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Practical Wireless

MAY 1981 VOL. 57 NO. 5 ISSUE 890

contents

Please see page 33 for a special announcement regarding the *PW* "Winton" Stereo Tuner

FREE WITH THIS ISSUE
***PW* DATACARD "2m Repeaters"**

THE SHIMIZU SS105S *80-10 metres ssb/cw transceiver*

This super new transceiver covers 80-10 metres, gives 10W out and is smaller than anything else we have seen so far. Ideal for transverter driving, the SS105S has FM transmit and receive options as well as excellent performance on SSB/CW for HF band use. The SS105S is supplied in semi kit form so as to keep down the price, but all the RF and mixer boards are ready built and aligned so no test equipment is required. All the cabinet work has been carried out so all you have to do is assemble the IF strip, xtal oscillator, and fit them to the completed chassis. Great idea and it brings back the flavour of home brew with the added advantage that the rig will work when you've finished it. For more info, just ask us or come along and see it. It's a great little rig.

		NETT.	inc. VAT	CARR.
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*Also available is a marine version of the AR22, the **AR22M,** 156-162 MHz **£89.***

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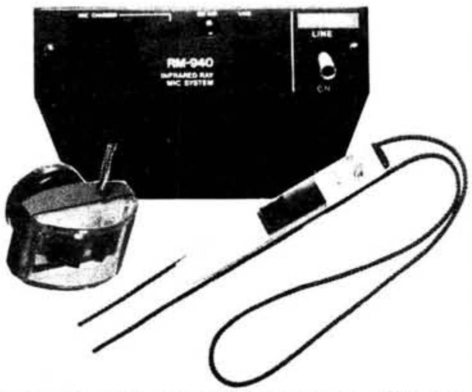

The Daiwa infrared mike system, comprising of a control box, sensor and infrared mike enables you to dispense with the hand mike and cable when operating in your car or shack. By using an infrared beam audio is transmitted from the mike to the sensor and then to the control box which activates the transmitter. To transmit, press the locking switch on the mike and talk. To receive, release the switch and your rig immediately returns to receive. When you have finished your contact return the mike to its slot in the control box and the mike nicad battery is maintained at full charge. For those of you who like fresh air and drive with all windows open there is a matching wind shield available at an additional 75p. So there we are, the latest in technology to bring safety to your mobile operation, the Daiwa infrared mike.

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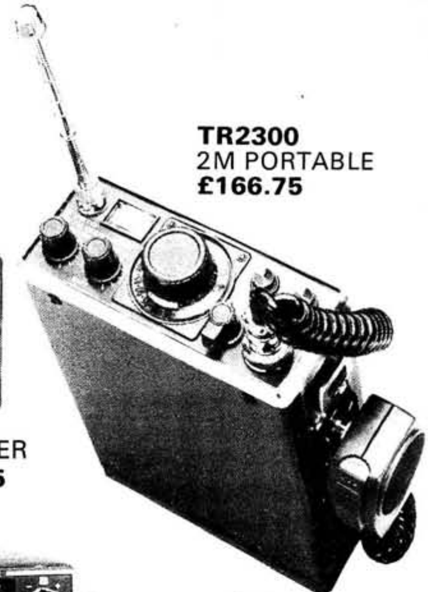

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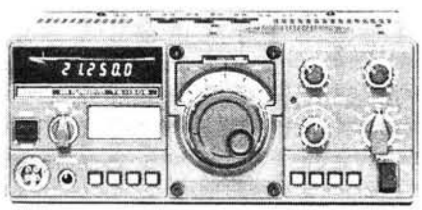

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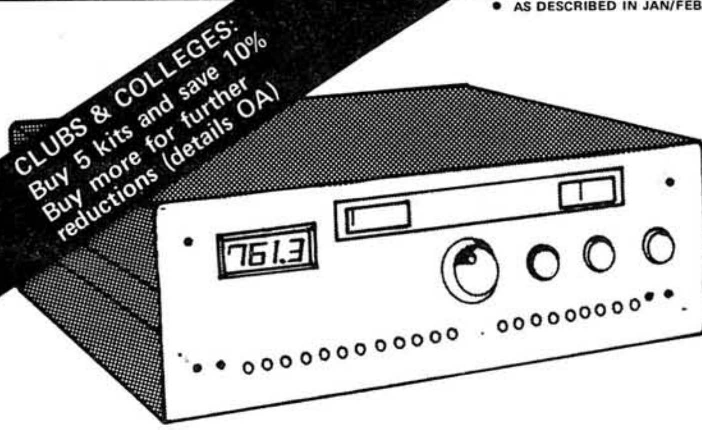

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- ★ DUAL CONVERSION BASED ON A 3-4 MHz SSB IF, WITH MECHANICAL IF FILTER, AUDIO DERIVED AGC, BALANCED MIXER, WITH ON–BOARD AF AMP AND VOLTAGE REGULATOR
- ★ CAPACITY FOR UP TO 12HF/VHF/UHF 1 MHz WIDE CRYSTAL CONTROLLED CONVERTERS WITH TRACKED RF TUNING
- ★ EACH CONVERTER SELF CONTAINED – SO MORE CAN BE USED EXTERNALLY IF REQUIRED. RF PATHS ARE DC SWITCHED AT LOW IMPEDANCE

PRICES

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A/A but with low cost 4kHz CFM2 series filter	..£32.42
HF Converters, including crystal for the following bands: 1-2MHz, 7-8MHz, 10-11MHz, 14-15MHz, 18-19MHz, 21-22MHz 24-25MHz, 28-29MHz, 29-30MHz	..£9.10 ea
Hardware: Case, meters, pots, knobs (exc. DFM)	..£25.00
Complete RX 80, 6 converters, switches, case, PSU	..£132.50

CURRENT OPTIONS INCLUDE

★ LCD DFM with built in IF offset, interface PCB	..£23.75
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★ NBFM adapter inc 8kHz multielement ceramic IF filter	..£9.95
★ Constant Z PIN diode attenuator	..£4.95
★ 12v low RF noise mains PSU	..£7.95

PLANNED ADDITIONS TO THE SYSTEM

- *3-4MHz IF frequency synthesiser*
- *'UP Conversion' front end system*
- *AM IF adapter* ■ *Noise blanker*
- *VHF/UHF converters with helical filters*

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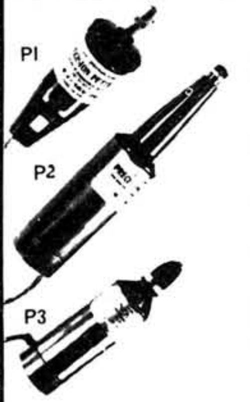

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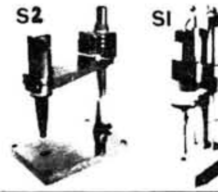

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160R	1k6	16k	160k
180R	1k8	18k	180k
200R	2k	20k	200k
220R	2k2	22k	220k
240R	2k4	24k	240k
270R	2k7	27k	270k
300R	3k	30k	—
330R	3k3	33k	330k
360R	3k6	36k	—
390R	3k9	39k	—
430R	4k3	43k	—
470R	4k7	47k	470k
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An advanced solid state general purpose mono amplifier suitable for Public Address system, Disco, Guitar, Gram, etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp.). Input 1, 15mV into 47k. Input 2, 15mV into 47k (suitable for use with mic. or guitar etc.). Input 3, 200mV into 1 meg. suitable for gram, tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 30 watts music power. Very attractively finished purpose built cabinet made from black vinyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200/240 volts. Size approx. 12¼in wide × 5in high × 7¼in deep.

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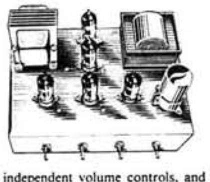

A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple intruction booklet **50p** + SAE (Free with parts). **All parts sold separately.** ONLY **£18·40,** P. & P. £3·20. Also available ready built and tested **£22·50,** P. & P. £3·20.

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SIZE 1¼" × 2.5/16" × ½" ready built. Pre-aligned and tested for 10-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions supplied **£7·00** plus 30p P. & P. Stereo beacon light if required **40p** extra.

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Pye VHF FM Tuner Head covering 88-108MHz 10·7 MHz I.F. output. 7·8V + earth. Supplied pre-aligned, with full circuit diagram with precision geared F.M. gang and 323PF + 323PF A.M. Tuning gang only **£3·40** + P. & P. 60p.

