiteful reactions are all too simple when there are vulnerable things like repeaters, and CB rigs labelled "2m transceivers" readily accessible to the thwarted CBer wishing to get into amateur radio.

Outraged of Chelmsford . . . .

CB is a topic that is guaranteed to extract an extreme response from anyone wish an opinion on the matter. The interminable correspondence in the electronics press bears witness to this fact.

But one aspect of CB that hasn't been too closely examined is the relationship between CB and amateur radio — and if ever there was a league of opinionated fraternities, amateur radio enthusiasts would come in the top half. The Masons couldn't hold a candle to the average amateur radio club (or is it a pair of compasses? I never did understand the funny handshakes either . . .) when it comes to coded speech and 'knowing' looks.

This is not to say that such attitudes are necessarily to be condemned, but that any organisation operating along the lines of the Cosa Nostra has potential for trouble through misinformation, and the general blanket of subversiveness that surrounds the hobby. Many is the time that the writer has been having QSO (rachet) on the 2m band, only to find from subsequent comments and third party revelations that half the local amateur population have been eavesdropping without bothering to let their presence be known.

As far as CB goes, radio amateurs tend to polarize in favour of CB, and those who would dearly like to see all breakers whipped to death with the nearest DV27. Those in favour tend to be able to see the benefits to the amateur fraternity, as CB inevitably draws a bigger following to 'real' amateur radio. After the rather bad press image afforded to amateur radio by such infamous events as the Tony Hancock "Radio Amateur" sketch, and the general 'eccentric boffins' image retained by most members of the public, they should be grateful that CB has given amateur radio communication a relatively normal image at last — at least, as long as the jargon can be kept under control.

On the other hand, the first of these R&EC supplements was received at one amateur radio club as the next worst thing since Ghengis Khan. This information was passed second hand onto us by one of the more enlightened members who couldn't really understand what the fuss was about, since it appears the contentious bit was the publication of the table of frequencies of the 120 channel sets.

Well, we're very sorry if the fact that some of these occur in the 10m amateur band has engaged the wrath of some amateurs, but that just happens to be a fact of life. A fait accomplis, and not likely to be influenced by anything we have to say. Larger powers than the amateur radio associations have been distinctly impotent when it comes to trying to sort out the basic problem of the original 40 channels.

Many breakers with these 120 channel rigs have no idea what the frequencies are, and so they have no idea that they have absolutely no hope of ever being legalized in Europe — let alone the UK. Many CBers think that these extra channels are simply conjured out of the existing space available through some miracle of modern technology. If anything, publishing these frequencies will tend to inform CBers that these rigs gobble up an unacceptable additional chunk of the precious spectrum.

Furthermore, there is a motto in the amateur radio world known as "use or lose". This basically refers to the lack of activity on many amateur bands, and the fact that if the bands were not more fully occupied, chunks of spectrum might be taken away for more worthy causes. It is only really since the availability of ready-made 'plug it in and switch it on' equipment for amateur radio that the hobby has got going in a big way, and also enabled the seedier elements to make their unwelcome presence felt on too many of the 144MHz repeaters.

So before there is much more sanctemoneous preaching about the evils of CB, some amateurs might reflect sheepishly on their own contribution towards the furtherance of constructive technical achievement within the hobby. A net deficit to our balance of payments more frequently results from their participation in the hobby.

A SCANNING MONITOR RECEIVER SYSTEM

Part 1

L. Power

The rapid growth of 'private' telecommunications (as opposed to the broadcast variety) has encouraged a market for receivers capable of monitoring this activity – both in the capacity of surveillance devices, and as simple receivers for listening to 'what's happening'.

Applications range from receivers for the 35MHz model aircraft band to check activity on the channels being used for model aircraft, to 144MHz (2 metre) band receivers to check propagation conditions, and general activity. This is especially useful for local repeater frequencies where most basic 'calling' is routed these days. Other uses include boat owners who need to check the local VHF frequencies for emergency and general harbour information, and anyone else with a need for checking activity in sectors of the VHF NBFM communications spectrum from 25MHz to 200MHz.

THE 'R&EC' BAND MONITOR

Commercial scanners are available from a number of sources. Many of these oriental marvels tend to be overcomplicated (but a lot of fun nevertheless) and manage to cover virtually every communications band from 30MHz to 515MHz. But many users of a scanner simply want to keep an ear open on three to ten local communication channels to see what's going on, and find the £200+ spent on one of the more comprehensive scanners is not necessary. The device described here can be built for £40 or less. In fact, as little as £25 with careful buying (excluding crystals).

The scanner described here is very versatile and lends itself to being built to cover any two bands in the range 25MHz to 200MHz, simply by selecting the correct coils for the RF and mixer stages. The bands are restricted in width by the practical consideration of the design of tuned circuits, but work out to be about 2-6% of the chosen centre frequency, depending on the RF tuned circuit coupling factors.

In other words, one band might be the 35.050 to 35.250MHz model aircraft band, and the other might be 144-146MHz for the 2m amateur band. The choice of RF coils and the crystal frequency used in the oscillator are the only variables.

This scanner is the first in a long line of R&EC radio projects that will cover the entire spectrum of radio interest from LF to UHF (and beyond). It is to be presented in a proprietory case for visual appeal and general enhancement, since one of the major 'turn offs' for the home constructor is the relatively indifferent finish and appearance of what might otherwise be an exceedingly good project.

The scanner has been derived from a number of ideas and designs, and should offer the constructor both an opportunity to save money, and get a thorough insight into the way in which commercial equipment is designed and constructed.

Despite the apparently daunting complexity of the circuit, the availability of a PCB design greatly simplifies the construction of this project, and brings it within the scope of many enthusiasts with a basic appreciation of some of the finer points of RF construction – namely the special brand of patience available only to enthusiasts.

WHAT DOES IT DO?

The scanner provides 2x8 channels of coverage, this may be 2 separate bands in the region of 25-200MHz (NBFM) or it may cover 16 channels in a single band.

When active, the receiver clocks along a row of LEDs on the front panel to indicate which channel is 'active', and which one of the 2 blocks of 8 channels currently being scanned is indicated on a further LED lamp when the scanning process is halted.

The receiver 'squelch' (interstation muting) remains shut whilst there is no signal present on any of the channels being monitored – but when a signal appears on a channel, the sequencing is stopped, and the loudspeaker is activated. The squelch and volume levels are both preset by front panel controls.

The complete receiver unit built into the case supplied with the kit.

The LED remains lit above the appropriate channel indicator until the transmission ceases – and after a brief pause (determined by presettable values in the circuit) – the scanning is resumed until stopped by a signal once again.

However, there are many instances where some of the 'local' and frequently used channels may not be of interest, and so it is essential to be able to bypass them from the scanning process – or the receiver will remain permanently 'hung up'. One solution is to pull out the crystals – but this is obviously tedious in the extreme, so the circuit incorporates an electronic bypass system which can be switched in to skip unwanted channels.

BLOCK DESCRIPTION

Fig. 1 outlines the basic approach of the scanner, which will be seen to be a relatively straightforward double superhet system.

The signal from the antenna is routed to the active RF section via diode switching, according to the output of the sequencing counter. From there, the signal passes through a bandpass pair tuned circuit (using top capacity coupling) in front of the RF stage.

The RF amplifier is nothing very exotic, being a straightforward transistor amplifier using self biasing. The output is fed to a second bandpass pair before the mixer. The mixer stage converts down to 10.7MHz for the first IF, where the crystal filter provides roof-

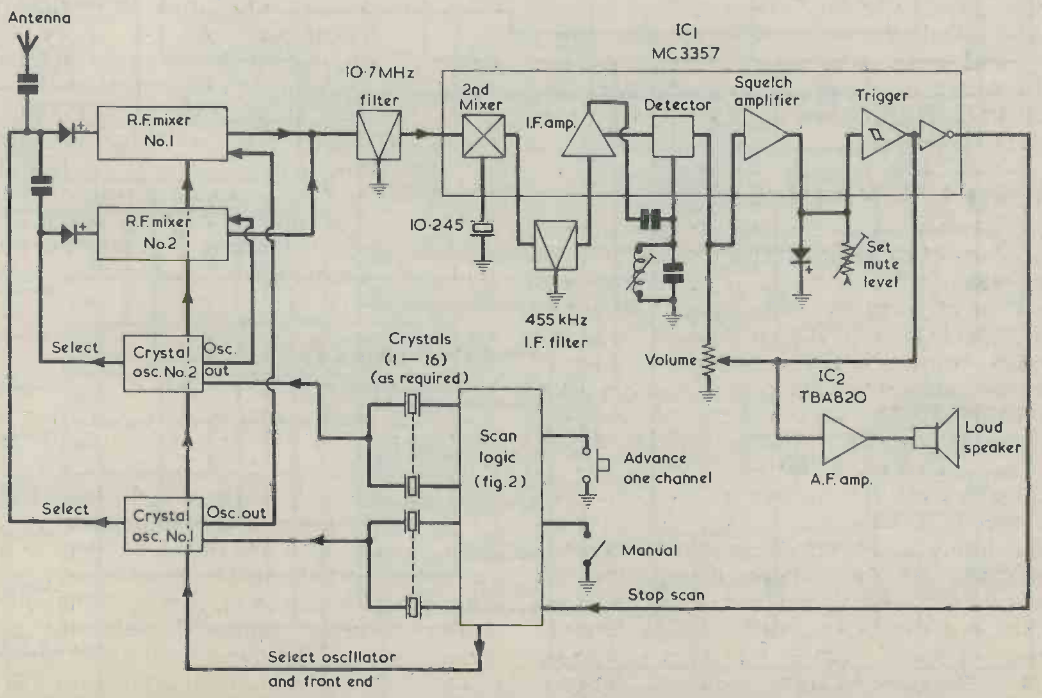


Fig. 1. Block schematic of receiver. The oscillator and mixer stages are duplicated to allow scanning over two widely separated bands.

ing selectivity to prevent unwanted image responses occurring at 10.7MHz-910kHz as a result of the second conversion to 455kHz.

The main signal processing is carried out in an MPS5071/MC3357 IC, which includes all the features necessary to accept the 10.7MHz IF input, and provide demodulated audio output with squelch amplifier, detector and 'switch'. The device includes a 10.245MHz 2nd conversion oscillator, balanced mixer, 455kHz IF amplifier, detector, noise amplifier and squelch gate with hysteresis. All that remains is the audio amplifier, which is a simple TBA820M stage to drive an internal loudspeaker. If additional volume is required for any reason (mobile applications) then a higher output amplifier may be desirable – but this should be fitted externally, and possibly built into the extension speaker device itself. The basic receiver has been designed for minimal current consumption in applications where a switched (as opposed to automatically scanned with its relatively thirsty logic) receiver is required, the overall consumption can be as low as 9ma.

The scanning system logic is described in Fig. 2. A simple two transistor astable oscillator provides the system clock and drives a 7493 using a 3 bit binary counter connected to a 74145 one-of-ten decoder.

Switching between the two 'front ends' of the scanner is achieved by dividing the MSB of the counter by 2, and using the output to select one of the two 'front ends' in alternating sequences of eight.

The clock is stopped by the squelch line going 'low' – or by switching the same line manually.

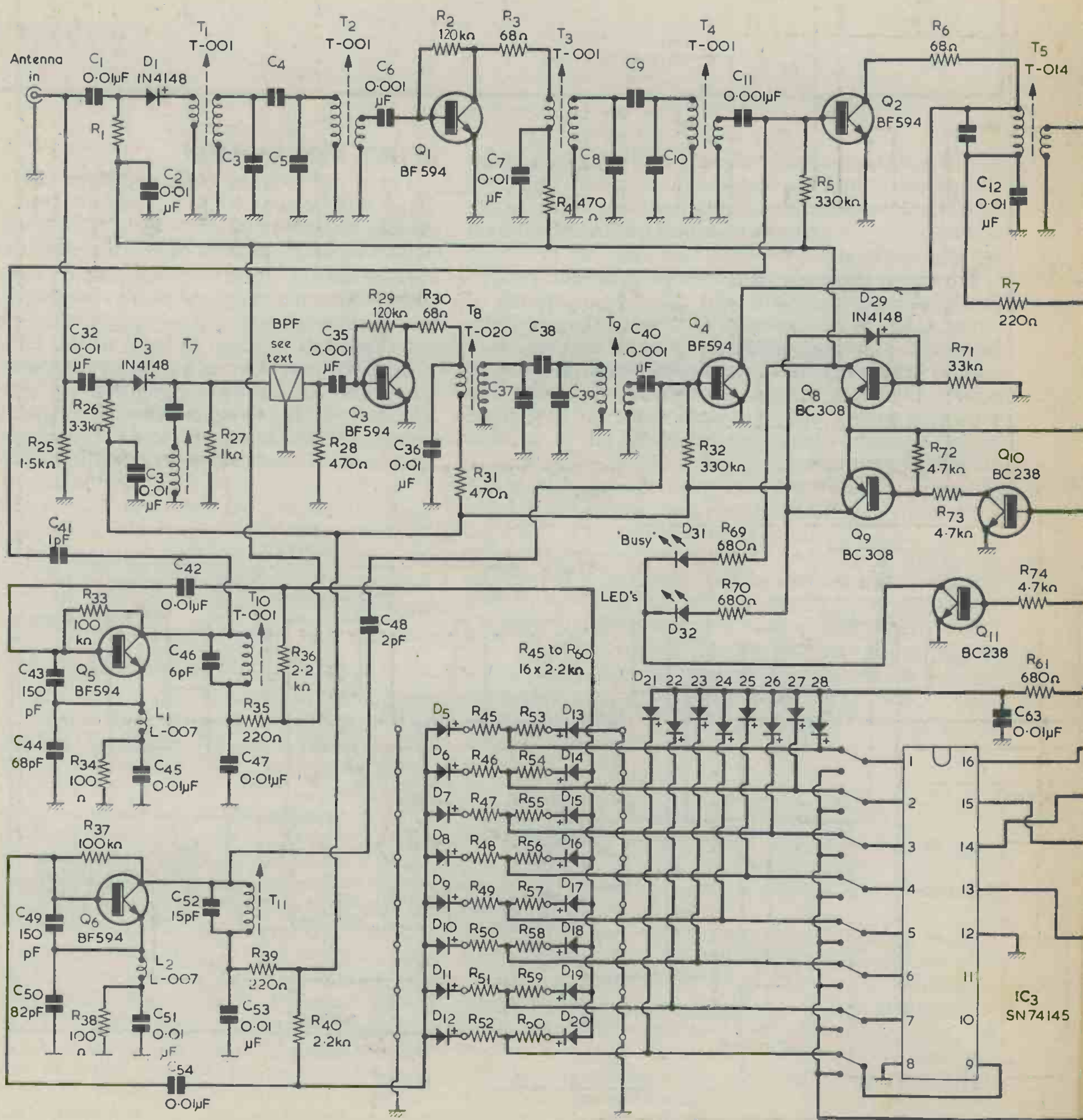


Fig. 3. Circuit of complete receiver. Dets

THE CIRCUIT DESCRIPTION (Fig. 3)

The RF/IF/AF sections . . .