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A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integral pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response: ±3dB 12-30,000 Hz Sensitivity: better than 80mV into 1M Ω: Full power bandwidth: ±3dB 12-15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp.

Overall Size 12"w. × 8"d. × 2¾"h.

Fully detailed 8 page construction manual and parts list free with kit or send 50p plus large S.A.E.

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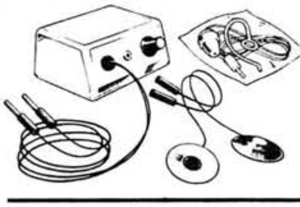

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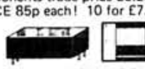

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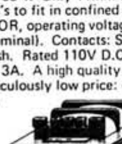

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1	2114	220	10	BC109	80	5	LM380	325	5	7402	45
1	4116	220	5	BCY34	200	5	LM381	500	5	7414	200
10	7805	480	10	BD131	250	50	NE555	900	5	7442	200
10	7812	480	10	BD132	250	5	OC29	350	5	7447	250
10	7815	480	10	BD135	210	10	OC35	800	5	7490	140
10	7818	480	10	BD136	210	5	R2540	550	10	7473	180
10	7824	480	10	BD137	210	3	TBA520	300	10	7474	230
10	7905	450	10	BD138	210	3	TBA530	300	5	7485	380
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10	AC127	160	10	BD140	210	3	TBA550	300	5	7495	250
10	AC128	160	10	BF180	180	3	TBA560	300	10	74107	150
10	AC187	160	10	BF258	180	3	TBA800	150	5	74119	500
10	AC188	160	10	BFY50	140	3	TBA920	315	5	74141	190
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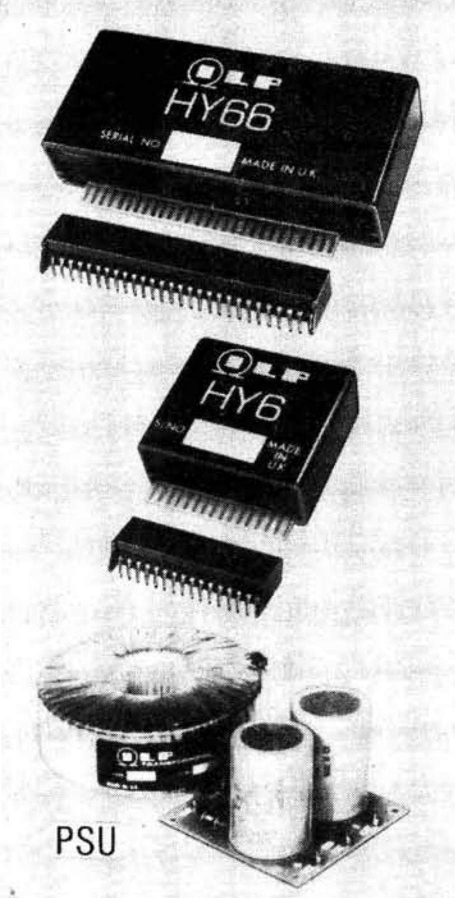

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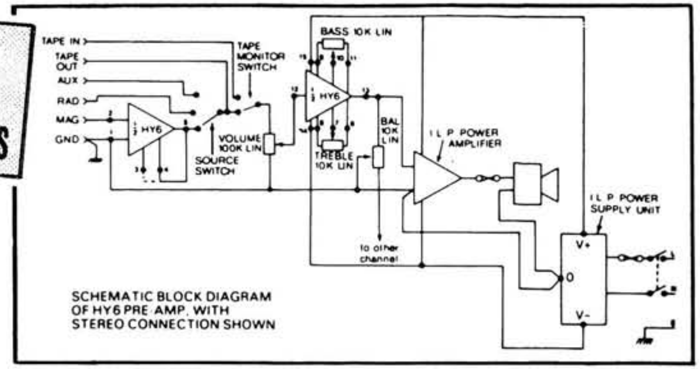

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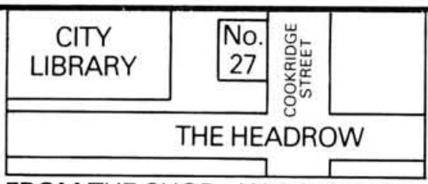

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comment...

It's Coming!

AT LONG LAST we have a Government announcement on the legalisation of CB in the UK, though it doesn't reveal a lot of the things we need to know. There are to be two services, one on the 27MHz band and one around 930MHz, both using frequency modulation. Technical details such as channels, powers, etc., and licensing arrangements have not yet been finalised, and the whole thing will not become legal until the autumn, at the earliest.

The solution chosen by the Government is a technically elegant one. It can provide a limited number of channels on 27MHz, which gives a reasonable range for use in open country, on motorways, etc. The adoption of f.m. brings with it the benefits of "capture effect", and of reduced interference to other services. The CB enthusiasts like to maintain that they do not cause interference to radio, TV and hi-fi, but I know from first-hand experience that this is not so, and they should remember that **any** transmitter can cause interference. On 930MHz, there is the potential for a far greater number of channels, which will be needed to beat congestion in big cities, coupled with limited range, to allow re-use of a channel in other parts of a city.

The use of 27MHz a.m. transceivers will remain illegal, this fact is naturally causing some gnashing of teeth among enthusiasts already illicitly using a.m. sets, and a few importers with warehouses bulging with the things. What may happen about possible modification of these sets to the f.m. mode depends upon the way the new regulations are framed. And what will happen to the existing multi-mode (a.m./f.m.) sets?

If CB is really to help ordinary people in emergencies, in the way its promoters say it will, one essential will be to get away from the use of the American truckers' CB slang so beloved of the present illegal users. It's going to be no good for example, asking the little old lady who's just been mugged: "What's your 20?" Plain language is a must.

* * * * * *

In response to requests from our readers, we have decided to devote the whole of future issues of *Practical Wireless* to radio. We shall cover all aspects and applications of radio of interest to the enthusiast, plus components and techniques used in radio, but we shall not be carrying designs for burglar alarms, ignition systems or household gadgets and the like.

Geoff Arnold

services

QUERIES

While we will always try to assist readers in difficulties with a *Practical Wireless* project, we cannot offer advice on modifications to our designs, nor on commercial radio, TV or electronic equipment. Please address your letters to the **Editor, "Practical Wireless", Westover House, West Quay Road, Poole, Dorset BH15 1JG,** giving a clear description of the problem and enclosing a stamped self-addressed envelope. Only one project per letter please.

Components for our projects are usually available from advertisers. For more difficult items, a source will be suggested in the "Buying Guide" box included in each constructional article.

PROJECT COST

The approximate cost quoted in each constructional article includes the box or case used for the prototype. For some projects the type of case may be critical; if so this will be mentioned in the Buying Guide.

CONSTRUCTION RATING

Each constructional project will in future be given a rating, to guide readers as to its complexity:

Beginner

A project that can be tackled by a beginner who is able to identify components and handle a soldering iron fairly competently. Generally this category will be used for simple projects, but sometimes for more complicated ones of wide appeal. In this case, construction and wiring will be dealt with in some detail.

Intermediate

A project likely to appeal to a wide range of constructors, and requiring only basic test equipment to complete any tests and adjustments. A fair degree of experience in building electronic or radio projects is assumed.

Advanced

A project likely to appeal to an experienced constructor, and often requiring access to workshop facilities and test equipment for construction, testing and alignment. Constructional information will generally be limited to the more critical aspects of the project. Definitely not recommended for a beginner to tackle on his own.

SUBSCRIPTIONS

Subscriptions are available to both home and overseas addresses at £11.80 per annum, from **"Practical Wireless" Subscription Department, Room 2613, King's Reach Tower, Stamford Street, London SE1 9LS.** Airmail rates for overseas subscriptions can be quoted on request.

BACK NUMBERS AND BINDERS

Limited stocks of some recent issues of *PW* are available at 95p each, including post and packing to addresses at home and overseas.

Binders are available (Price £4.30 to UK addresses and overseas, including post and packing) each accommodating one volume of *PW*. Please state the year and volume number for which the binder is required.

Send your orders to **Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF.** All prices include VAT where appropriate.

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The following is the full text of the Home Office announcement, made on 26 February 1981.