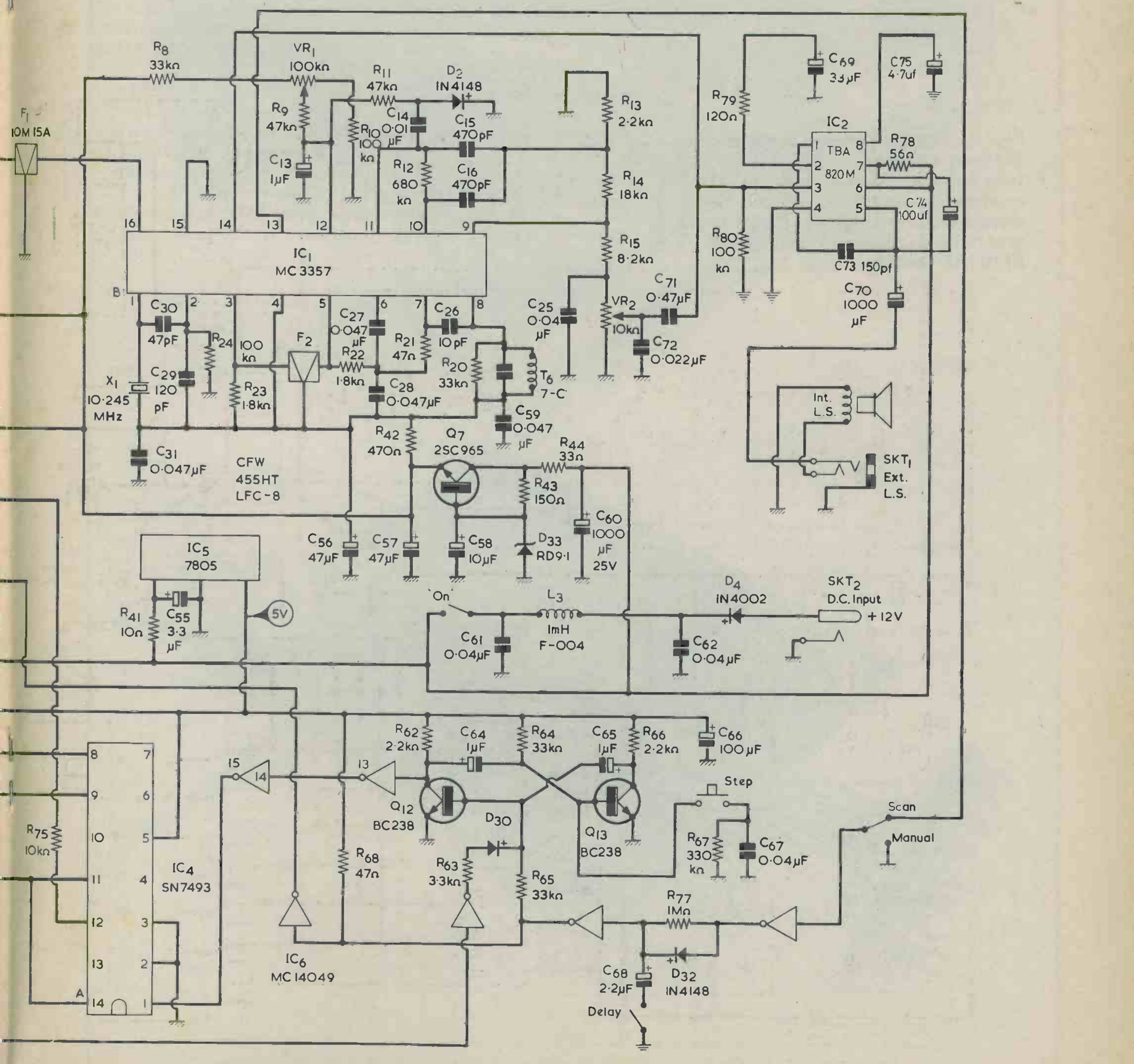
The antenna is connected via the switching diodes D1 or D3 to the appropriate front end as selected in the scanning circuitry. A nominal 50/75 ohms impedance is used.

Two top coupled bandpass pairs using two standard coils and capacitors selected according to the frequency range required (Table 1 in Part Two) determines the RF response on either side of the RF amplifier transistor. The RF stages are thus fixed bandwidth, and can operate over a relatively narrow range based on the centre frequency selected. The use of ganged tuning with varicaps would enable a 20%-30% range to be achieved, but this is not the prime function of this receiver. The actual bandwidth is determined by the coupling capacitor (C4/9). Mathematical analysis of top coupled filters is available (Reference 1).

The two mixers, Q2 and Q4, are fed from the crystal oscillators (Q5 and Q6) selected by the scanning logic.

These oscillators are standard Colpitts devices, using a tuned emitter load to ensure operation on the 3rd overtone of the crystal. The crystal frequency is selected according to the formula:

$$\frac{\text{Desired RF frequency} - 10.7\text{MHz}}{3}$$



ls of the main IC (IC1) are shown in Fig. 4.

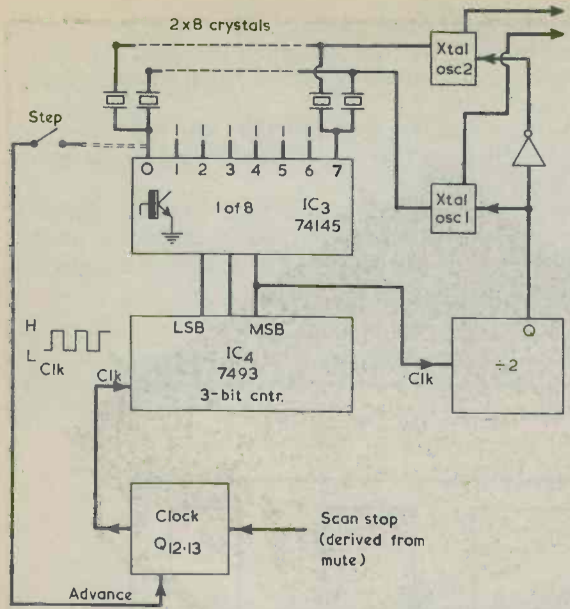


Fig. 2. The automatic scanning logic. Sixteen channels can be scanned in two separate bands of eight. The frequency coverage of each band is determined by the choice of crystals and coils, explained in paragraph "The RF/IF/AF sections".

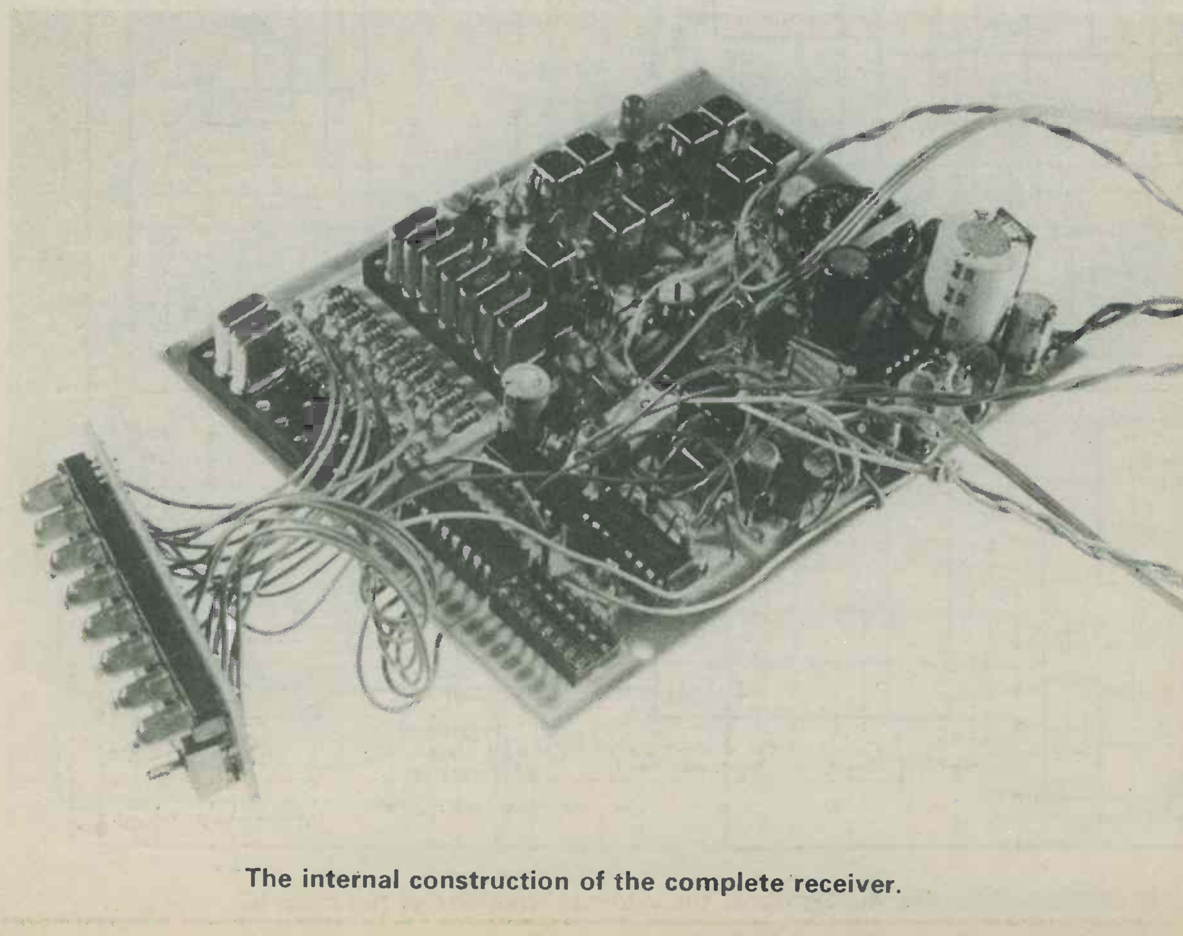
Crystal type should be parallel resonant, 3rd overtone cut, 20pF load (or 30pF if C44 is increased to 82pF). The injection frequency is determined by the collector circuit, which is set to 3x the crystal frequency.

The 'self-oscillating' tripler is a highly effective method of producing the necessary injection to the mixer but the level of oscillation is relatively low. Injection via the base circuit is best – but it does mean that the circuit does not readily lend itself to feeding FET of MOSFET mixers, which require at least a volt of LO for optimum operation. A separate tripler amplifier is necessary for FET/MOSFET mixers.

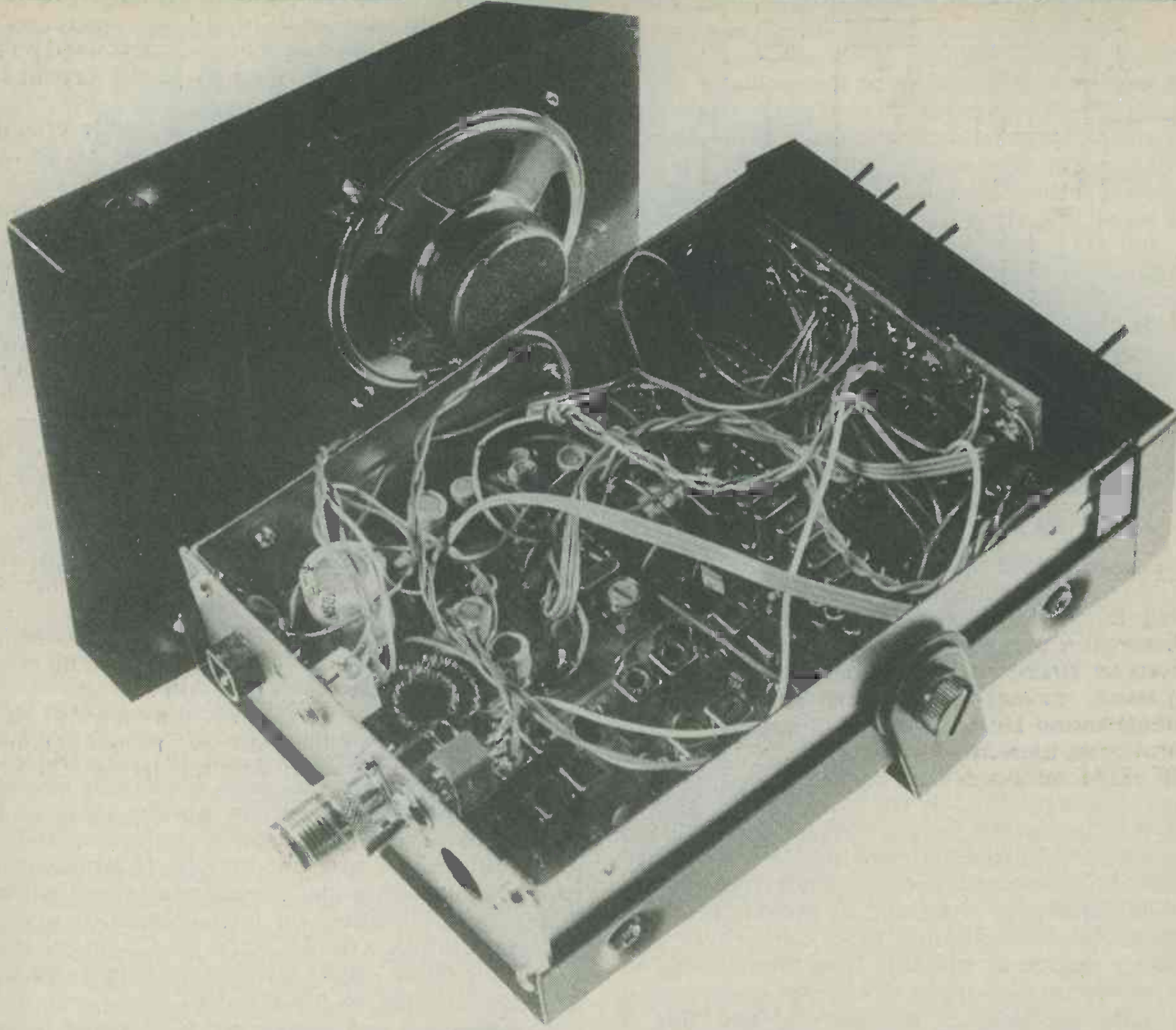
The two mixer transistors feed a common output IF transformer at 10.7MHz, which matches into the monolithic two pole crystal filter – used for 'roofing' selectivity, as opposed to the narrower 'channel' selectivity provided later on. The main purpose of this filter is to suppress the –910kHz images that arise from the second conversion derived from mixing 10.7MHz with 10.245MHz.

Everything from 10.7MHz IF to audio output is contained within IC1 – so it is as well to consider this device in some detail (Fig. 4). The input at pin 16 is to one half of a balanced mixer, the other half of which is fed from the Colpitts oscillator formed around pins 1 and 2, with the external conversion crystal.

The mixer output is resistively terminated at pin 3, to match the input impedance of the main channel filter – a multi element ceramic ladder filter of



The internal construction of the complete receiver.