CITIZENS BAND RADIO APPROVED ON 27MHz FM AND 930MHz FM. 27MHz AM EQUIPMENT REMAINS ILLEGAL

Britain is to have a legal citizens band radio service. Mr William Whitelaw, the Home Secretary, announced this today in a Parliamentary answer to Mr Patrick Wall MP. It is hoped that the new service will be introduced in the autumn.

The new personal two-way service will be authorised on 27MHz f.m. (frequency modulated), and a further frequency will be made available around 930MHz. Equipment will be required to meet a technical specification, and users will have to buy a licence.

The 27MHz a.m. (amplitude modulated) equipment currently being used in this country is illegal and will remain so.

Commenting on the introduction of the new service, Mr Timothy Raison, MP, Minister of State at the Home Office, said today:

> "We are offering a new service which we hope will provide enjoyment for many people. It will give as good a service as the illegal a.m. equipment—indeed some of this is already obsolete. It should soon cost about the same and should cause fewer problems for others. The interference which illegal CB equipment is causing to TV reception and emergency services is giving rise to concern, and now that the Government has gone so far towards meeting the wishes of supporters of CB, I hope that we can rely on those with illegal equipment to act responsibly and stop using it."

Choosing the Frequency

The Home Secretary said in a written Parliamentary reply on 18 December 1980 that he favoured the introduction of a CB facility on a frequency around 930MHz, but because of public demand for an alternative he undertook to consider the possibility of legalising additionally on a lower frequency. The final decision had to take into account the need to introduce a legalised service with the minimum of delay; the risk of interference to radio, TV and other authorised services both in the United Kindom and in neighbouring countries; the availability of frequencies; and the desirability of adopting an international standard. The frequency selected—27MHz f.m.—should give CB enthusiasts the performance they want at about the same cost as illicit equipment with far less interference to other users. France, the Netherlands and Germany are among those European countries who have legalised on 27MHz f.m. equipment and the Irish Republic has recently announced its intention to do the same. The other frequency proposed—around 930MHz—is going to be adopted in North America and some European countries, and is seen as being capable of giving a good quality service, especially in towns and cities, with the minimum of interference. It offers the prospect of an international market for British manufacturers.

Other alternative frequencies, such as 41MHz and 450MHz, were reviewed but none was free of interference difficulties or met the other requirements.

Existing authorised users of the 27MHz band, for example, hospital paging systems, may be affected by the Government's decision and the implications for them will be taken into account during the planning period.

Existing Equipment

Existing illegal 27MHz a.m. (amplitude modulated) equipment will not be legalised. The volume of interference from CB sets using 27MHz a.m. equipment is increasing—in the last five months alone there were nearly 5000 complaints of interference to radio, TV and hi-fi which were directly traced to the use of illegal 27MHz a.m. sets; this represents an increase of about one-third of all recorded complaints of interference from all sources. Emergency services have also been affected. Although recent a.m. equipment of US origin causes less interference to some services than earlier models, its potential for interference to TV remains high.

Equipment Specification

Specifications for the new f.m. (frequency modulated) equipment will be drafted to ensure that it causes the minimum of interference to other radio users; standards will be set to which manufacturers, importers and assemblers will conform. The equipment will have to be permanently marked so that a purchaser knows the set he is buying meets these standards. Such specifications are vital to ensure that other radio services (police, fire, aviation) are not adversely affected.

Licensing

Users of the new service will have to buy a licence, renewable annually, which will entitle them to use equipment on either frequency. Talks are taking place with the Post Office to see if they can issue licences on behalf of the Home Office. It is too early to say what the cost of a licence will be.

Commencement Date

It is hoped to complete the arrangements for technical specification, equipment marking and licensing, and bring the new service into operation, by the autumn.

NEWS NEWS NEWS

Rallies and Events

Spalding and District Amateur Radio Society are once again holding their "Tulip Time Rally" on Sunday, 3 May 1981, at Spalding Grammar School.

Further details from: *Hon Sec, G. C. L. Parker G4EMK, 29 Saxon Way, Bourne, Lincs.*

The Welsh Amateur Mobile Rally, organised by the Barry College of Further Education Radio Society will be held on Sunday, 10 May, at the Barry Memorial Hall.

Further details from: *Simon Lloyd Hughes GW8NVN, 1 Min Y Mor, Barry, South Glamorgan CF6 8QG.*

Otley Radio and Electronics Society will be holding the Northern Mobile Rally on Sunday, 17 May, at the Victoria Park Hall, Keighley, between 1100hrs and 1630hrs. Wheelchair and blind visitors will be welcome at 1045hrs.

Further details from: *Rally Manager, Mrs P. A. Horne G8KRU, 14 Fieldhead Road, Guiseley, Leeds LS20 8DT.*

East Suffolk Wireless Revival, organised jointly by Ipswich Radio Club and Martlesham Radio Society, will take place on Sunday, 24 May, at the usual venue, the sports ground of the Ipswich Area Civil Service Sports Association, Straight Road, Ipswich (between Bucklesham Road and Felixstowe Road (A45) and adjacent to the Suffolk Show Ground).

Further details from: *Jack Tootill G4IFF, 76 Fircroft Road, Ipswich IP1 6PX. Tel: (0473) 44047.*

Hull and District Amateur Radio Society wil be holding their Mobile Rally 1981 on Sunday, 7 June, at Hull University.

Further details from: *I. B. Carress G8EAH, 124 Dayton Road, Priory Road, Hull, Yorks.*

Video Recording Techniques

With UK sales of video recorders expected to rocket during 1981, both Sony and JVC have produced literature to assist customers in utilising the facilities of their recorders in all aspects of making home video movies.

Sony has produced a 48-page handbook which is amply illustrated and uses simple non-technical language, the handbook—entitled "How to Video"—is currently on sale at *Sony London Showroom, 134 Regent Street, London W1*, price 60p. It is also available by post from the showroom (30p extra).

JVC's publication entitled "Video the Better Way", comprises five volumes, each illustrated with colour and black and white photographs and diagrams. Each volume contains an aspect of video—"Basics", "Production", "Enhancement", "Applications" and "Supplements". Costing around £3.95, "Video the Better Way" is available from JVC dealers and specialist video outlets.

Keep Your Eyes Open

Following a meeting at a hotel in Bournemouth on 6 February, Martin Linda G4GTH, RAYNET controller for SE Dorset, returned to his car to find his mobile rig had been stolen.

The rig comprised a Trio TR2300, serial No. 921187, with reverse repeater and without case or strap, and a homebuilt 25W amplifier, housed in a 300 × 75 × 75mm dark grey case with two switches and l.e.d.s on the right and three fuse holders on the left of the front panel.

If you have any information regarding this equipment, please contact either Bournemouth Police or G4GTH QTHR (Tel: 0202 763899).

CW Course

It is hoped that a new course will shortly be available in the Cheshunt area of Hertfordshire for potential Class A licence holders. The Cheshunt and District Radio Club are currently trying to organise the course at the East Herts. College at Turnford, starting late in April (the beginning of the summer term) for approximately 12 weeks and is intended for absolute beginners in c.w.

If the course is successful, it may be possible to repeat the course in the new college year starting in September.

For further details, please contact: *Jim Sleight G3OJI, QTHR. Tel: Ware (0920) 4316.*

Sale of Surplus Stock

In a joint effort, Home Radio, Harvesons and G.P. Transformers have organised a "bargain sale", at which will be offered resistors, capacitors, potentiometers, speakers, transformers, tools etc., at exceptionally low prices (many items below manufacturing cost).

Home Radio are turning over their first floor to the sale, and it will run from Saturday 25 April until Saturday 2 May, between 9.00am and 5.30pm (Wednesday 1.00pm).

Ample parking space is available at the sale venue at: *269A Haydons Road, London SW19. Tel: 01-543 5659.*

Club News

Saltash and District Amateur Radio Club would like to extend a welcome to prospective new members and visitors.

The Club, G4GXK, has approximately 70 members and meets on the first and third Friday of each month at 1930hrs.