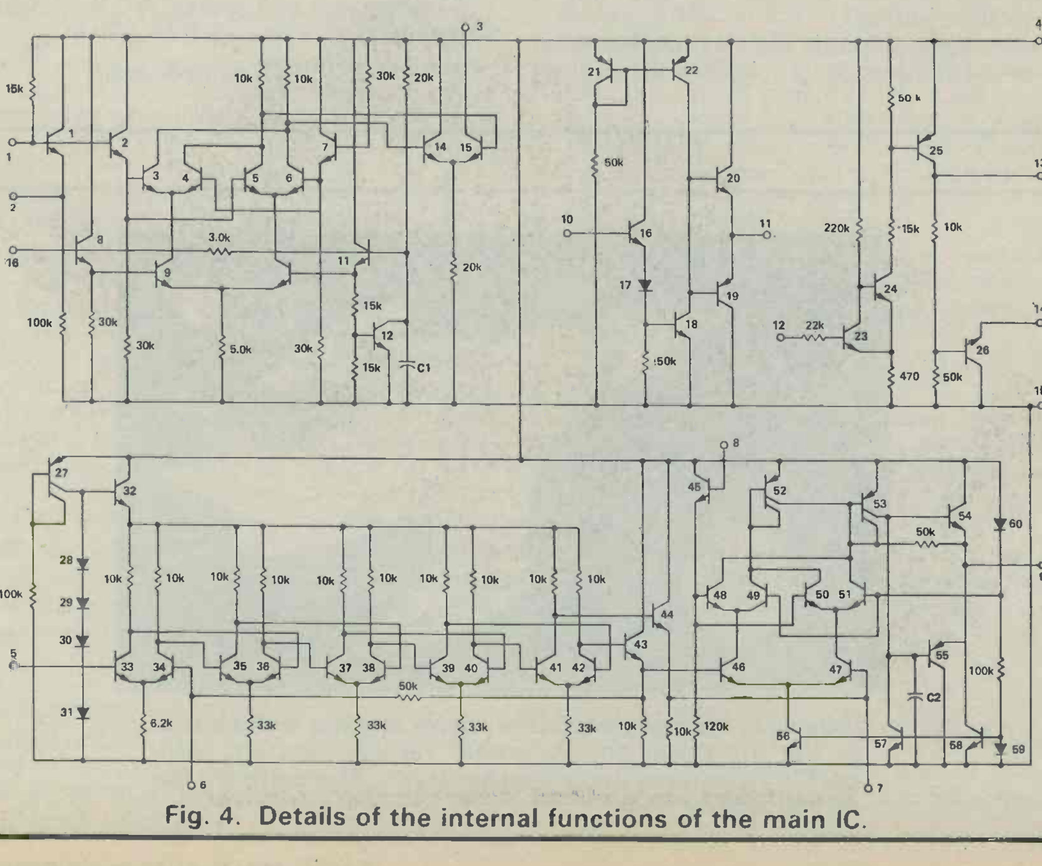


Fig. 4. Details of the internal functions of the main IC.

approximately **8kHz-12kHz bandwidth.** Since there is no direct mechanism for trimming the crystal frequency, it is as well to err on the wide side here to cover some of the tolerances at the oscillator stage.

The limiting IF amplifier input at pin 5 is biased by R22, which also terminates the filter in the correct impedance. The IF amplifier output at pin 7 is also terminated at the same bias point, and so decoupling the IF signal to earth at the conjunction of C28, R22, C27, and R21 must be very effective. A low RF impedance capacitor is essential in this position.

The quadrature detector phase shift coil at pin 8 is a straightforward 455kHz IF transformer with a Q of between 100 and 150. The deviation-to-audio conversion is too efficient for this level of Q, so the coil is damped by R20 to achieve an audio level to suit the deviation in use. For the 2m amateur band, deviation levels of 5-7kHz are commonplace, but for commercial frequencies, the deviation levels are kept to 2-3kHz, allowing more scope for a higher Q component.

The audio output appears at pin 9 of IC1, and is immediately fed to the inverting input of an 'on-chip' operational amplifier active filter at pin 10 of IC1, in a bandpass filter configuration with centre frequency set at about 10kHz. In other words, well above the audio band, and only likely to be activated by the broadband noise characteristic of a limiting FM IF with no signal present.

The output of this noise amplifier appears at pin 11, and is then rectified by D2 to provide a signal to switch the input of the Schmidt trigger at pin 12. An external mute adjustment is provided by VR1, which alters the DC bias on the mute Schmidt trigger input, and thus adjusts the threshold of operation. Good voltage stability is essential here, and whilst C13 provides a degree of isolation from the spikes and audio present on the supply, an effectively decoupled series pass regulator is necessary – and this is provided by Q7 and D33.

The mute trigger output at pin 14 is connected to the input of the audio stage, IC2, so that the audio is shorted to ground (via an internal switch of IC1) when the muting is active – and open circuit when a signal is being received.

IC2 is a simple, cheap and efficient 1W audio stage of which little more need be said. See the manufacturer's data sheet if you want to delve deeper (Reference 2).

The scanning logic . . .

Most of the description of this section is covered in the analysis of the block diagram and Fig. 2. The actual switching of the crystals is achieved by grounding the appropriate cathode of diodes D21 to D28, thus enabling the crystal whose anode is being fed from either R40 or R36, according to the status of the scanning sequence through Q8 and Q9.

Bypassed channels are simply selected by switching the appropriate output of the 74145 back to the transistor astable, causing it to prematurely reset and thus advance the 7493.

5v for the logic is provided by a cheap 5v regulator – IC5 – which also keeps the switching noise out of the rest of the circuit.

POWER SUPPLY

The unit operates from a 12v supply. Unless the sequencing logic is omitted, the consumption is too high for primary cell battery operation. A thorough RFI input filter is provided just after the DC input jack, to prevent external hash (especially useful if used in vehicles) from getting into the sensitive RF stages. D4 is the reverse polarity protection, and can save you a lot of cost and trouble. If problems are experienced with audio motorboating and general instability or 'chatter' on high volume, it may be necessary to place the DC feed to IC2 on the input side of the diode – or to increase the supply decoupling capacity close by pin 6 of IC2.

Construction and testing will be covered in Part Two . . .!

(To be Continued)

"We have a suppressed state power storage malfunction in the unilateral entertainment receiver system skipper!" "What does that mean Scotty?" "The battery's flat on the tranny Skip."

SHORT WAVE NEWS
FOR DX LISTENERS

By Frank A. Baldwin

Times = GMT *Frequencies = kHz*

Continuing with our review of some of the results achieved during the last far-eastern season (see the previous issue of this journal) we commence with an often reported station but on a not often reported frequency.

●NORTH KOREA

Pyongyang on a measured **7203** at 0855, OM with announcements in an Asian vernacular, sign-off after some military music. This is thought to be the termination of the Korean programme for the Near and Middle East and Africa, probably scheduled from 0800 to 0855. Information from North Korea is sparse to say the least!

●NEW CALEDONIA

Turning our attention to the Pacific area we did manage, after several attempts, to log Noumea on **7170** at 0830 one morning last January. A moderate signal on a clear channel produced a log entry from the time shown up to 0858 when Vienna opens with its tuning signal and blasts Noumea right off the air! The reception of Noumea however was unmistakable, OM with announcements and station identification in French at 0831, this being followed by music from a mandolin-type instrument. The power is 20kW.

●VANUATU

Formerly the New Hebrides, Vanuatu may be logged by listening for Port Vila operating on **7260** where we heard it at 0801 on the very last day of January.

This one has a power of just 2kW and, as one might expect, it is quite difficult to log. OM with a newscast in vernacular – several Pacific place-names mentioned – according to the schedule the language used would be Bislama. Reception was on LSB to avoid adjacent channel QRM but the signal slowly faded until lost under the noise at 0812.

AROUND THE DIAL

In which are listed some of the transmissions recently received which may interest some readers and also act as a general guide to what may be heard via the short waves.

●U.S.S.R.

Moscow on **17790** at 0837 with a relay of Orbita 1 and 2 programme for Soviet Youth. This programme is scheduled from 0815 to 0900.

Moscow on **17795** at 0832 when radiating the Standard Chinese programme to China, scheduled from 0700 to 0900 on this channel and in parallel on **17860.**

Moscow on **17820** at 0810 with the Russian language 5th programme "Pravda Review", timed from 0800 to 0815.

Moscow on **17880** at 0840, classical music with announcements in English in the World Service, scheduled from 0200 through to 1500 on this particular channel.

●CZECHOSLAVAKIA

Prague on **17705** at 1557, male and female announcers with alternate items in the English programme for Africa, South Asia, the Far East and Europe, scheduled from 1530 to 1625.

Prague on **9605** at 1500, station identification at the commencement of the Czech programme for Africa, South Asia, the Far East and Europe, scheduled from 1500 to 1530.

●SWITZERLAND

Berne on **9535** at 1340 when radiating a talk about world affairs in the English programme to the Far East, South and South East Asia, North America and Europe, scheduled from 1315 to 1345.

Berne on **9725** at 0434 with a review of local affairs in the English programme for the West Coast of North America, scheduled from 0430 to 0500.

●NETHERLANDS

Hilversum on **9895** at 1340, a commentary on world affairs from the Dutch point of view in the English programme for Europe, scheduled from 1330 to 1420.

●VATICAN CITY

Vatican on **9645** at 1450 with a news review of internal affairs, mostly religious, in the English programme intended for the UK and Eire and timed from 1445 to 1500.

●WEST GERMANY

Cologne on **17765** at 1110, OM with a newscast of African affairs in the English programme beamed to Central and East Africa from 1045 to 1115. Into the Swahili programme at 1115.

●EAST GERMANY

"Radio Berlin International" on **9730** at 1440, OM with a talk about public libraries in the German Democratic Republic, all in the English programme for East Africa and scheduled from 1415 to 1500.

Berlin on **9665** at 1257, OM with station identification in German then into the Arabic programme for the Near East, South Arabia and North West Africa, scheduled from 1300 to 1415.

● **AUSTRIA**

Vienna on **9770** at 1500, station identifications in English and other European languages then into a newscast in the German programme for Europe, scheduled from 1430 to 1600.

● **ITALY**

Rome on **9575** at 1555, interval signal (bird-song), OM station identification followed by the Italian programme for Europe, timed from 1555 to 1635 on this channel.

● **POLAND**

Warsaw on **9525** at 2005, OM with a newscast in the English programme directed to Africa and scheduled from 2000 to 2030. Also logged in parallel on **9675**.

● **EGYPT**

Cairo on **9455** at 0426, religious chants in the Domestic Service General Programme which may be heard on this frequency from 0400 through to 0645.

● **CHINA**

Radio Peking on **11635** at 0854 with a review of agricultural achievements in China in the English programme intended for Australia and New Zealand and scheduled on this channel from 0830 to 0930.

Radio Peking on **17680** at 0858, female announcer with the Indonesian programme for Indonesia, scheduled from 0830 to 0930.

Radio Peking on a measured **17533** at 0859, 'East is Red' theme then OM in Chinese to South East Asia scheduled from 0900 to 1000 but heavily jammed soon after commencing the programme.

● **VIETNAM**

Hanoi on **9840** at 1346 with announcements in the Cambodian Programme for South East Asia scheduled from 1100 to 1200.

● **PAKISTAN**

Rawalpindi on **5010** at 0135, OM with religious chants, OM announcer, identification as "Radio Pakistan" at 0140. Logged on USB to clear an unmodulated carrier on channel.

Islamabad on **5060** at 0150, OM announcements in vernacular, local songs and music in typical style. A good clear signal at this time. Both these channels are 'seasonal'.

● **AFGHANISTAN**

Ariana Radio and TV Service, Kabul, on **4740** at 0205, OM with song in vernacular then local music on a mandolin-type instrument in the Home Service 1 programme scheduled here from 0125 to 0330 and from 1340 to 1930.

● **GABON**

Libreville ("Africa No. 1") on **4811** (originally heard on **4807.6** which would have effectively blotted out Sao Tome) with a programme of recorded pops and announcements in French. All part of the current French plan to 'push' the language internationally and equal, if not surpass, the BBC with its English language world coverage. They'll have a mammoth task to rival the Moscow emanated World Service in English!

● **CAMEROON**

Garoua on **5010** at 0504, a newscast in English of African and Middle East affairs then "More news in English at 0700". Into African songs and music at 0506. The schedule is from 0500 to 0700 and from 1700 to 2200 and the power is 100kW.

● **BOTSWANA**

Gaberones on **4845** at 0617, local songs and chants complete with drum beats, a good signal in the clear at this time. The schedule is from 0400 to 0630 and from 1500 to 2100 (Thursdays to Saturdays inclusive from 1430). The power is 10kW.

● **CONGO**

RTV Congolaise, Brazzaville on **3265** at 1838, OM in vernacular then into local music and songs. This one has a schedule from 0400 to 0700 and from 1700 to 2300. The closing time is variable as is the frequency. The power is 50kW.

● **VENEZUELA**

La Voz de Carabobo, Valencia on **4780** at 0125, OM with an excited commentary on futebol! The schedule is from 1000 to 0400 and the power is 1kW.

Radio Mundial, Bolivar on **4770** at 0333, OM song in Spanish, dance music Latin American style. The schedule is from 1000 to 0400 and the power is 1kW.

● **NICARAGUA**

La Voz de Nicaragua, Managua on **5950** at 0330, OM station identification in Spanish, many announcements with place-names. Schedule unknown. Power 50kW.

● **ECUADOR**

Radio Federacion, Sucua on **4960** at 0319, announcements in Spanish, folk songs and music in typical local-style. The schedule is from 1030 to 0300 (Sundays from 1100). Closing time on Saturdays is 0400 and on Sundays at 0100. The power is 5kW.

● **COLOMBIA**

Radio Neiva, Neiva on **4855** at 0451, OM with songs in Spanish with local-style folk music. Station identification at 0455 as "Radio Centro". The schedule is from 2300 to 0530 but on an irregular basis. The power is 1kW.

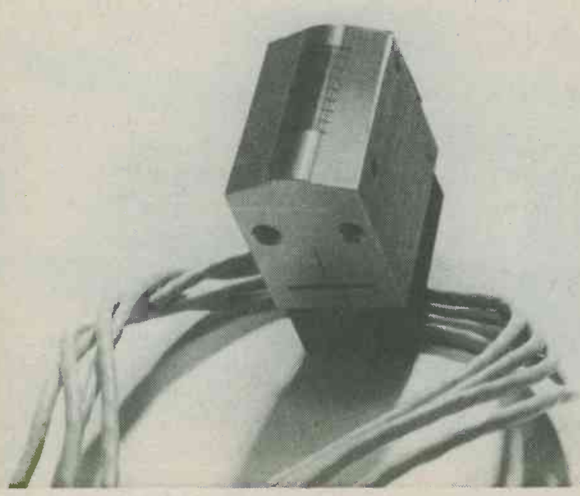
Radio Guatapuri, Valledupar on **4815** at 0438, OM station identification in Spanish, commercials, local pops on records. The schedule is around the clock and the power is 10kW.

Ondas del Meta, Villavicencio on **4885** at 0202, OM with a long political talk all about Colombian affairs. The schedule is from 1000 to 0500 but has been reported closing as early as 0410 on occasions. The power is 1kW.

● **PERU**

Radio Atlantida, Iquitos on **4790** at 0411, OM pop song in Spanish, OM announcer, The schedule is from 0900 to 0500 (Sundays until 0400) but sometimes radiates around the clock. The power is 1 kW.

High specification magnetic tape heads



Marketed exclusively in the UK by Patrick Cole, P.O. Box 14, Sevenoaks, Kent, the new Bogen GmbH range of Magnetic Tape Heads has been specifically designed for high quality Audio, Data and Copying applications with special Hall Effect and customer specified heads also being available.

Covering tape widths of 3,81mm, 6,35mm, ½" and 1", the Audio Heads cover cap lengths ranging from <1μm, to several μ. Optimum sensitivity, frequency response and, in particular, long term stability, is achieved in all cases by special material selection.

In Copying Head format speed variations ranging from 1:1 to 64 times normal speed can be accepted with, dependent upon operational conditions, slave or master head core material being selected from Recovac, Sendust or ferrite material, thereby significantly increasing service life.

Bogen Data Heads, using solely Recovac core material, cover storage densities of from 800 frpi to 9000 frpi and have either flat, radial or hyperbolic face profiles, individually adapted to the requirements dictated by the operational speed and storage density. When used for instrumental purposes, wide-band 1 and wide-band 2 ranges can be covered which, in conjunction with ease of adjustment make these heads uniquely versatile. Further increase in service life is achieved by hard-chromium plating or oxide// carbide coating of the metal contact surface.

Hall Effect playback heads, as well as, for instance, individual designs for video-sound equipment, speed-independent information evaluation, and special control purposes are also available or can be designed/customised dependent upon normal commercial criteria.

Soundex crack the IEC 468-2 noise problem

The new Soundex AMM 200 Noise Meter is a small economically priced instrument exactly meeting the difficult CCIR 468-2 specification, for the measurement of audio frequency noise in broadcasting, recording systems and on sound programme circuits.

A vital feature of the AMM 200 is its overload warning light. This is imperative because amplifier stages before the weighting network may overload at frequencies attenuated by the weighting network and therefore not be apparent by the meter reading.

With a measuring range of – 100dB to –8dB, (–80dB to –10dB selected by push buttons in 10dB steps and 22 dB of calibrated meter scale), the AMM 200 has a balanced P.O. jack input terminated to either 20K ohms or 600 ohms as selected by a push button.

A front panel BNC socket provides a means of looking at the measured signal on an oscilloscope, either before or after the weighting network filter.

Mains operated on a double insulated power supply, the dimensions are 175 x 113 x 67mm (7" x 4" x 2¾") and the weight 1.2Kg (2¾lbs).

Produced to meet the company's concept of a range of very portable audio instruments for the engineer, whether working in the field, the studio or on general test bench work, it comes complete and ready to use with Broadcast Weighting network as standard.

A range of plug-in alternative filters will be available in the near future.

The Soundex AMM 200, is very competitively priced at £350. Enquiries to Soundex Ltd., Park Lane, Broxbourne, Herts.

Radio Switch-Off Timer

John Baker

Night-time radio switches itself off. **Timer triggered by touch contacts.**

A very useful feature incorporated in many bedside clock radios is a "sleep" or "slumber" timer circuit which provides automatic switch-off after a predetermined length of time. This enables the person listening to the radio to fall asleep without having to bother about turning off the set. The unit to be described is a "sleep" timer which can be used with any 9 volt battery operated radio without this facility.

The unit has three switch-off delays of approximately 3, 5 and 7 minutes, the desired delay being selected by a 3-way switch. The battery which operates the radio (and the timer) is situated in the timer case, and the output of the timer is taken to a battery clip which connects to the battery clip of the radio. In most instances it will not be necessary to modify the radio in any way. The timer is triggered by applying a finger to two touch contacts, and an ordinary push-button switch can be fitted instead of the touch contacts if preferred. There is also a bypass switch on the timer unit which allows the radio to be used normally.

CIRCUIT DETAILS

The circuit for the timer is given in Fig. 1. Basically, it employs a CMOS monostable device, IC1, to operate the radio via a VMOS switching transistor. IC1 is a CMOS 4047, and is employed in the positive edge triggered monostable mode.

Pin 8 is the trigger input and is normally held low by resistor R4. If the two touch contacts are bridged by a finger the skin resistance between the contacts will be sufficiently small, when compared with the high value of R4, to take pin 8 positive by at least 70% or more of the supply voltage which constitutes a logic high in CMOS circuitry, IC1 is then triggered.

The 4047 has both Q (pin 10) and not-Q (pin 11) outputs, the former being normally in the low state and going high during the timing period. The not-Q output is the inverse of this. It is the Q output which is used here, and it directly drives the gate of the switching transistor, TR1. VMOS transistors are enhancement mode devices and TR1 is therefore cut off when its gate is low, and is biased hard into conduction when the gate is taken high. Before the 4047 is triggered TR1 is cut off and passes only a minute leakage

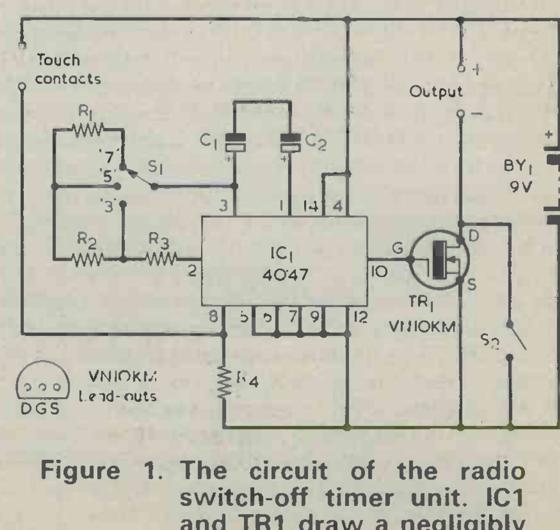


Figure 1. The circuit of the radio switch-off timer unit. IC1 and TR1 draw a negligibly low current in the standby condition.

current. During the timing period it allows virtually the full 9 volts from battery BY1 to be applied to the radio connected to the output terminals. There is a voltage drop across TR1, of course, but it has a typical "on" resistance of only about 4R and the voltage drop will be insignificant when the circuit is used with any conventional 9 volt radio. Closing S2 bypasses TR1 and allows the radio to be used normally.

The length of the timing period, during which the Q output IC1 is high, is governed by a resistance connected between pins 2 and 3, and a capacitance connected between pins 1 and 3. The nominal duration of the timing period is 2.48 RC seconds, where R is in megohms and C is in microfarads. In this circuit the capacitance is given by C1 and C2 in series. The 4047 is not suitable for use with a plarised timing capacitance, but in the present application the very long timing periods require an electrolytic component. The well-known technique of using two electrolytic capacitors connected in series with opposing polarity has therefore been employed, and in practice this gives reliable results provided the capacitors are good quality types (which, in any case, they would have to be in any RC timer circuit incorporating a high timing resistance). It will be in order to use capacitors with a higher working voltage than 16 volts if these are more readily available.

With S1 in the "3" minute position the timing resistance is given by R3. In the "5" minute position the timing resistance is R3 plus R2, and in the "7" minutes position R3, R4 and R1 are all in series to provide the timing resistance.

It should be noted that the actual timing periods will almost certainly be longer than the nominal values ascribed to them. First, the calculated periods are a few seconds longer than the nominal periods. Second, electrolytic capacitors have values which, on average, are greater than those marked on them. This is simply because tolerances on value of electrolytic capacitors are typically −10% to+50%. The third reason for extended periods is that a small leakage current will flow in the electrolytic capacitors. The cumulative effect of all these factions is that, for instance, the timing period given with S1 at "7" may be 8 minutes or more. This effect is not of any real significance in a non-critical application such as the present one.

No on-off switch is required as the unit has a negligible current drain of only about 1 microamp under standby conditions, and this will not seriously affect battery life even if a small battery is used. Most of the standby current consumption is leakage current in TR1, and IC1 has virtually no current consumption in

COMPONENTS

Resistors
(All .25 watt)
R1 1MR 5%
R2 1MR 5%
R3 1.5MR 10%
R4 10MR 10%

Capacitors
C1 100 microfarad electrolytic, 16V. Wkg.
C2 100 microfarad electrolytic, 16V. Wkg.

Semiconductors
IC1 4047
TR1 VN10KM

Switches
S1 4-pole 3-way rotary (only 1 pole used)
S2 s.p.s.t. miniature toggle

Miscellaneous
Case
Veroboard, 0.1in. matrix
9 volt battery
Battery connector (see text)
Control knob
Nuts, bolts, wire etc.

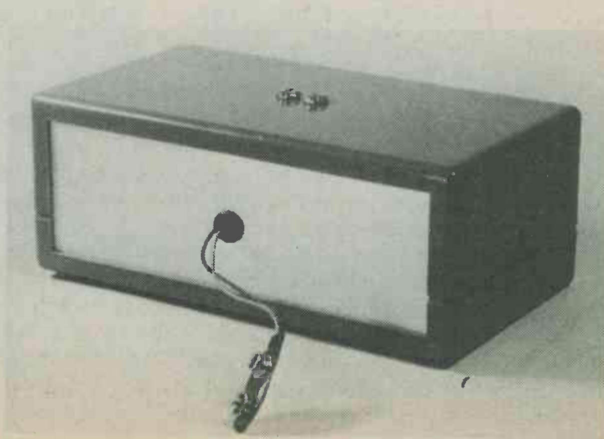
the standby mode. Even when IC1 is triggered it still only draws a current of about 10 to 20 microamps, whilst TR1 requires no significant gate current since it is a voltage rather than a current operated device and has an input impedance of thousands of megohms. Thus, the addition of the timer should not result in any noticeable reduction in battery life. Note that even the tiny current in TR1 will be eradicated if the radio is turned off at its own on-off switch.

CONSTRUCTION

The size of the case required for the unit will depend on the battery to be employed. The author's unit is housed in a Verocase type 202 21041C, which has dimensions of 153 by 84 by 59mm, and this is large enough to accommodate a PP3 or PP6 battery. (The old Vero part number for this case was 75-1238-D).

The two touch contacts are fitted at the top panel of the case and, when these are used instead of a push-button, it is necessary to have a case with a top panel made of insulating material. The contacts consist of

The output leads pass through the rear panel of the case and are terminated in a connector (or connectors) suitable for the particular radio used.



two M4 panel-head screws with solder tags under their nuts inside the case to faciliate connection to them. The two screws should be mounted with very little space between them.

S1 and S2 are mounted on the front panel. A hole is required in the rear panel for the output lead and, if the panel is metal, this hole should have a grommet fitted to it.

Most of the components are assembled on a piece of 0.1in. Veroboard having 16 copper strips by 18 holes. Details of this board and all the other wiring of the timer are given in Fig.2. After the board has been cut out, the two mounting holes should be drilled and the seven breaks made in the copper strips. The board is then wired up as shown. IC1 should be the last component to be soldered in place, and the soldering iron must have a reliably earthed bit. R1 and R2 are mounted on S1 and not on the board. Check the positioning of the inside and corresponding outer tags with an ohmmeter before soldering to S1, as relative positioning of the tags with some switches may differ from that shown in Fig.2.

The two battery clips in Fig.2. are shown as PP3 types. The output clip may appear to be connected with incorrect polarity, but this is because it mates up with the correct polarity clip in the radio. If the receiver has PP9 style clips, and if a battery with PP9 type terminals is fitted in the timer unit, individual clips at the ends of flexible wires will need to be fitted instead of the 2-way clips shown. The two output clips will again be of apparent opposite polarity. Take care to ensure that the supply to the radio is correct polarity, as damage could result if a supply of incorrect polarity is applied.

The component panel is mounted by means of two 6BA bolts and nuts at any convenient place on the bottom panel of the case, leaving sufficient room for the battery. Spacing washers on the 6BA bolts keep the board underside clear of the inside surface of the case.

If it is desired to have a push-button instead of the touch contacts this is wired up in place of the contacts. The push-button should be of the press-to-make type. A "cancel" switch can also be added, and this may consist of a press-to-make push-button wired up in series with a 1kR resistor, as shown in Fig.3. Pressing this push-button will bring a timing period to an end.

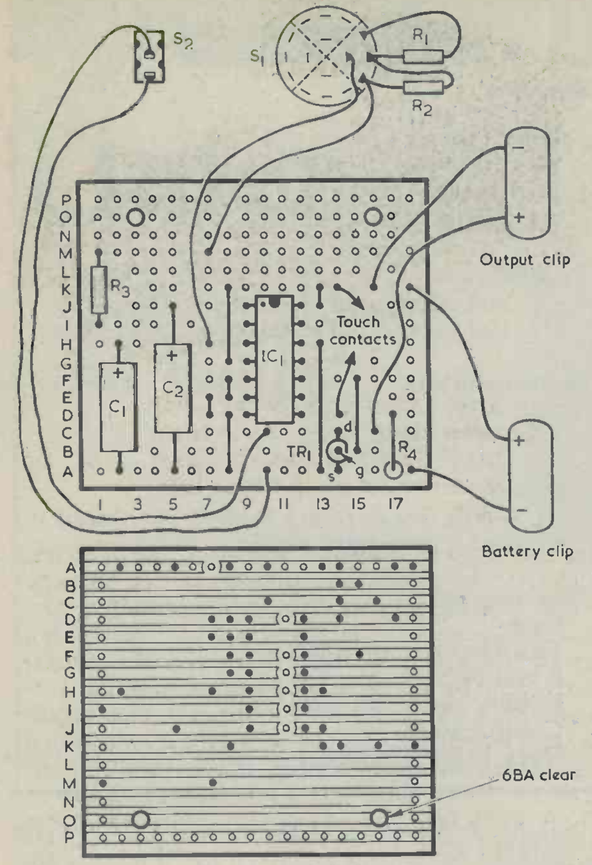
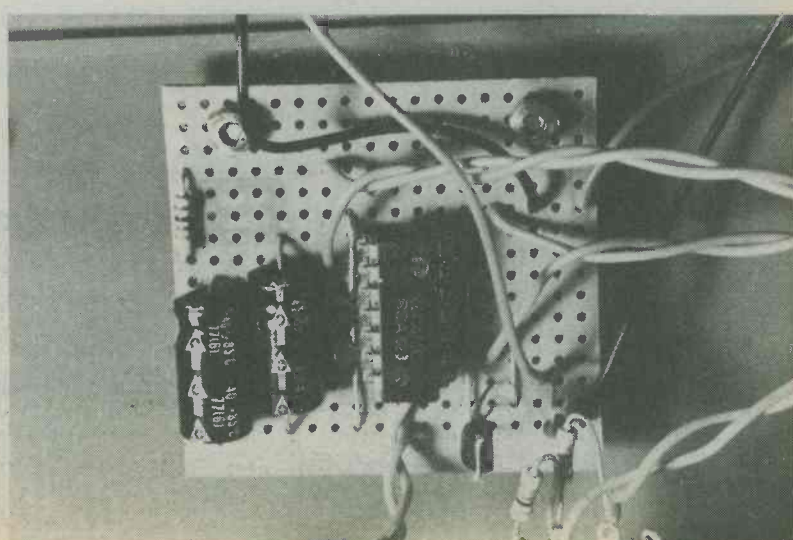


Figure 2. The component and copper sides of the Veroboard panel, on which most of the components are assembled. The output clip connects to the battery clip of the radio, hence its apparent reversed polarity.



The Veroboard module. This carries all the small components except R1 and R2.

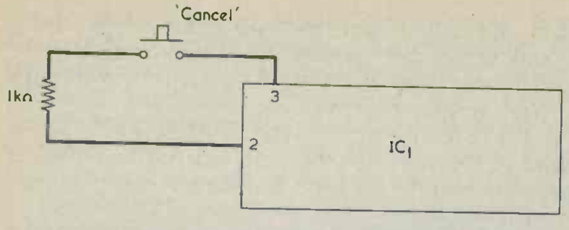
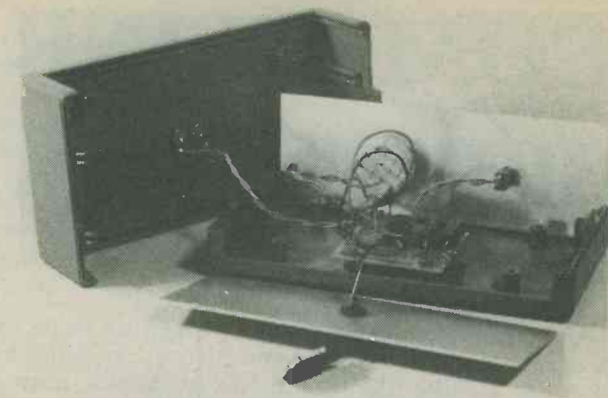


Figure 3. If desired, a "cancel" push-button can be connected to the circuit, as shown here. When pressed, this brings timing period rapidly to a close.



The prototype timer unit with the case disassembled. The Veroboard panel is mounted on the case bottom.

CONNECTING TO THE RADIO

With most radios there will be no difficulty in taking the output lead of the timer into the radio battery compartment, and it will merely be necessary to leave the battery compartment cover slightly open to provide an opening for the lead. If preferred, a small notch can be cut in the battery compartment cover to allow the lead to pass through with the cover fully closed. If there is any risk of the timer output and radio battery clips touching any metalwork or connections inside the receiver they should be covered with insulating tape. PP9 type connectors should be covered with insulating tape in any case, because of the possibility of their short-circuiting each other.