Further details from: *Paul Lamerton, 17 Baber Court, St Diminick, Saltash, Cornwall.*

Introduction to Amateur Radio & SW Listening

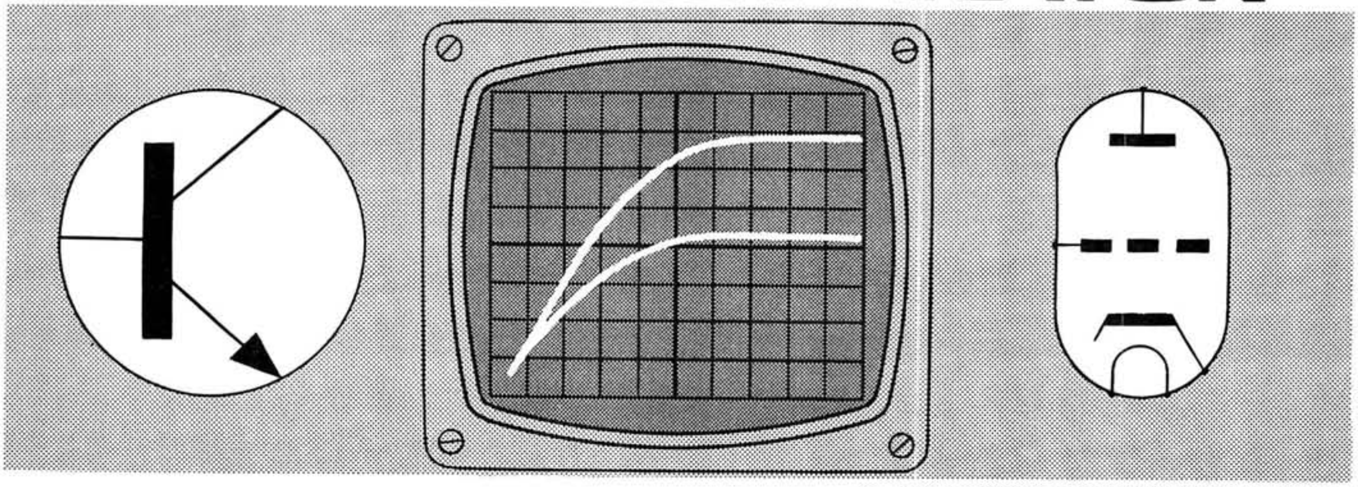
As a result of the success of this short course last year, it has been decided to repeat it at two centres in Nottingham immediately following the current RAE courses.

Commencing on 18 May 1981 at Hucknall College of Further Education and on 20 May at Arnold and Carlton College of Further Education, the course runs for five weeks excluding Spring Bank Holiday week.

The syllabus includes an outline of the RAE, some basic theory, receiver operation for the amateur and commercial bands and practical points concerning construction techniques and aerials. In short, a useful preliminary to the RAE.

Further information can be obtained from: *The Course Tutor, Alan Lake G4DVW, on Nottingham (0602-382509), from Hucknall CFE (0602-637316) or from Arnold and Carlton CFE (0602-876503).*

BI~PHASE COMPARATOR



A.J. BIRKINSHAW G3DMC

Valves and transistors provide the active elements of most electronic equipment. The term "characteristic" is used to identify distinguishing electrical features and values of active devices.

Manufacturers' data sheets normally include a graph of anode or collector current plotted against supply voltage in the form of a characteristic curve. Families of curves, each at a different bias setting, may be used for the determination of performance and the calculation of additional parameters.

Although well designed circuits will tolerate a wide change in characteristics there are extremes that will affect overall performance.

A valve will eventually degenerate with age due to loss of emission, reducing gain, or release of gas occluded in metal electrodes causing hysteresis. Gain does not normally change as a transistor ages; defective transistors can readily be detected because they will have little or no gain and exhibit a shorted or open-circuit condition or have excessive leakage.

Curve Tracing

Characteristic curves may be displayed on an oscilloscope for comparison with published data enabling ageing devices to be identified and compared with younger or unused samples.

Whilst the instruments and techniques to be described in this article are capable of a wider application, their use will be confined to analysis of 6·3 volt heater valves and popular silicon *npn* transistors.

The bi-phase comparator is a measuring instrument for simultaneously comparing the characteristic curves of two electronic valves or semiconductor devices whilst varying the operating conditions of either. A bi-phase source of alternating voltage energises each device alternately and the sweeps of applied voltage versus current are graphically displayed by horizontal and vertical deflection of a cathode ray tube. The rapidly alternating images appear to the eye simultaneously. If one device is operated at a fixed bias whilst the bias on the other is controlled manually the controlled characteristic curve may be adjusted in comparison to the fixed curve.

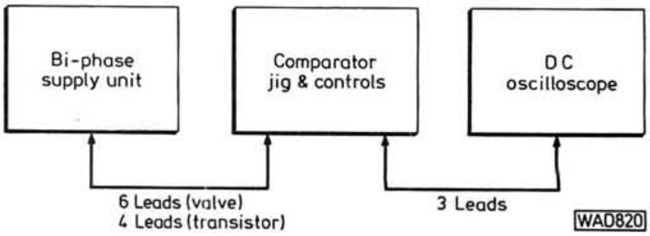
Calibration of each ordinate is pre-set: horizontal voltage deflection against a reference voltage supply and vertical current deflection by the volts per milliampere across a calibrated resistor.

The instrument is used to test devices against published characteristic curves, to check samples against a standard, to check deterioration of used devices, to match two samples for pairing in symmetry circuits or to decide the optimum bias required for a particular application. The characteristic of each device is traced alternately at a rate dependent on the supply frequency.

The display section of the instrument can be separate in the form of a basic oscilloscope having d.c. amplification to both X and Y plates.

The power supply unit can be specially built or adapted from a similar unit having a bi-phase secondary winding on the power transformer.

Fig. 1



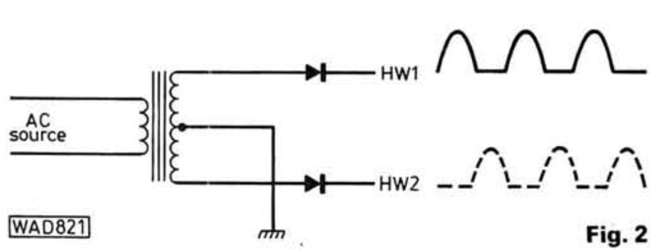


Fig. 2

Fig. 3

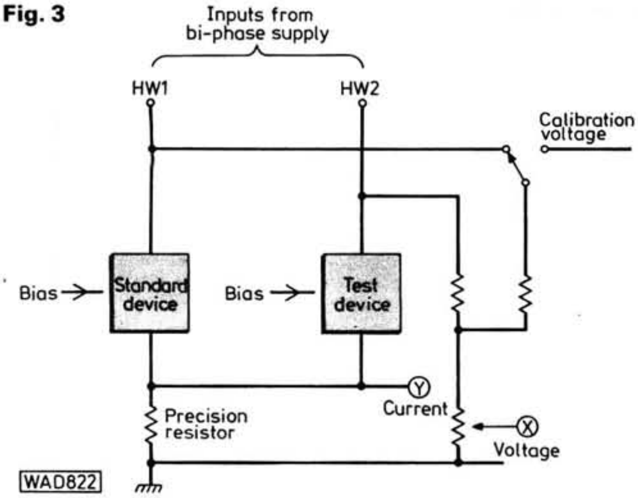


Fig. 4

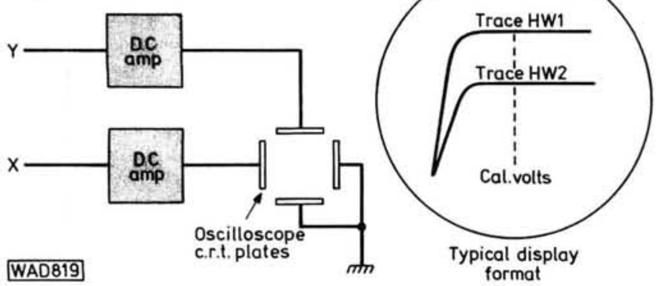
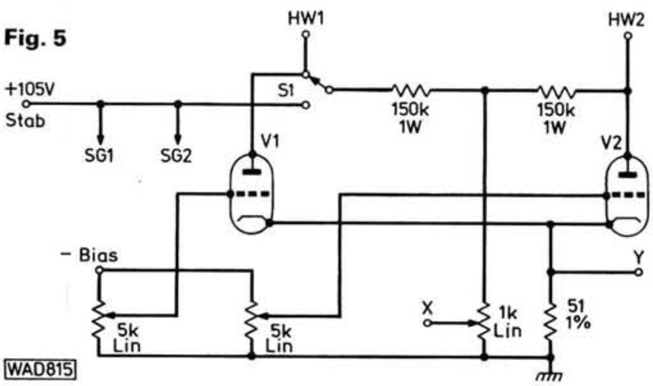