When completed, the timer unit is ready for testing. It is possible that IC1 will trigger when the battery is first connected but, after that, control will be exerted by the touch contacts only. The lengths of the timing periods for the three positions of S1 can then be checked, bearing in mind that these can differ from the nominal periods. If, as is desirable, C1 and C2 are good quality new components, the first few timing periods could be significantly different from the subsequent ones. This is merely because electrolytic capacitors which have been in stock for a long period require a short-time with voltage applied for the electrolytic to "form", and it is not a fault condition.

The VN10KM specified for TR1 is available from several retail sources, including Maplin Electronic Supplies. ■

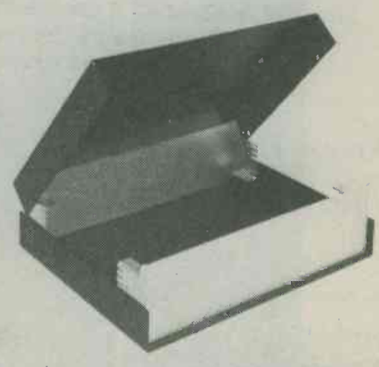
New all aluminium instrument cases

Recently introduced by ZAERIX Electronics Ltd, a new series of 70mm high, all aluminium instrument cases is available in 10 sizes ranging from 150 x 150mm to 300 x 200mm deep.

Comprising a unique 4 piece construction, the top and bottom covers of these ECOBOXES can be independently removed from the 1.5mm thick front and rear panels, which incorporate pre-punched holes and deformable teeth, thereby providing integral supports for pcb's and chassis etc.

Eminently suitable for both development and OEM applications, the front and rear panels of these inexpensive cases are professionally finished in natural coloured anodised aluminium, with the covers in aesthetically contrasting matt black.

Enquiries to Zerix Electronics Ltd., 46, Westbourne Grove, London.



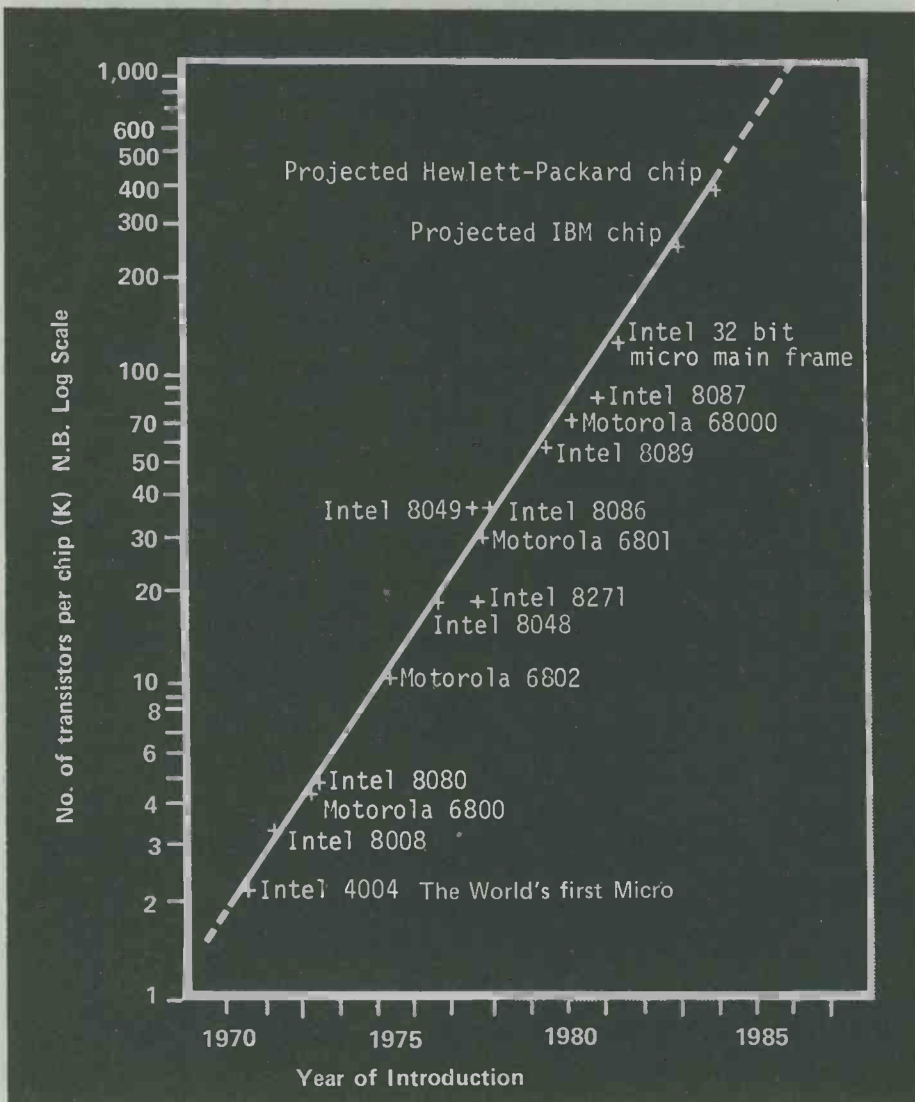
NEW ALL ALUMINIUM INSTRUMENT CASES

COMPULINK SERIES – No. 1:

Compu-link is a new series in which we hope to provide sufficient practical and theoretical information, to enable the reader to construct microprocessor based projects which "really do something!"

Introduction

Advances made in integrated circuit design during the mid seventies has meant that instead of only being able to incorporate several hundreds of active devices on a single integrated circuit die (the chip) manufac-



turers were able to build devices using tens of thousands of active devices. This technology which became known as Large Scale Integration, meant that products previously constructed from numerous Small Scale Integration parts (such as many of the standard 74xx series logic parts) could now be produced on a single custom Integrated Circuit.

This ability to shrink the size of an application from a bench-full of devices to one single integrated curcuit, meant that many products which would have previously been impossible to manufacture due to the high cost of assembly or even the sheer bulk of the electronics, were now quite feasible.

The new technology was quickly put to work producing high volume consumer applications such as digital clocks/watches and simple personal calculators. However the initial cost of development was extremely high and could only be successfully amortised if the final application was to be of tremendous volume. Moreover, the resulting integrated circuit was so specific that it could only be used in that one particular application, therefore it was very susceptible to being overtaken by a new and better device from a competitor.

What was needed was a truly universal "logic" element which could be produced in high volume and then characterised or programmed for the customer's final application, thus the idea of a micro-processor was born.

The first micro-processor was produced by Intel Ltd as the basis of a scientific calculator they had been asked to design. Two design solutions were pursued, one based on the production of yet another custom integrated circuit and the other based on the production of a universal programmable controller or micro-processor, the processor solution was finally adopted and the first commercial use of micro-processors had begun.

At the time the full implications of this new device had not been fully realised and Intel were quickly overwhelmed by people wanting to use micro-processors as the basis of a new product. This tremendous commercial pressure ensured the rapid development of new and better offerings by all semiconductor 'Giants', and has accounted for the phenomenal rate at which advances have been made in the availability and application of micro-processors.

It is interesting to note that the intended applications of these new devices were not as personal computers, but rather as intelligent control elements in consumer equipment. It was probably the American computer hobbyists who first used micro-processors as personal computers, and opened the way to a whole new previously unimagined industry.

Motorola semiconductors now feel that by the end of this decade each household in America will contain some ten micro-processors in applications as diverse as washing machines, energy management and conservation. (e.g. intelligent central heating controllers and personal computers/diaries).

Already the availability of serious business/scientific computers for under £5,000 coupled with the availability of personal computers such as the Sinclair ZX81 for around £50 means that many of today's engineers and enthusiasts are already learning and developing the new technology of "personal computing".

In future issues of *R & EC* we hope to provide an 'in depth' review of the background to the development of the micro-processor coupled with an original and instructive course on the elements of programming and small computer system construction, but most importantly of all, we intend to develop a number of control applications for you to construct and use.

These applications will hopefully include such things as intelligent burglar alarms, lighting and heating controllers, waveform generators, test equipment, morse and TTY decoders and perhaps, most excitingly of all, control of complete radio/audio systems. The technology now exists to enable the enthusiast to build a fully synthesised radio offering features such as preset stations, search scanning for activity, timed recording of programme material and many other facilities that a micro-processor based unit can provide.

As we intend to devote ourselves to developing the control side of micro-processors, we will be describing a custom control unit based on a well known processor chip, and offering 8-16 programmable outputs and a similar number of programmable inputs. This unit will then be used as the basis of the constructional features. Sufficient information will be given to enable readers to programme the units themselves or if they prefer, to buy already programmed units from *R & E.C.* ■

Universal 12v 5W amplifier

Most people will have come up against the problem of trying to obtain spare parts for imported consumer electrical equipment. The most frequent and troublesome part for many radios, cassette recorders, tape players, and other radio equipment is the audio output integrated circuit. A good example is the Hitachi HA1366 IC which is very widely used in many types of car radio, cassette player and CB radio, but is officially designated obsolete by the manufacturer. Whilst it would suit Hitachi very well if persons requiring spares threw the equipment away and bought a new set, this does seem a rather drastic solution when there is a cheaper alternative.

This project describes such an alternative, in the shape of a micro-sized universal audio amplifier replacement based on the TDA2002 IC, which is available from many manufacturers and widely used in European car radio and audio equipment. The rather high quiescent current consumption makes this device unsuitable for battery equipment, but as a replacement for the many obscure types of audio IC which seem to fail with monotonous regularity in Japanese and Far Eastern in-car entertainment, it is an excellent solution. The integrated circuit itself, is not a pin for pin replacement for any of the fragile Japanese devices it replaces, and so it must be fitted as a complete entity with its own peripheral circuitry.

However, from the illustrations and diagrams you will see that the complete unit requires only a minimal amount of space, and is therefore readily accommodated in most types of equipment. Some care needs to be taken with regards to the earthing as far as ground potential considerations are concerned, and with the almost universal application of the negative earth for vehicles, this is not a severe problem.

As a further point in its favour, TDA2002 is a great deal less likely to fail in use than the devices it will be replacing, and so should be a once and for all substitution.

FIRST THINGS FIRST . . .

The first thing you need to do is establish that there is in fact room in your piece of equipment for the board described herein. Bearing in mind, that you may remove the existing audio IC and all components directly connected thereto to make room, and so this should not present much of a problem. The main thing is to locate the audio input and this is easily traced by following the wiper on the volume control to the audio output IC. (Fig.1). The output should present little trouble either, since this can be traced back from the loudspeaker leads. This just leaves the positive supply, which can be located either using a multi-meter or simple visual inspection.

If you actually possess the handbook for the equipment concerned, it is very likely that a circuit diagram and parts list will enable easy identification of these features without having to resort to trial and error.

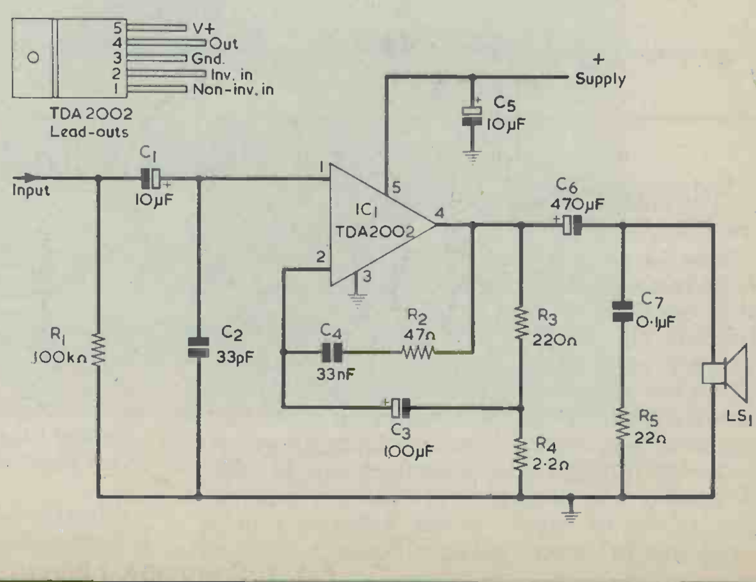
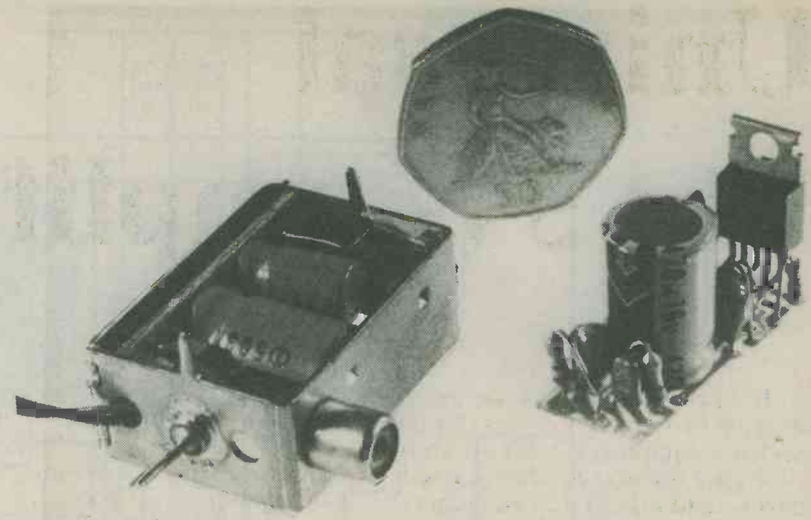


Fig. 1. Circuit of the Universal Audio Amplifier.

Photo of Universal Amplifier PCB, and when mounted in screening can.



CIRCUIT DESCRIPTION

Fig. 2. demonstrates the basic circuit of the universal audio amplifier. This is a straightforward application of the TDA2002, with a few precautions to prevent low frequency instability (C2 at the input, and C7/R5 at the output). The major point to consider is the decoupling of the positive supply, since the board space available in this application only permits a 10 microfarad device for C5, on the assumption that the existing application will already be complete with at least a few hundred microfarads to decouple the heavy audio current peaks drawn from the positive supply for the existing audio output IC. If the application has inadequate decoupling, it will be apparent very quickly as audio peaks cause the whole circuit to become unstable and start to oscillate (motorboating). The input and output are capacitively coupled, and once again these components may well be available on the existing board.

The amplifier will provide 3-5 watts RMS output for a typical car supply, which will be adequate for the vast majority of applications. The actual voltage gain of the device is determined by the external feedback components R3, and R4 – and if a more detailed analysis of the device characteristics is required, you should ask for a copy of the manufacturer's data sheet when ordering.

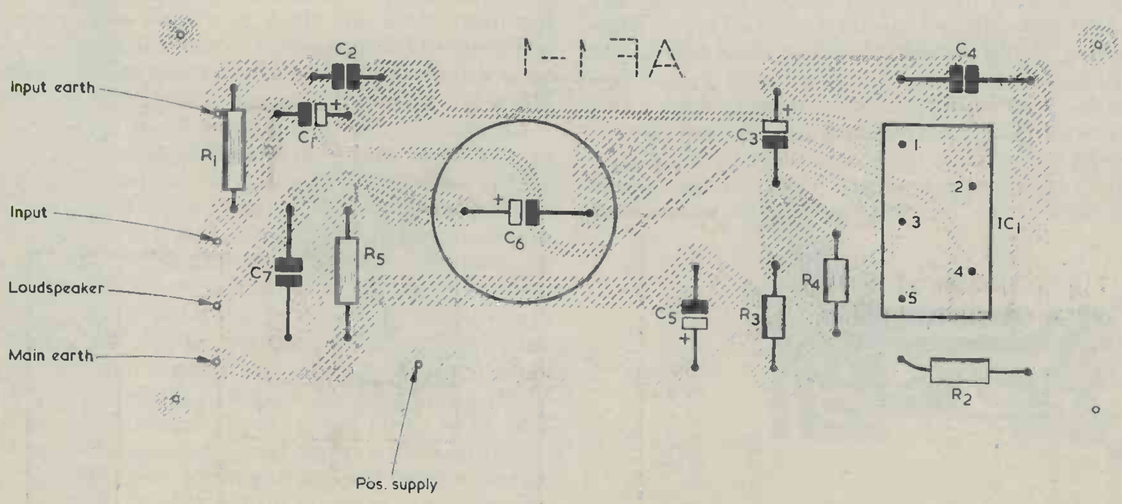


Fig. 2. Component layout.

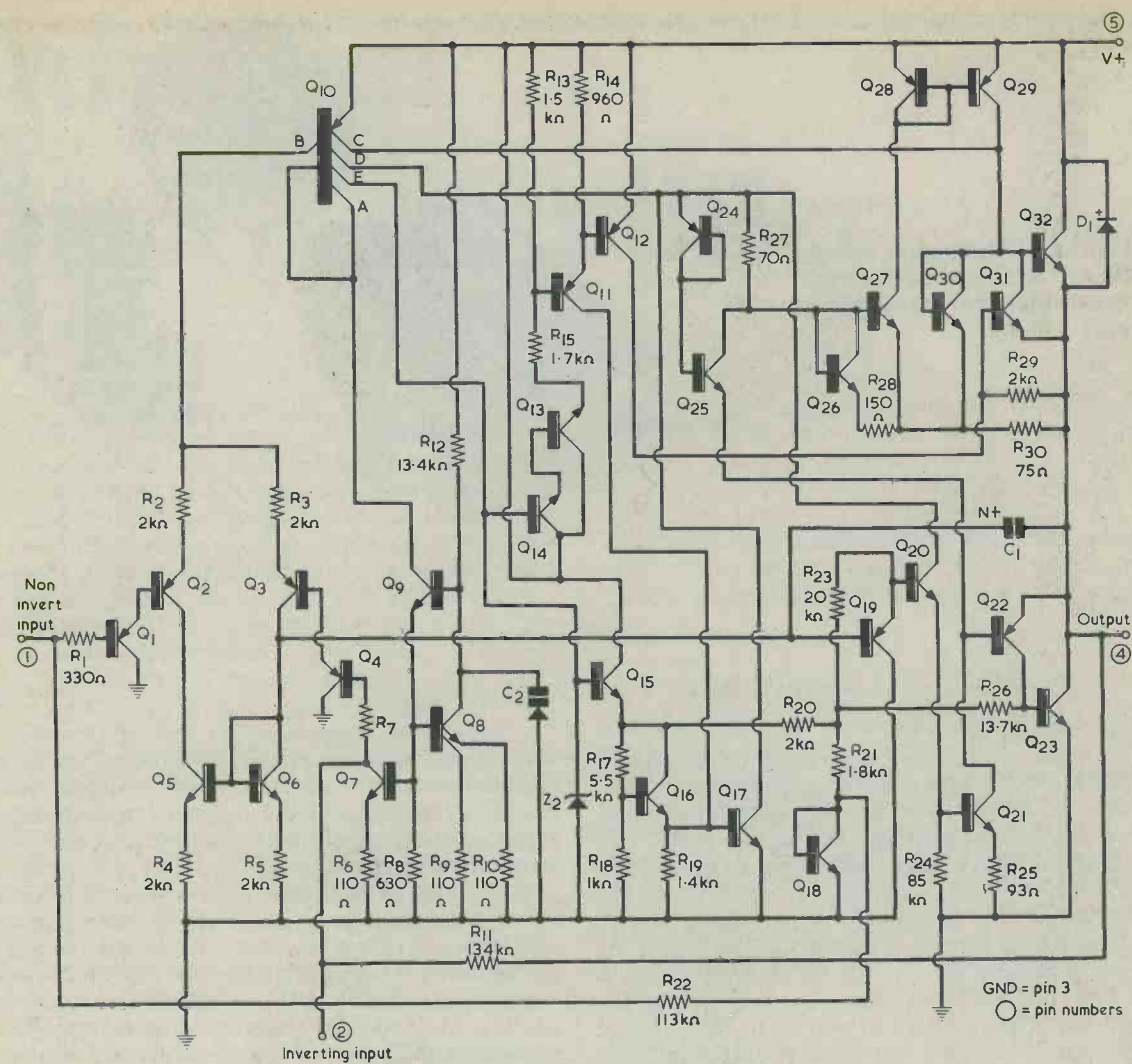


Fig. 3. TDA 2002 internal circuit diagram.

CONSTRUCTION

Construction of this project hinges around a very tightly laid out printed circuit board. This is illustrated in Fig. 3 and is available pre-etched and drilled from Ambit International for those who do not possess the nerve or skills necessary to make such a fine piece of work. The illustration is four times full-size, as opposed to the more usual same-size or twice-size, since the very compact nature of the circuit would make details of the layout (Fig.4) quite indecipherable. There is nothing particularly awkward about construction, provided care is taken to avoid soldering more than one track at a time and most of the difficulty in this project, will come in actually picking your way through the maze of wires inside the defunct piece of equipment you are attempting to repair.

Of course, this unit may be built for stand-alone operation as an audio amplifier from a 12v source, and is sufficiently compact to be built into a loudspeaker enclosure. Bearing in mind the nature of the power supply requirements, this device would make an excellent PA speaker amplifier, and fits easily inside the housing of most weatherproof horn speakers available today. A major point to consider is the very high input impedance, which will make long input leads susceptible to the pick up of RF and 50 cycles hum along the length of the input connection. The TDA 2002 has a simple heatsink requirement, requiring only a single fixing hole and this can either be taken from the existing audio amplifier, or drilled in convenient position on the case of the equipment. If the power requirement is relatively low, an internal heatsink, such as a piece of aluminium bracket, may be fitted. ■

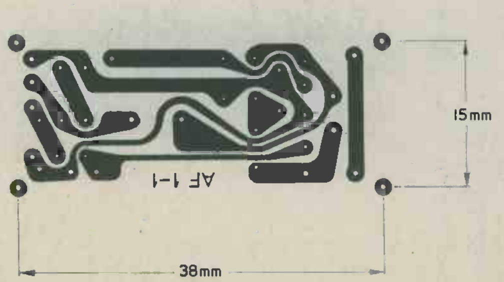
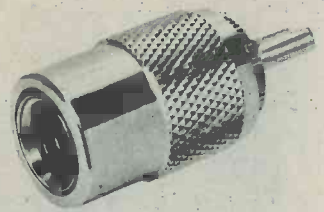


Fig. 4. PCB layout. Scale 4:1.

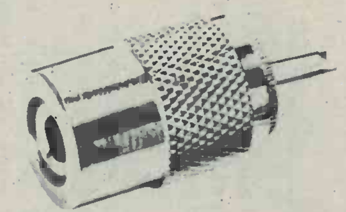
ELECTRONICS DATA

71

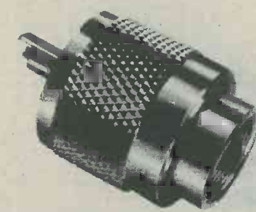
NC-551 (PL-259) CABLE CONNECTOR
Bakelite insulation
Net weight: 22gr.



NC-551/2 (PL-259/6) CABLE CONNECTOR
With Built-in Adaptor
Bakelite insulation
Net weight: 23gr.



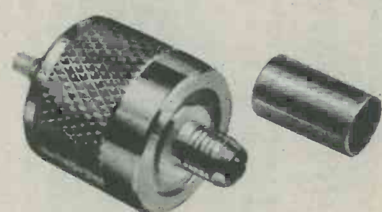
NC-573 SOLDERLESS CABLE CONNECTOR
For RG-8/U cable
Noryl insulation
Net weight: 15gr.



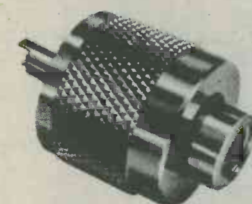
NC-555 (UG-175/U) ADAPTOR
For RG-58/U Cable
Net weight: 10gr.

NC-556 (UG-176/U) ADAPTOR
For RG-59/U Cable
Net weight: 9gr.

NC-572/C CRIMP TYPE CABLE CONNECTOR
For RG-58/U cable
Noryl insulation
Net weight: 16gr.



NC-572 SOLDERLESS CABLE CONNECTOR
For RG-58/U cable
Noryl insulation
Net weight: 15gr.



Know your RF connectors (1)

The popular PL-259 series of RF connectors comes in a variety of guises, and the unwary frequently fall into the trap of thinking that a 'PL-259' is a totally standard designation identifying a single part. The above illustrations show the prime variations on the theme of the connector - with the NC-572 and the NC-551/NC-555 representing the most popular types in the UK.

The NC572 is one of the simpler types to use, since the bared coax is simply screwed into the plug, with the inner soldered into the centre connector. Provided to correct diameter cable is used, this type of fixing is perfectly secure - and in many cases a good deal better than an imperfectly made NC-551 with adapter.

LCD digital stopwatch/clock

J. L. Mills

LCD clock modules are fairly commonplace these days, although surprisingly few people appreciate the actual scope of the range available to the designer/constructor. One of these devices is available from PC1 and is designated the CM174/5L, and apart from simple time-keeping functions, various alarms and a stopwatch facility are also available. The external components required are fairly minimal, being those required for setting the time and functions, plus the external peripheral drivers for the sleep and alarm control functions.

Once again, the versatility of "doing it yourself" allows a very large number of different approaches to be adopted when constructing this project, although the text relates to the "all up" version covering every conceivable feature that the module has to offer.

CHIEF DESCRIPTION

The diagram indicates the complete circuit of the digital stopwatch clock with the CM174 module. The actual timing device involved with the integrated circuit more closely resembles a microprocessor than a clock, it still manages to operate from a single 1.5 volt battery for a period of several years. The quiescent current drain is only 15 microamps, which means that a single AA cell will probably keep the entire system running for three to four years. A separate power source will be required for the external functions such as a loud alarm tone and a relay for switching external loads, and this can either be a separate battery, or derived from the equipments own power supply.

The setting of the various functions and the selection of certain functions is achieved using momentary type switches for positions S1,2,3,6,7,8,9. Multiple switching is required for S4,5,10 and 11 where optional features are to be selected.

It is worth noting that the supply to the clock module is primarily a positive earth function, and thus is not easily obtained by simply tapping some power off an external circuit using a negative earth. In view of the low current consumption, it is invariably better to keep the supply for the clock module entirely independent of any other power considerations concerned with this application.

The audible alarm is derived from the output on the clock module and this is amplified by TR2 to drive a piezo electric sounder with a multiplier inductor. The purpose of the inductor L1 is to provide very large voltage spikes which will greatly increase the volume from the high impedance transducer.

TR1 provides the relay switching function for the automatic sleep timer (for example, a delayed switch

The CM17415 LCD clock module.

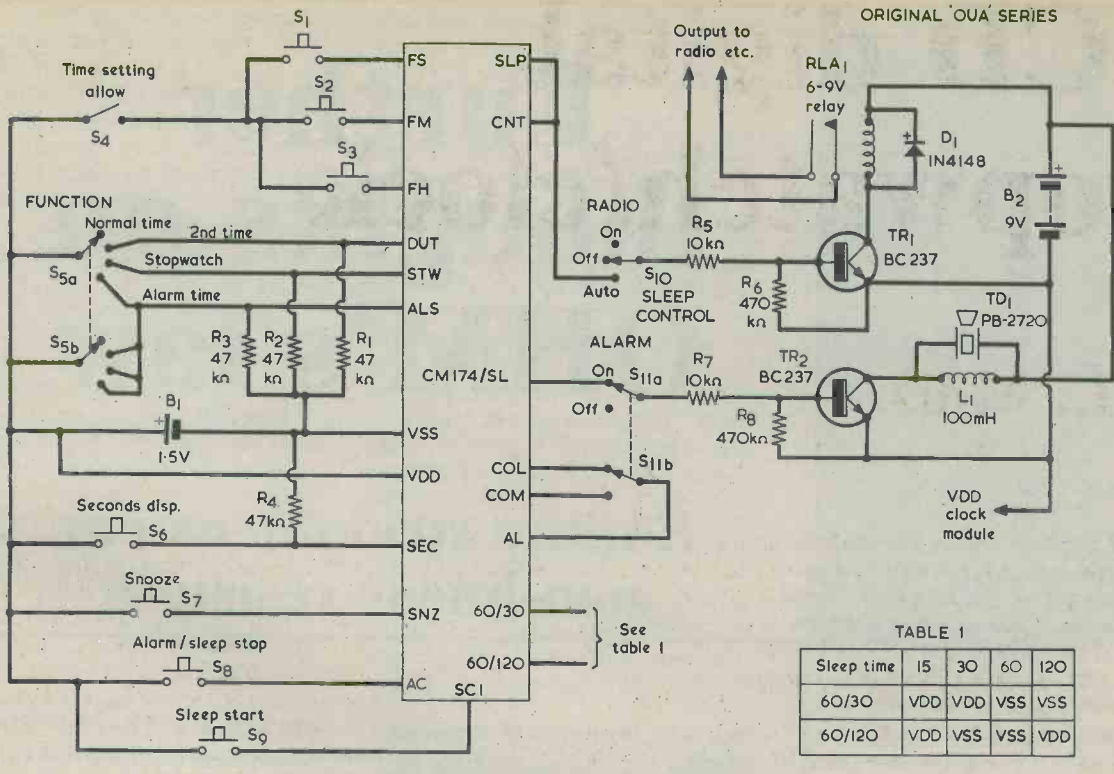


TABLE 1

Sleep time	15	30	60	120
60/30	VDD	VDD	VSS	VSS
60/120	VDD	VSS	VSS	VDD

Circuit of the Digital Stop Watch/Clock.

or function for a bedside radio). The relay can be virtually any type of relay that can be driven from a DC237 and line volt supply. A prototype used an original series OUA or OUB relay, selected according to the number of poles required to be switched.

Various functions are offered by the CM174/5L and are best described by reference to the appropriate pin function.

FS During normal time operation this pin enables the clock to be set accurately to a time signal. Depressing FS on the time 'pip' will reset the seconds to '00'.

FM In normal mode is used for setting minutes, each push advancing the clock one minute. In stopwatch mode this pin resets the stopwatch to 00.0.

FH In normal mode this is used for setting hours. In stopwatch mode FH is used as a start/stop button.

DUT A second time zone is displayed when DUT and ALS are taken to +1.5v. Time setting is carried out as before using FH and FM.

STW Taking STW and ALS to +1.5v. puts the module into its stopwatch function and it displays 00 mins 0 secs.

ALS As can be seen ALS is used with STW, or DUT. Taken to +1.5v on its own however, it displays an alarm time. This is a 24 hour type, settable for any one alarm time within a 24 hour period. Again, setting is achieved by FH and FM.

It should be noted that the dual time, stopwatch and alarm cannot be used together. For example, if a dual time is set, selecting alarm or stopwatch will destroy the DUT setting.

SEC Selecting SEC simply changes the hours/mins display to read min/secs thereby providing the equivalent of a 6 digit clock.

SNZ This snooze function should be familiar to most digital alarm clock users – when the alarm sounds depressing SNZ will reset the alarm for another 4 mins, when the alarm will again sound.

ACS This function immediately cancels the alarm, control and sleep functions.

SCI This function starts the sleep/control timer. The time period selected is determined by the wiring of 6/3 and 6/12 terminals – see Table 1.