Fig. 5



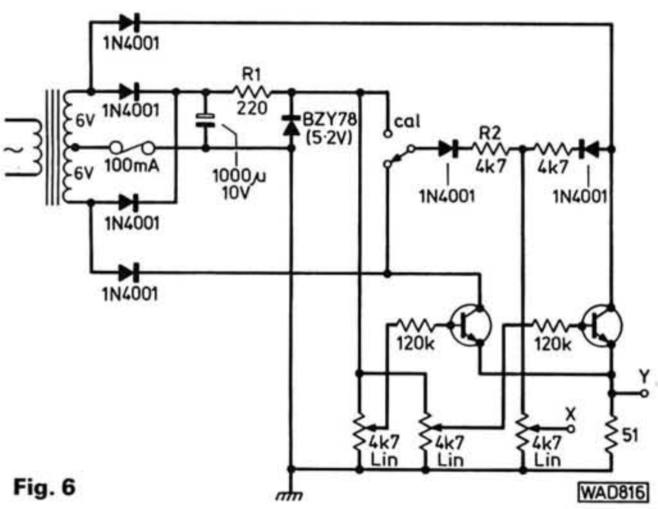


Fig. 6

Basic Principle

The arrangement of units is shown in block form in Fig. 1 coupled by connector lead assemblies.

A suitable bi-phase source is shown in Fig. 2 and consists of a transformer with a centre tapped secondary winding feeding two rectifiers to provide alternate unidirectional half-wave outputs HW1 and HW2. During the sweep of one half wave the other output remains at zero.

The half-wave voltages are applied separately to each device being compared in Fig. 3, current flowing through a precision resistor common to both circuits—the small voltage sweeps across this resistor are proportional to the currents passing through each device providing the vertical Y input of an oscilloscope.

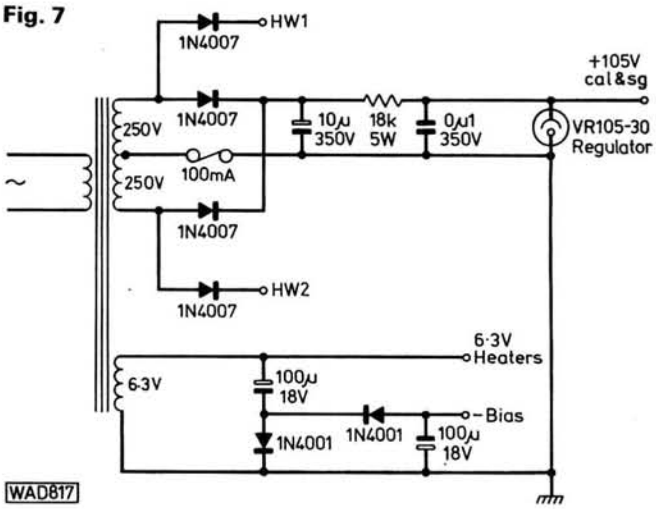
Horizontal sweep voltages are taken from a combined potentiometer circuit across the half-wave inputs giving X input proportional to the applied voltage.

Internal d.c. amplifiers of the oscilloscope produce the characteristic display of device current plotted against applied voltage shown in Fig. 4. Trace identification is available by altering the bias to one of the devices.

Calibration

Vertical current is known by the volts per milliampere at the precision resistor and the calibrated volts per centimetre of the oscilloscope Y input. Horizontal volts are checked by switching one leg of the potentiometer chain to a voltage reference source and setting the output control for an unswept vertical trace to a graticule line.

Fig. 7



Construction

Although the circuit is simple and the wiring layout not critical, attention should be paid to adequate mechanical arrangement of interconnections. These will consist of a four or six pole plug and socket lead assembly to the power supply unit, 4mm plug leads to the oscilloscope and pairs of valve or transistor sockets suitable for the devices being tested.

A slow blow 100mA fuse at the centre tap point is essential. The transistor comparator is shown in Fig. 6, complete with its own power supply, as this is less cumbersome than the valve arrangement, allowing assembly in a small plastics box.

continued on page 41 ▶▶▶

RADIO SPECIAL PRODUCT REPORT

FT-707

YAESU

H F TRANSCEIVER

The Yaesu FT-707 "Wayfarer" is part of a matching range of units including the FP-707 power supply for a.c. mains operation (the FT-707 is a 13·5V d.c.-powered unit), the FC-707 antenna coupler, and the FV-707DM external digital v.f.o. The FT-707 covers all the amateur bands from 80 to 10 metres including the WARC '79 additions, with a nominal power output of 100 watts on s.s.b. and c.w., and 50 watts on a.m. (d.s.b.). There is also a low-power version, the FT-707S, with a power of 10 and 5 watts for the respective modes. Our photographs are of the FT-707S, but most of our tests were carried out on its big brother, which differs in appearance by the addition of the 100W p.a. heatsink on the rear of the case.

The transmitter is basically designed for s.s.b. use, being of the balanced ring modulator/filter format, with an 8987·5kHz i.f., followed by a diode ring mixer to convert the signal up to the final radiated frequency for delivery to the power amplifier. The output of the p.a. passes via bandswitched low-pass filter networks and a directional coupler to the rear-panel SO239 antenna socket. On c.w., a separate 8988·3kHz carrier signal is generated and fed to the ring modulator which is unbalanced by the application of a d.c. bias. Keying is carried out in the r.f. amplifiers driving the p.a. On a.m., the microphone modulates the 8988·3kHz carrier and the s.s.b. filter is bypassed. On c.w. and a.m., the power output can be reduced to around 10W by means of the front-panel carrier level control. Both manual and voice-operated transmit/receive switching are provided, the VOX operates on c.w. as well. There are external controls for VOX sensitivity and hang-time, and an internal anti-VOX adjustment.

The p.a. is protected against excessive antenna v.s.w.r. by using a signal from the directional coupler to reduce the gain of the r.f., i.f. and a.f. stages of the transmitter. Protection against over-driving or overheating of the p.a. transistors is also provided, and there is a temperature-controlled fan for the p.a. heatsink. The a.l.c. (automatic level control) circuit allows the FT-707 to develop 50 per cent of its full rated output power safely into a load with a v.s.w.r. of 3:1. Operation of the a.l.c. circuit and the power output can be monitored by means of the l.e.d. level meter.

On the receiver side, the antenna is fed via a 1·7MHz high-pass filter (for enhanced medium-wave broadcast band rejection) and individual antenna coils for each band to a dual-gate MOSFET amplifier. A 9MHz i.f. trap improves i.f. rejection to a level which we measured as 88dB—a very creditable figure. The amplified signal passes via diode-switched band-pass filters to a Schottky barrier diode ring mixer, which produces the 8987·5kHz i.f. signal. This is fed via a 20kHz monolithic crystal filter to the noise blanker, which is a very impressive performer indeed. For example, impulsive noise causing an S4 meter reading and completely obliterating a weak station on 10m, could be virtually eliminated to improve the wanted signal to Q5.

From the noise blanker, the signal goes to a variable bandwidth circuit, which can be adjusted between 300Hz and 2·4kHz at the −6dB points on s.s.b. and c.w. Very effective a.g.c. is provided, with a choice of fast and slow decay time-constants. A diode ring demodulator converts the signal to audio, which is ultimately fed to the loudspeaker via an i.c. amplifier.

Concentric r.f./i.f. and a.f. gain controls are provided, and a clarifier permits a receiver shift of up to ±3kHz relative to the transmitted frequency. A 25kHz crystal calibrator is available for scale checks.

Both digital and analogue (dial skirt) frequency readouts are provided. The tuning rate is 100kHz per revolution of the main dial, rather faster than the ideal for resolution of s.s.b. signals, but the knob is well-placed, clear of other controls and very smooth in operation, and no problems were experienced in tuning on s.s.b. The l.e.d. level meter operates as an "S" meter on receive, and was found to be accurate within ±1·5dB above the S9 mark.

Special filters with −6dB bandwidths of 350Hz and 600Hz are available as an optional extra for use on c.w., but neither of these was fitted to the review transceiver. Another untested option is a single crystal-controlled fixed channel in each amateur band except the new 30m band.