Whilst the basic clock operation should now be clear the operation of TR1 and TR2 circuits may not.

The switch S10 has three functions. In 'auto' position RLA1 will be activated when the SLP/CNT output goes high.

This will be achieved only when S9 (sleep start) is pushed, after which SLP/CNT will be 'on' for the time period set by 6/3, 6/2, see Table 1.

After this time period has elapsed SLP/CNT will go low, thereby switching off an external circuit connected to RLA1. If for example a radio is connected to RLA1 it can be switched on for any length of time by placing S10 in 'radio on' position, thus acting as an 'off/on' switch for the radio.

S11 Alarm 'on/off' simply activates TD1 via TR2 to provide an audible alarm when ALM output provides a 2kHz output. S11b activates a symbol when the alarm is 'on'. When 'off' the symbol is connected to the BP drive of the LCD (COM) thereby disabling it.

Construction of the project is left up to the individual, since many people may not wish to use all the functions shown. To ease mounting, a bezel is also available, enabling the module to be affixed to a panel without any visible fixings. ■

In your work-shop

Further thoughts on OHM's law

Smithy straightens out non-linear resistors

Smithy looked across at Dick's bench for the third time in as many minutes. Dick was unusually quiet and inactive and it was this strange calm which attracted Smithy's attention.

The morning had passed uneventfully with a satisfying number of repairs to show for their labours so far, but now as it was approaching teabreak time, Dick's thoughts were clearly very far from the television set on the bench in front of him. Any particularly tricky problem usually brought on a flurry of mutterings and frantic activity at Dick's bench, so Smithy found the silence somewhat unnerving.

Another minute passed and then Smithy moved over to Dick's bench, flicking the switch down for the electric kettle as he passed. But even this familiar noise which heralded their tea-break did not break Dick's reverie. Smithy's curiosity was too much.

"Penny for your thoughts Dick," he said.

Dick blinked, glanced down at the set in front of him, sighed and said "Oh I don't know Smithy, it seems you just can't rely on anything."

After their years together Smithy had seen most of Dick's moods, but he wondered if this remark was directed at the fickleness of life in general, or the non-functioning T.V. set in particular.

So he asked cautiously "What's the problem, anything I can help with?"

"Oh, it's Ohms Law," said Dick dispiritedly and after a pause, "they keep changing it."

Smithy was bewildered. Now it was his turn also to stand silently for a moment staring into the middle distance.

"How do you mean, they keep changing it?" he queried. "Is this something you are doing at evening classes?"

Dick nodded. "Yes." he said. "Last week we did some problems on Ohms Law and it was all straightforward stuff really. You know the sort of thing, resistors in series and parallel and I thought it was all a doddle. Old Johnson who takes us for circuit theory was saying that all this Ohms Law stuff was 'linear' and I even understood that."

Dick paused and frowned as he struggled with the unfamiliar theoretical concepts.

"You see" he continued "in maths we've been doing linear functions. How one thing changes the same as another, or at least not the same, but in proportion to another. You know, Smithy, X is proportional to Y and all that stuff. Well it didn't seem to mean much at the time, but when we did Ohms Law it sort of 'clicked' and there it was, volts and amps related to each other linearly, or as Old Johnson puts it, 'directly related' to each other. I was feeling quite chuffed at that, I thought I'd managed to tie it all together. And then this week they went and changed it all."

Clearly Dick was troubled and Smithy knew that this would take some time to sort out. So he settled himself on the stool alongside Dick's bench and probed a little deeper into the source of Dick's troubles.

"What was Old John . . ." Smithy corrected himself, ". . . . Mr. Johnson's lecture about this week then?" he asked.

"Same sort of thing really," explained Dick, "but to do with non-linear resistors, you know – thermistors and things like that. I can't say I understood it all like I did the last lecture though. It was all graphical solutions and old Johnson said that we probably wouldn't get it in the exam anyway. But I was thinking about it when I found the problem on this set, or at least I thought I had found the fault."

"What was it?" asked Smithy glancing down at the set, and then, noticing the absence of a 'repaired' tag added "Or what is it?"

"It was the thermistor" said

Dick, "it had gone open-circuit. Straightforward enough, but it's still not working."

Smithy looked at the blackened thermistor lying on the bench alongside the television and then glanced over the old and dusty chassis.

"So what's wrong with Ohms Law?" he asked.

"Well, is it linear or non-linear," demanded Dick.

Smithy looked up from the chassis, paused and then said "Let's get a pencil and paper and see if we can sort this out."

A few moments later he had sketched out the familiar battery and resistor circuit which Dick had been working on the previous week at his recently started evening classes. (Fig.1).

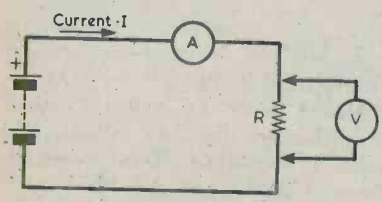


Fig. 1. Smithy's first sketch $I=\frac{V}{R}$, or Current is proportional to voltage and inversely proportional to resistance.

"I don't suppose we need go back to the usual explanations involving water tanks and water flow in pipes and all that," said Smithy, "where you compare the voltage in a circuit to water pressure and the current in the circuit to the rate of flow of water in a pipe, because it could get very confusing when you start to deal with non-linear circuits."

"Blimey," muttered Dick, "non-linear plumbing, it doesn't bear thinking about, whatever it is."

Smithy ignored Dick's interruption and pointed to the circuit he had drawn.

"This is the simplest circuit I can think of," he said. "It's got a battery and a resistor."

"And two meters," added Dick.

"Yes, but we are going to ignore the effect of the meters and say that for our purposes the ammeter is a short circuit and the voltmeter is an open circuit."

Dick blinked. "But they won't work if they're open circuit or short circuit," he protested.

Smithy scowled. "Look," he said "if we are to get anywhere with this explanation then we are going to assume that the ammeter is just like a piece of wire and that the voltmeter is not touching the circuit at all."

"I'll go along with that," said Dick affably, "but it already seems like one of old Johnson's tricks."

Smithy ignored Dick's scepticism and continued with his explanation.

"The current flowing in the resistor is due to the voltage in the battery." Smithy paused, but there was no protest from Dick.

"And," Smithy continued, "this current is limited by the resistance of the resistor."

"Amps, volts and ohms," muttered Dick.

"Right," said Smithy "and these amps volts and ohms, as you put it, are all in the same circuit. So if we know the battery volts and we know the value of the resistor then we can say what the current will be before we connect up."

"Good thing," chuckled Dick "when the meters are open-circuit and short-circuit."

"OK, OK," snorted Smithy "so you don't need the meters. But that's the point, with Ohms Law you can calculate one of the circuit conditions if you know the other two."

"Current equals Volts divided by Resistance," he intoned as he jotted down the familiar expression:

$$I = \frac{V}{R}$$

Dick brightened. "This I understand," he said. "If the voltage is doubled, the current doubles, but if the resistance is doubled the current is halved."

"Correct," said Smithy. "And if the resistance is fixed then the relationship between the voltage and current is linear."

"Yes I know what you mean," said Dick and added suspiciously "but why did you say 'if' the resistance is fixed. I mean, the resistance alters the current too, doesn't it."

"Certainly," said Smithy, "but the resistance may not be fixed. That's to say it may not be an independent element in the calculation. Look at this graph."

Smithy sketched the axes of a graph and with a flourish added a nearly perfect straight diagonal line). (Fig.2).

"There we are," he said "Current plotted against volts." Then, as he added some numbers to the axes he explained, "For every voltage value along the horizontal line there is a corresponding current value on the vertical line, and each pair of voltage and current values has a single and unique point on the graph."

"And if you join the points up they form a straight line."

"Right," said Smithy "and if you had a different resistor value you'd get a different straight line."

Dick pointed to the second line which Smithy had just drawn. "How do you know which is which? he asked.

"Because the higher the resistance the lower the current and so the slope of the line is less."

"So this ***lower*** line is for ***higher*** resistance."

"Yes," said Smithy "and there's a separate line for each value of resistance."

"But what if you use a variable resistor?" demanded Dick.

"That's the point," said Smithy. "The graph will move from the points on a line for one value of resistance to the points on another line for another value."

Dick brightened. "And bang goes your straight line."

"Exactly, because the resistance is varying."

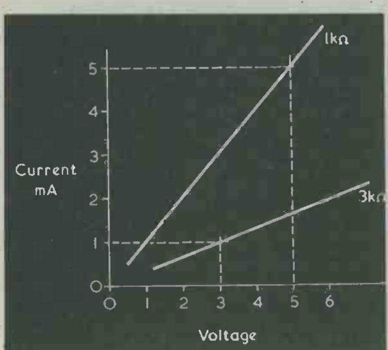


Fig.2. Smithy shows the straight line or 'linear' relationship between voltage and current for fixed values of resistance.

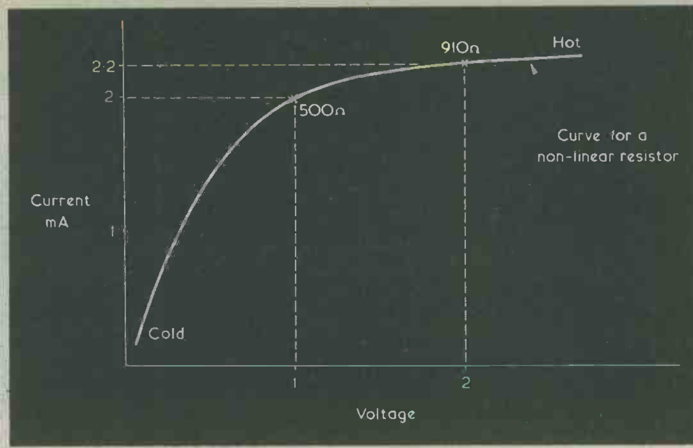


Fig. 3. Positive Temperature Coefficient. Although the resistance is different at each point of the graph, the volts, amps and ohms still obey Ohm's Law.

POSITIVE TEMPERATURE COEFFICIENT

Smithy sketched another pair of axes and with a deft flourish drew a line which rose and then flattened out. (Fig.3).

"Just a minute," protested Dick, "Old Johnson never said anything about variable resistors, only these non-linear resistors."

"Right," said Smithy, "so what happens if the resistor changes its value while you are increasing the voltage or current in the circuit?"

Dick looked puzzled. "How would it do that?"

"It might get hot," explained Smithy, and added "in which case the resistance could go higher or lower."

"That'll muck things up," muttered Dick, looking glumly at Smithy's second sketch, and thinking about Ohms Law.

"Not always. It can be very useful to a designer," said Smithy.

"Look at what's happening here." He pointed to the start of the graph line.

"As the voltage increases, the current increases. But if you increase the voltage across the resistor," said Smithy moving his finger up along the graph line to where it levelled out, "it gets hot and its resistance increases so that the current isn't as high as you might have thought at first. It's called Positive Temperature Coefficient because its resistance increases with temperature."

Dick was silent for a moment as he thought about the meaning of the phrase 'Positive Temperature Coefficient' then he brightened suddenly. "Oh I see, so in the end it won't let as much current through. It varies its own resistance, well I'm blowed!"

"And blowed it well might be," Smithy chuckled at Dick's choice of words. "If you applied all the voltage at once, the resistor wouldn't have time to warm up and with the resistance still very low the high current could cause excessive heating at a small spot in the resistor and damage that one small spot."

Dick frowned suddenly. "I've never heard of it happening," he said, thinking of all the resistors in sets which had passed through the workshop.

"That's because the effect is very small in the usual resistors we have in circuits," explained Smithy. "In fact they are designed to have a stable value of resistance over their normal temperature range."

"So what's the problem?" asked Dick. "Why worry about it at all if the effect is small?"

"Because some resistances, such as the heaters in valves or television tubes are meant to run hot, so there is a great deal of difference between their cold resistance and their hot resistance."

Dick pointed to the tip of Smithy's third sketch. "But surely they're meant to be hot. I mean, they're meant to be heaters aren't they?".

"Yes," agreed Smithy, "but the heater is a long thin resistance which is like a chain of small resistors in series. Now if you apply the full working voltage straight away, when the heater is cold, the high current might just vaporise one small part of the heater."

"The weakest link in the chain!" interjected Dick. "It burns out before the others have got hot and done their job. They don't stop the current, and it sorts out the weakest part and blows it to smithereens!"

Smithy winced at Dick's phrasing. "Not quite how I'd put it," he said "but that's right."

But Dick wasn't to be put down by Smithy's careful approach to this idea. "What you need is a thermal cut-out," he said, and added "no not that – something to let the current build up slowly."

Smithy looked across the workshop. "Just so," he mused. Then he scowled, slid from the stool, stepped across to the still silent kettle and stabbed a finger at the automatic thermal trip. "I don't know why we went in for this newfangled thing," he said glaring at the stone cold kettle. He returned to Dick's bench and settled himself on the stool. "More trouble than it's worth," he grumbled, forgetting his displeasure of times past at the steam filled workshop when his able assistant's enthusiasm for some knotty problem or other had distracted him from the simple task of tea-making.

"Quite a good protection gadget, I thought," said Dick brightly.

"Which is what we need here," Smithy pointed to the neck of the tube in the set on Dick's bench, "if we're not to have heaters blowing every time we switch on the T.V."

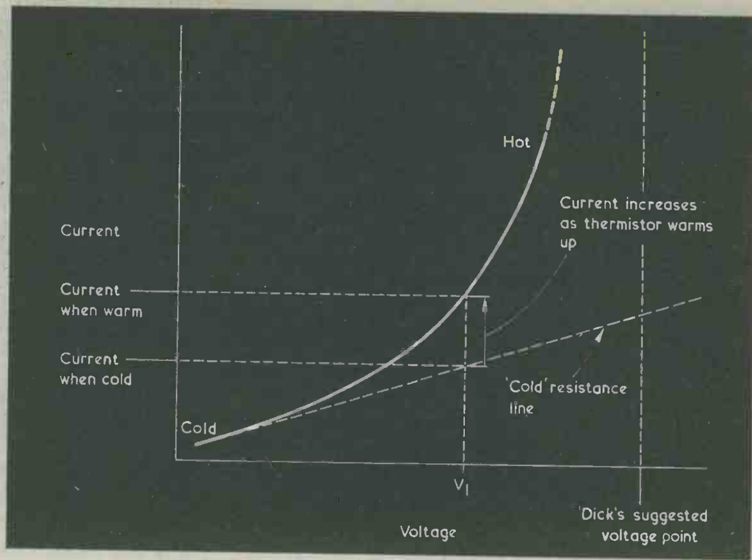


Fig. 4. Graph showing how the current through a Negative Temperature Coefficient thermistor increases as it heats up.

NEGATIVE TEMPERATURE COEFFICIENT

Smithy drew another pair of axes and this time added a line which swept upwards. (Fig.4).

"That looks familiar," said Dick. "Where have I seen that before?"

"I know what you're thinking of," said Smithy, "but first let's consider it to be a resistor whose resistance falls as it gets hot."

"Falls!" exclaimed Dick. "That's unusual isn't it?"

"Yes," agreed Smithy "but it can be very useful". Smithy added a dotted line on the graph. "This shows the resistance of the device when its cold. At voltage V1," Smithy marked a point on the horizontal axis and drew a line vertically up across the dotted line and on to the curving line, "the current is low," he finished. His pencil point rested on the intersection of his new vertical line with the dotted line. "But as the device warms up the resistance falls and the current increases until we reach a final stable condition."

Dick studied the situation on the graph for a moment and said, "But what happens if we put a high voltage on it? Say just here." And he indicated a point over to the right of Smithys point V1. The current will keep rising until . . . ." he trailed off, his finger tracing a path up past the top of the graph. "There's nothing to stop it!" he protested.

"In practice there's always something to limit the current," Smithy added quickly, "look here." He drew another circuit, this time with two resistors each with its own voltmeter. (Fig.5).

"More magic meters," muttered Dick.

Smithy ignored Dick's cynic-

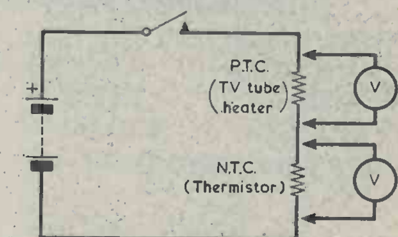


Fig. 5. When first switched on the heater and thermistor are cold. The heater is therefore low resistance, but the thermistor is high resistance and prevents any damaging current surge.

ism and wrote 'PTC' alongside one resistor and 'NTC' alongside the other. "Two resistances," he said. "One a tube heater, which has a positive temperature coefficient and the other a thermistor which has a negative temperature coefficient. When we apply a working voltage to this set-up both devices are cold and so the NTC thermistor is high resistance while the tube heaters are low resistance."

"And so could be damaged by any sudden voltage," interrupted Dick.

"Exactly, but the current is limited by the NTC thermistor because most of the voltage is dropped across its high resistance. Now the thermistor will heat up, its resistance falls, and . . ."

"The voltage is transferred to the tube heater." finished Dick.

"Well, yes," Smithy agreed hesitating at Dick's graphic explanation. "I'd rather put it that the circuit conditions change so that the proportion of the voltage dropped across the heater increases while that dropped across the thermistor decreases."

"And so the heater comes on very slowly," emphasised Dick. "And doesn't blow up."

"Yes," agreed Smithy, "and all the time during this process the voltage current and resistance values for both the heater and the thermistor obey Ohms Law."

There was silence for a moment as each perused his own line of thought.

Dick spoke next. "Where have I seen that graph before?" he asked as he pointed to Smithy's third sketch with its upward curving line.

"You're probably thinking of the semiconductor diode law," explained Smithy. "That's a non-linear law, but in that case the effective resistance of the device varies with the applied voltage so the effect is instantaneous rather than the slow thermal effects of heaters and thermistors. But that's a topic for another time."

Silence settled again and Smithy returned to his own bench.

"So Ohms Law itself is always linear," mused Dick, and added, "except in special cases where thermal effects can change things."

"Thermal effects always change things," stressed Smithy, "even in a good conductor like a piece of wire."

Dick looked puzzled. "Oh, come off it," he protested, "not enough to make any difference."

"Not necessarily," said Smithy as he settled himself firmly on his own stool at his own bench. "What happens if you pass too much current through a piece of wire?"

"It gets hot, but so what?"

"What if you increase the current further?"

"The resistance will increase?"

"Yes but if you take it beyond that?" persisted Smithy.

"The wire will burn out, and the current will stop."

"Just so," muttered Smithy as he bent over the set on his bench. "The wire goes open-circuit and the current stops."

"So Ohms Law is still satisfied," said Dick puzzled. "But so what?"

"The current definitely stops." The Serviceman fell silent.

His puzzled assistant turned back to the T.V. chassis on his bench.

There was silence for a full minute as Dick's gaze roamed the valves and other components on the dusty and very dead old chassis. And then Dick spotted it. "Well I'm . . . . ."

We will protect our gentle reader's mind from the expletives used by Dick as he glared at the blackened and blown fuse set alongside the power supply components.

Smithy bent lower over his work and tried not to grin too broadly.

Dick turned to Smithy. "The fuse is blown. After all that it's just the blooming fuse. I might have known what you were driving at, it's just clicked!"

Smithy straightened and turned to face Dick, now grinning broadly. He pointed to the kettle which had long gone off the boil. "You're wrong," he said, "it clicked about five minutes ago."

"Nice one Smithy," and Dick set about making the long delayed tea. ■

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BOSS Industrial Mouldings Ltd, 2 Herne Hill Road, London, have launched their new range of LED Filament and Neon 'Winged Bimdicators' which, where appropriate also house an integral ballast resistor.

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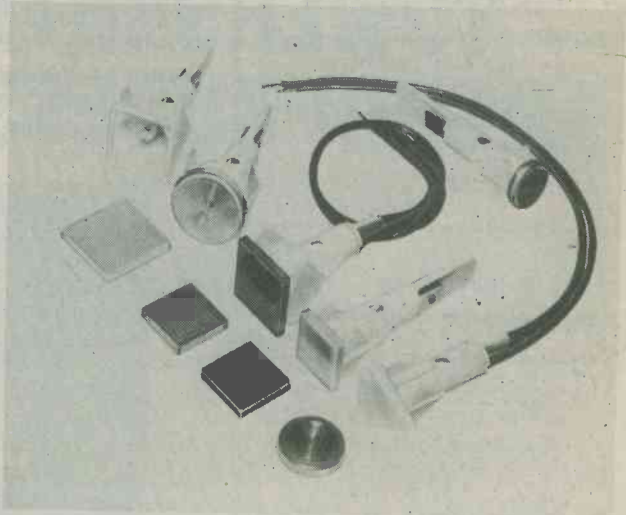

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Also recently launched is the MPUroBreadBoard, a new Eurocard size breadboard laid out specifically for microprocessor designs, which interlocks with all existing BOSS BIMBOARD components. Incorporating a special central microprocessor section, flanked on both sides by peripheral chip areas, this new MPUroBreadBoard has single or double bus strips on all sides, plus 5 turret terminals for incoming power lines. Ideal for beginners and professionals alike, all rows and columns are numbered and lettered for exact contact location, this being imperative for educational use where step-by-step build up instructions are used.

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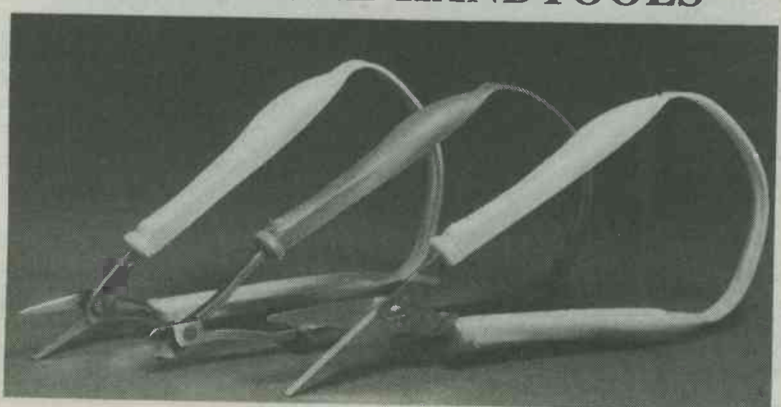

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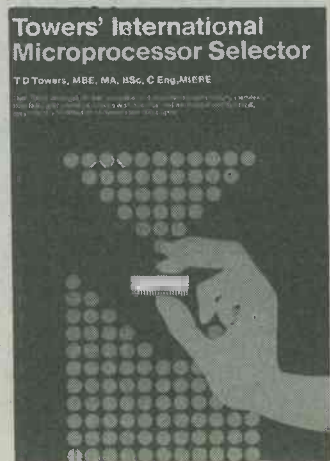

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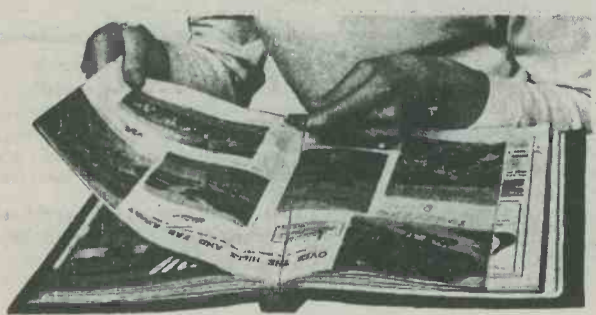

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7473	0.28
7474	0.28
7475	0.35
7476	0.30
7480	0.26
7481	0.20
7482	0.75
7483	0.60
7485	0.75
7486	0.24
7489	1.05
7490	0.30
7491	0.55
7492	0.35
7493	0.35
7494	0.70
7495	0.60
7496	0.45
7497	1.40
74100	1.10
74104	0.62
74105	0.62
74107	0.26
74109	0.35
74110	0.54
74111	0.68
74112	1.70
74166	1.98
74118	0.85
74119	1.20
74120	0.95
74121	0.35
74122	0.34
74123	0.40

74125	0.40
74126	0.40
74128	0.65
74132	0.50
74136	0.65
74141	0.45
74142	1.85
74143	2.50
74144	2.50
74145	0.75
74147	1.50
74148	1.09
74150	0.79
74151	0.55
74153	0.55
74154	0.55
74155	0.55
74156	0.55
74157	0.55
74159	1.90
74160	0.55
74161	0.55
74162	0.55
74163	0.55
74164	0.55
74165	0.55
74166	0.70
74167	1.25
74170	1.25
74173	1.10
74174	0.75
74175	0.75
74176	0.75
74177	0.75
74178	0.90
74179	1.35
74180	0.75
74181	1.22
74182	0.70
74184	1.20
74185	1.20
74188	3.00

74190	0.55
74191	0.55
74192	0.55
74193	0.55
74194	0.55
74195	0.55
74196	0.55
74197	0.55
74198	0.85
74199	1.00
74221	1.00
74246	1.50
74247	1.51
74248	1.89
74249	1.89
74251	1.05
74265	0.66
74273	2.67
74278	2.49
74279	0.89
74283	1.30
74284	3.50
47285	3.50
74290	1.00
74293	1.05
74297	2.36
74298	1.85
74365	0.85
74366	0.85
74367	0.85
74368	0.85
74390	1.85
74393	1.85
74490	1.85

'LPSN'

7400	0.11
7401	0.11
7402	0.12
7403	0.12
7404	0.13
7405	0.14
7408	0.14
7409	0.14
7410	0.13
7411	0.14
7412	0.15
7413	0.28
7414	0.49
7415	0.14
7420	0.13
7421	0.15
7422	0.15
7426	0.18
7427	0.14
7428	0.35
7430	0.13
7432	0.14
7433	0.16
7437	0.17
7438	0.16
7440	0.13
7442	0.40
7447	0.42
7448	0.65
7449	0.61
7451	0.14
7454	0.15
7455	0.15
7463	1.50
7473	0.21
7474	0.18
7475	0.28
7476	0.22
7478	0.24
7483	0.50
7485	0.70
7486	0.18
7490	0.32
7491	1.25
7492	0.39
7493	0.38
7495	0.48

7496	1.20
74107	0.25
74109	0.25
74112	0.25
74113	0.25
74114	0.25
74122	0.40
74123	0.55
74124	1.80
74125	0.29
74126	0.29
74132	0.45
74133	0.30
74136	0.25
74138	0.40
74139	0.40
74145	1.20
74147	2.10
74148	1.60
74151	0.35
74153	0.35
74154	0.99
74155	0.50
74156	0.50
74157	0.36
74158	0.40
74160	0.40
74161	0.40
74162	0.40
74163	0.40
74164	0.50
74165	1.20
74166	1.75
74168	0.85
74169	0.85
74170	1.85
74173	0.75
74174	0.55
74175	0.55
74181	1.35
74183	2.96
74189	1.28

74190	0.60
74191	0.60
74192	0.68
74193	0.68
74194	0.42
74195	0.42
74196	0.65
74197	0.65
74200	3.45
74202	3.45
74221	0.60
74240	0.99
74241	0.99
74242	1.65
74243	1.65
74244	0.83
74245	1.50
74247	1.35
74248	1.35
74249	1.35
74251	0.46
74253	0.46
74257	0.55
74258	0.39
74259	0.39
74260	0.70
74266	0.24
74273	0.90
74275	3.20
74279	0.35
74280	2.50
74283	0.44
74290	0.58
74293	1.30
74295	1.50
74298	1.50
74365	0.35
74366	0.35
74367	0.35
74368	0.35
74373	0.78
74374	0.78
74375	1.15
74377	1.99
74378	1.40
74379	2.15
74384	2.50
74385	4.20
74386	0.29
74390	0.68
74393	0.61
74395	2.10
74396	1.99
74398	2.75
74399	2.30
74445	1.40
74447	1.95
74490	1.10
74668	1.05
74669	1.05
74670	1.70

74C CMOS

7400	0.20
7402	0.20
7404	0.20
7408	0.20
7410	0.20
7414	0.55
7420	0.20
7430	0.20
7432	0.20
7442	0.80
7448	1.03
7473	0.50
7474	0.50
7476	0.48
7483	0.98
7485	0.98
7486	0.26
7489	2.68
7490	0.80
7493	0.80
7495	0.94
74107	0.48
74151	1.52
74154	2.26
74157	1.52
74160	0.80
74161	0.80
74162	0.80
74163	0.80
74164	0.80
74165	0.84
74173	0.72
74174	0.72
74175	0.72
74192	0.80
74193	0.80
74195	0.80
74200	4.52
74221	1.06
74901	0.38
74902	0.38
74903	0.38
74904	0.38
74905	5.64
74906	0.38
74907	0.38
74908	0.84
74909	1.52
74910	3.62
74914	0.86
74918	0.98
74925	4.32
74926	4.32
74927	4.32

E&OE

Subject to availability

TRANSISTORS

BF194	18p
BF195	18p
BF224	22p
BF241	18p
BF274	18p
BF440	21p
BF441	21p
BF362	49p
BF395	18p
BF479	66p
BF679S	55p
BFR91	1.33
BFW92	60p
BFT95	99p
BFY90	90p
40238	85p
BF256	38p
2SK55	28p
2SK168	35p
J310	69p
J176	65p
40823	65p
40673	3SK51
3SK45	49p
3SK51	54p
3SK60	58p
3SK88	1.24
MEM680	75p
BF961	70p
BC237	8p
BC238	8p
BC239	8p
BC307	8p
BC308	8p
BC309	8p
BC413	10p
BC414	11p
BC415	10p
BC416	11p
BC546	12p
BC556	12p
BC550	12p
BC560	12p
BC639	22p
BC640	22p
2SC1775	18p
2SA872A	14p
2SD666A	30p
2SB646A	30p
2SD668A	40p
2SB648A	40p
2SD760	45p
2SB720	45p
2SC2547	19p
2SA1085	20p
2SB753	2.34
2SB723	2.34
2SK134	3.10
2SJ49	3.10
2SK135	4.25
2SJ50	4.25
2SK227	3.55
2SJ83	3.55

CRYSTALS

32.768kHz	2.70
100kHz	3.85
455kHz	5.00
1.000MHz	2.95
3.2768	2.70
4.000	2.00
4.1934	2.00
4.096	2.00
4.032	2.00
4.433619	2.00
4.800	2.00
5.000	2.00
6.5536	2.00
7.000	2.00
7.68	2.00
8.000	2.00
9.000	2.00
10.000	2.00
10.240	2.00

CRYSTALS

10.245	2.00
10.6985	2.50
10.700	2.00
10.7015	2.50
11.00	2.00
11.115	2.00
11.520	2.00
8.9985	2.00
9.0015	2.00
21.000	2.00
24.000	2.00
25.000	2.00
26.000	2.00
18.000	2.50

XTAL FILTERS

10M4B1; 10.7Mhz, 15Khz BW, 8 pole. 14.50

10M22D; 10.7Mhz, 2.4Khz BW, SSB, 8 pole. 17.20

RADIO CONTROL

RC XTALS
AM TX/RX
FM RX:
3rd ot/30pF HC25U 1.65
FMTX: Fund 20pF HC25U ½ freq 1.85
PAIRS...AM 3.10
PAIRS...FM 3.25
CHANNELLING:
27MHz. 50kHz
35MHz: 20kHz

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