Microphone and headphone connectors are provided on the front panel, while at the rear there are a.f. outputs for a tape recorder, etc., and an external loudspeaker; Morse key jack; r.f. output for driving a transverter; accessory socket for remote microphone, etc.; external v.f.o. jack for connecting the FV-707DM; 8V d.c. output for the panel lamps in the FC-707; 13·5V d.c. supply input connector and antenna and earth connectors.

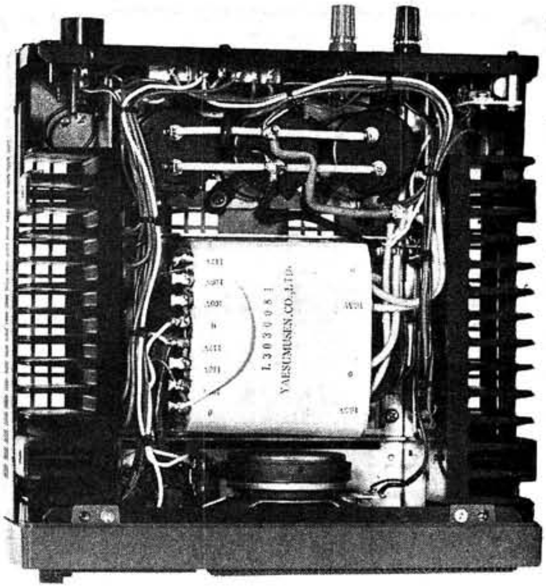
The FV-707DM external v.f.o. provides 12 memory channels plus scanning in 10Hz steps and offset from the memory channels. The latter functions are controlled from the scanning microphone.

The FC-707 antenna coupler (not shown in our photographs) will match an antenna with a feedpoint impedance of 10-250Ω to the 50Ω required by the FT-707. It also incorporates s.w.r. and power output metering, and a 50Ω dummy load.

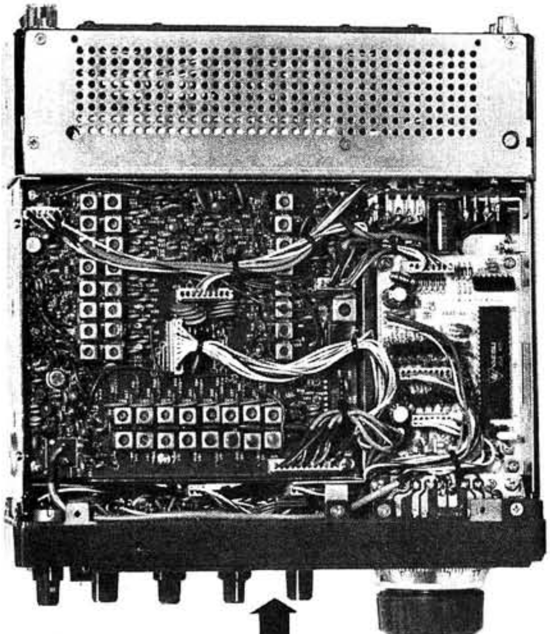
Results

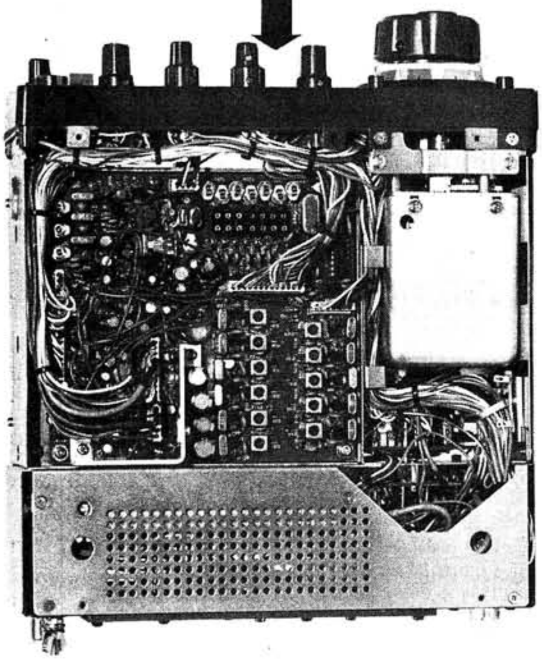
On-air tests, using a variety of antennas: long wire, trapped dipole and trapped vertical, all produced very good results. The receiver is sensitive and stable, with no apparent vices of any kind, and reports of transmitted quality are good. The transceiver is small enough for sensible mobile use (a mounting bracket is available) or, as the instruction

Inside view of the FP-707 power supply incorporating an extension loudspeaker ▶

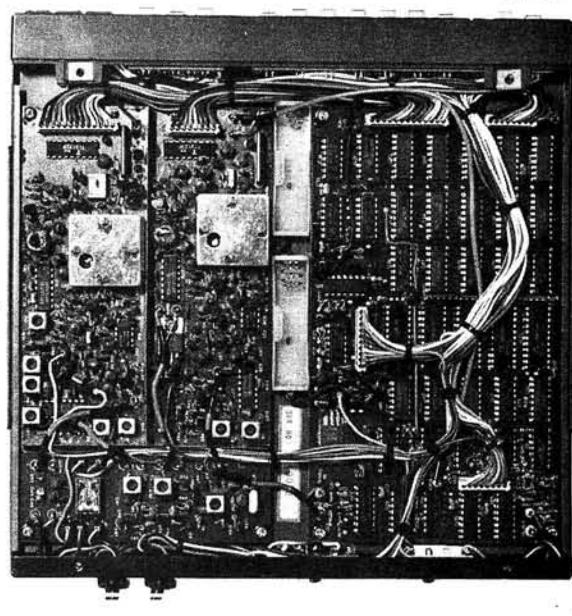


Top and bottom views of the FT-707S. Accessibility for servicing appears good, considering the very compact construction ▶





The FV-707DM. The battery holders in the centre are for a memory back-up supply ▶



★ specifications

Frequency coverage: 3·5– 4·0MHz (80m)
7·0– 7·5MHz (40m)
10·0–10·5MHz (30m)
14·0–14·5MHz (20m)
18·0–18·5MHz (17m)
21·0–21·5MHz (15m)
24·5–25·0MHz (12m)
28·0–29·9MHz (10m)

Types of emission: A1 (c.w.), A3 (d.s.b.) and A3J (u.s.b./l.s.b.)

Power input: A1/A3J 240W d.c.
A3 80W d.c.

Carrier suppression: Better than 40dB

Sideband suppression: Better than 50dB at 14MHz, 1kHz mod.

Spurious emissions: At least 50dB down

Third order distortion products: At least 31dB down

Frequency response: 350–2700Hz (–6dB)

Frequency stability: Less than 300Hz drift over 30 minutes after 10 minutes warm-up; less than 100Hz drift after 30 minutes warm-up

Microphone impedance: 500–600Ω

Antenna impedance: 50Ω unbalanced

Receiver sensitivity: A1/A3J 0·25μV for 10dB S/N
A3 1·0μV for 10dB S/N

Selectivity: A1/A3J 2·4kHz (–6dB)
4·0kHz (–60dB) plus variable bandwidth control
A3 3·6kHz (–6dB)
6·8kHz (–60dB)

Image rejection: 60dB (80–12m), 50dB (10m)

Audio output: 3W into 4Ω at 10% t.h.d. (permissible load range, 4–16Ω)

Power requirements: 13·5V d.c., negative earth 1·5A receive, 20A (peak) transmit

Case size (FT-707): 93 × 240 × 295mm

Weight (FT-707): 6·5kg approx.

★ Test measurements

TRANSMITTER

Power output: A3 75W carrier
A3J 212W p.e.p.

Carrier suppression: On u.s.b. –43dB
On l.s.b. –42dB

Sideband suppression: Output u.s.b. –53dB
Output l.s.b. –56dB

Two-tone intermodulation: –29dB relative to either tone

Harmonic and spurious outputs:

Band (m)	Spurious outputs	Harmonic outputs
80	All better than –70dB	2nd –60dB
40	All better than –70dB	2nd –53dB
30	No transmit	
20	All better than –70dB	2nd –52dB
17	No transmit	
15	All better than –70dB	2nd –50dB
12	No transmit	
10	Spurious output at ±1·6MHz at –60dB	2nd –60dB

RECEIVER

Sensitivity:

Band (m)	Input for 12dB SINAD (μV) A3J	A3	Input for S9 (μV)
80	0·3	1·1	16
40	0·19	0·75	15
30	0·23	0·95	15
20	0·2	0·95	15
17	0·17	0·75	15
15	0·18	0·85	15
12	0·18	0·8	15
10	0·18	0·9	17·5

Image rejection: From 72·5dB on 80m, to 52·5dB on 10m

Intermodulation: Input level of two equal signals at f + 10kHz and f + 20kHz which produce a 12dB SINAD signal at f, relative to that required at f to produce 12dB SINAD=71dB

Blocking: Input signal level (relative to 12dB SINAD level), 10kHz away from wanted signal, to degrade SINAD by 6dB=80dB

Audio output: 2·5W into 4Ω for onset of clipping
3·9W into 4Ω for 10% t.h.d.

manual suggests, to take away on holiday. It seems to incorporate all the really necessary features, without any gimmicks, and it's going to break my heart to send the review model back.

The four units mentioned in the review are so sized that they will stack (as shown in our heading photograph) or sit side by side along a desk top (see pages 50/51 in our March 1981 issue). There is also available a special mounting rack, while looks like a small version of the adjustable steel shelving used in warehouses. It certainly doesn't match the equipment in appearance or quality, and I personally wouldn't give it house-room. Please, Yaesu, bring out something more suitable, if you feel a rack is really necessary.

The instruction manual for the FT-707 is quite comprehensive, with information on controls, connections and installation, and operation. There are circuit diagrams, a block diagram and detailed circuit description, quite a lot of maintenance and alignment information, major component location pictures and a fairly detailed parts list. Similar manuals are provided with the external v.f.o. and antenna coupler, but that for the mains power supply is more basic.

The manufacturer's specification and our measurements are shown in the tables. The test equipment we used was: TF2002 signal generator, TF2370 spectrum analyser, TF2000 audio signal generator and TF893A audio power meter (all by Marconi Instruments), Hewlett Packard 1707B oscilloscope and Sinadder automatic signal-to-noise meter.

The FT-707 is currently available at around £500 including VAT, approximate prices for the associated items being: FP-707 £110, FC-707 £80 and FV-707DM £180, all including VAT. A range of microphones cost between £6 and £23, according to facilities offered. We are indebted to **South Midlands Communications Limited, SM House, Osborne Road, Totton, Southampton SO4 4DN, telephone Totton (0703) 867333,** for the loan of the review equipment. ●

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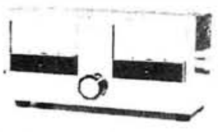

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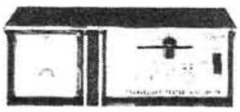

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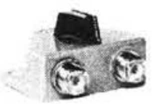

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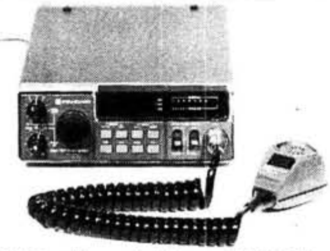

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Suppressing & Protecting Thyristors

Ben J. DUNCAN **Part 1**

Thyristors have gained a notorious reputation for being fragile devices electrically speaking, and this series of articles shows how thyristors and triacs may be confidently applied in power control circuits.

The word "thyristor" is derived from the Greek for "a door" and is the generic name for a large family of semiconductor devices. However, in the UK, the term "thyristor" is usually limited to the unidirectional device (also known as the silicon controlled rectifier or s.c.r.), whilst the bi-directional device is commonly known as the triac. There are many other members of the thyristor family, but for power applications we shall only need to consider the s.c.r. and the triac. Both of these devices are used primarily as switches, though thyristor amplifiers have been built.

Figs. 1 and 2 depict the differences between the thyristor and the triac. In Fig. 1, the thyristor is turned on or "triggered" by applying a small positive voltage to the gate. The device will then pass a large current at high voltage in one direction only, thus acting as a rectifier if the current being controlled is a.c. Once a thyristor is triggered, the gate current can be turned off and the device will continue to conduct between anode and cathode until the current flowing across these terminals drops below a certain level, typically 30 to 60mA. This is the "holding" current.

When a thyristor is used to control d.c., once triggered, it latches on and another switch is needed to reduce the anode to cathode current to below the holding current. For a.c. or pulsed d.c. control, the thyristor will, of course, turn off after the first positive half cycle unless it is triggered again.

The triac is rather like two thyristors connected back-to-front and in parallel with a common gate terminal, though this analogy is not entirely accurate. The triac will conduct in both directions and the triggering voltage at the gate can be either positive or negative.

In the thyristor, the gate current flows out of the cathode and this terminal is the reference point for voltage ratings. Because the triac is bi-directional, it does not have a cathode; the equivalent reference point is "main terminal one" (Mt_1) and the equivalent of the thyristor's anode is "main terminal two" (Mt_2) in the triac.

In mains supply applications, it is normal to connect Mt_2 to the live terminal via the load, whilst Mt_1 goes to neutral.

There are four triggering modes for a triac since it will conduct when Mt_2 is positive or negative, regardless of the polarity of the gate signal. Fig. 2 shows the triac in its four triggering modes. Note that a lot more gate current is required to trigger it in the III+ mode. Some triacs are also slightly insensitive in the I− mode.

Table 1 shows how thyristors and triacs perform as switches in comparison to other common devices. Note that they far outperform the power transistor in these duties; a thyristor gate current of 150mA can switch 2500A whilst the same current flowing into the base of a power transistor would scarcely control more than a few amps!

Moreover, the thyristor is inherently a high voltage device and doesn't have the secondary breakdown limitations of the power transistor, thus it can control very high currents and voltages simultaneously. For instance, whilst a transistor might be able to control either 500V at 5A or 50A at 7V, but not 500V at 50A, thyristors are readily available which can handle 2500A at 1300V!

Device Ratings

Before considering how to protect a triac or thyristor it is helpful to understand the significance of the manufacturer's data, notably the special voltage and current ratings which allow thyristors and triacs temporarily to accommodate special circuit conditions.

Average current $I_{T(AV)}$ applies to thyristors only. This is the maximum *average* current that can be passed through the device on a recurrent basis without overheating and destroying the junction. This figure usually assumes a

Fig. 1:

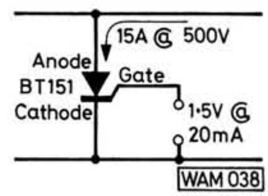
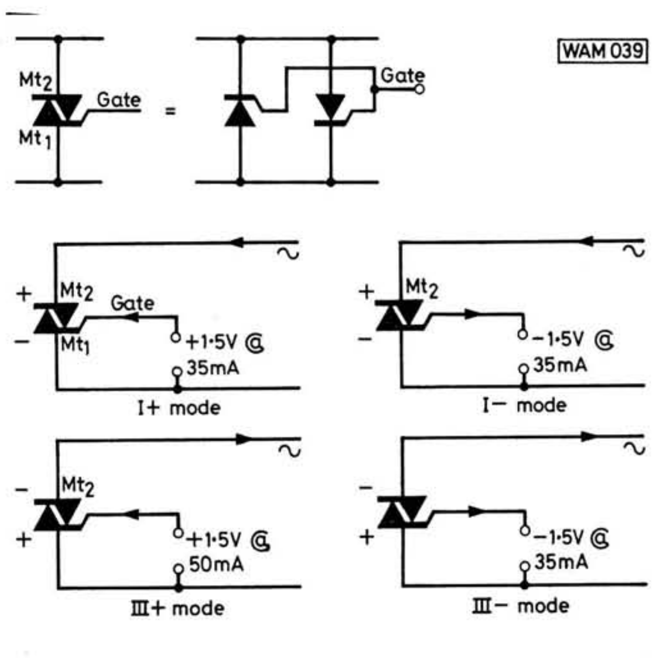


Fig. 2:



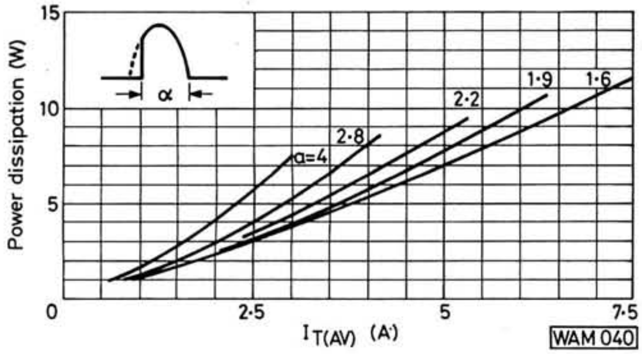


Fig. 3:

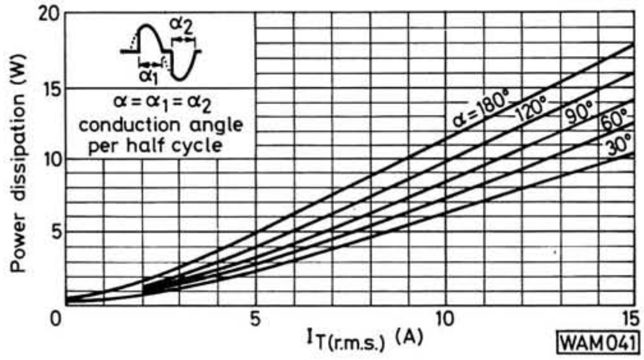


Fig. 4:

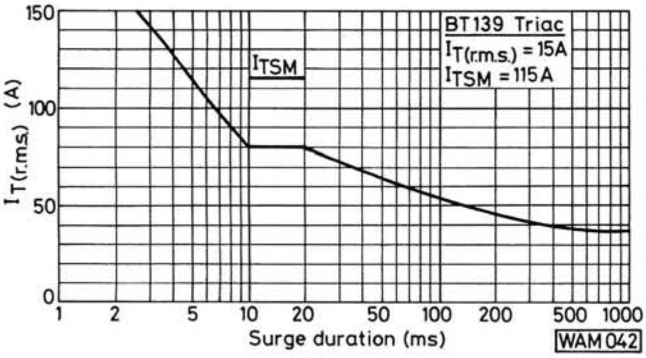


Fig. 5:

Table 1

	Triac Thyristor or Solid State Relay	Power Transistor	Electro-mechanical Relay	Contactor or Switch
Power Handling	Very high	Very low	Medium	Very high
Turn-off Time	Very fast	Fast	Medium	Slow
Current to Hold Switch ON	Low	High	Medium	Low or zero
Power Dissipation	Low	High	Very low	Very low
Switching Speed	Very high	Medium	Low	Very low
Electrical Robustness	High	Low	High	High

180° conduction angle, that is, the thyristor conducts throughout the whole of a half cycle. Fig. 3 is a typical graph showing $I_{T(AV)}$ against power dissipation for various conduction angles. Note that as the conduction angle decreases, the power dissipated increases or the $I_{T(AV)}$ rating falls.

RMS current, $I_{T(RMS)}$. This rating applies both to thyristors and triacs. For thyristors, however, this rating is usually only of significance if the waveform being switched is not sinusoidal, in invertors for instance. In this case the current could exceed the r.m.s. ratings yet be within the average rating. This is especially true when high peak currents are applied at low duty cycles. If you have to switch such a waveform, it's necessary to find out its shape and value and then to calculate the equivalent r.m.s. value of the pulse. For triacs, $I_{T(RMS)}$ is the general current rating and a graph of this parameter against power dissipation is often given (Fig. 4). This graph differs from the preceding one in that a smaller conduction angle allows more current to be safely passed or reduces the power dissipation. If a thyristor data sheet doesn't give the $I_{T(RMS)}$ value, it can be found from the expression:—$I_{T(RMS)} = (1{\cdot}55 \times I_{T(AV)})$.

Non-repetitive peak current, I_{TS}, is usually shown as a graph (Fig. 5). It may be either an average or a peak rating, and varies according to the duration of the current surge. Closely related is the I_{TSM} rating. This is the *absolute maximum* current a device can withstand over a half cycle at mains frequency, therefore 8·3ms for American devices (60Hz) and 10ms for British devices (50Hz). The I_{TSM} rating is particularly useful for fuse selection. A current which approaches the I_{TS} or I_{TSM} values will cause the junction temperature to rise close to its limits and until the device has cooled down many of its ratings will be invalid. Furthermore, a thyristor's characteristics may be permanently degraded or the device may fail if this catastrophic condition occurs regularly. Thus the I_{TS} and I_{TSM} ratings should only be used to accommodate unusual circuit conditions, such as short circuits. *The interval between surges does not change the I_{TS} rating.*

The thyristor has a forward blocking and a reverse breakdown voltage. The triac, on the other hand, because it conducts in both directions, can only have a forward blocking breakdown voltage. For thyristors only, the reverse voltage ratings are:

Continuous peak reverse voltage, V_{WRM}, is the maximum *continuous* peak reverse voltage allowable across a thyristor, for 240V mains, for example, the V_{RWM} must be $240\sqrt{2}$ or 340V; 400V is the nearest standard value here.

Repetitive peak reverse voltage, V_{RRM}, is the rating that takes into account any regular, but not *continuous,* transient voltage peaks that occur across a thyristor. In an invertor, for example, a small amount of ringing may cause the peak voltage to rise by 20 per cent for a few milliseconds in each cycle. Provided this voltage does not exceed the V_{RRM} rating, the device will not be harmed.

Non-repetitive peak reverse voltage, V_{RSM}, is the *absolute maximum* voltage ratings which a thyristor can withstand for short time periods, usually 10ms. It shows a thyristor's ability to withstand occasional transient voltages which are *not regular and inherent in the equipment,* for example, those originating in the mains supply.

These ratings have corresponding forward equivalents which also apply to triacs using the subscript "D". The forward equivalent of V_{RWM} is V_{DWM}, likewise V_{RRM} becomes V_{DRM} in the forward direction and V_{RSM} becomes V_{DSM}. Sometimes these ratings are equal, e.g.:—$V_{RWM} = 400V = V_{DWM}$ and sometimes continuous and repetitive voltage ratings are equal, for instance, $V_{RWM} = V_{RRM}$. Reverse breakdown in a thyristor will at best cause degradation of the device's characteristics and at worst failure will result. Forward breakdown in a thyristor or triac need not cause failure if the current is limited. Nevertheless, it is advisable to prevent forward breakdown whenever possible.

The multiplicity of voltage and current ratings for these devices need not cause confusion. It will be seen later that a V_{RSM} of 800V is often needed when mains operated thyristors are fused. These will also need a 400V V_{RWM} rating, and we simply need to look for the cheapest device which satisfies both conditions. To meet the V_{DSM} rating will often entail using a device with a 600 or 700V V_{RWM} rating, but this is quite in order. In a similar fashion, with current ratings, we may need an I_{TSM} of only 100A and an I_{TS} of over 20A; the fact that a 25A triac will have a 250A I_{TSM} rating is pure generosity!

Miscellaneous Ratings

Rate of rise of off-state voltage, dv/dt shows how fast a waveform a device can handle without turning on accidentally. Apart from applying a signal to the gate, a thyristor or triac can also be turned on by applying a rapidly rising voltage to the anode. A typical maximum dv/dt for a 25A triac is 100V/µs. The application of a waveform which rises more quickly than this may turn the triac on. Like forward breakdown, this effect is undesirable solely because the device loses control and may be damaged by suddenly conducting large currents. The circuit in Fig. 6 may be used to demonstrate dv/dt turn-on. If the switch is

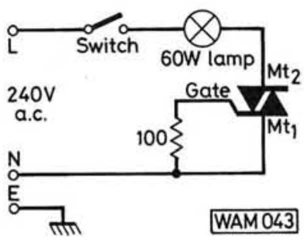


Fig. 6:

flicked rapidly, the lamp will light occasionally, even though there is no gate signal. Contact bounce in relays, contactors and other switches frequently cause this effect if switch-on happens to occur at the peak mains voltage. Thyristors invariably have better dv/dt ratings than triacs and are often connected back-to-back to provide bi-directional power control when high dv/dt ratings are required. Thyristors and triacs have other dv/dt ratings which concern commutation but these need not worry us here.

Rate of rise of on-state current, di/dt, concerns the inability of a triac or thyristor to turn on instantaneously. Initially, only a very small area of silicon is conductive, though within a few microseconds the whole area of the device conducts. A current which rises to its maximum value very rapidly and reaches a high value before the whole area of the device is conductive will pass through the very small area of silicon which conducts initially. This results in overheating which can destroy the device. A typical maximum di/dt rating for a 25A triac is 50A/µs. Although turning on a device by exceeding its dv/dt rating is not in itself harmful, some circuit faults can cause dv/dt breakdown in a device, which in turn causes sudden conduction of rapidly rising currents. Thus dv/dt breakdown can precipitate di/dt breakdown and the result is a dead triac.

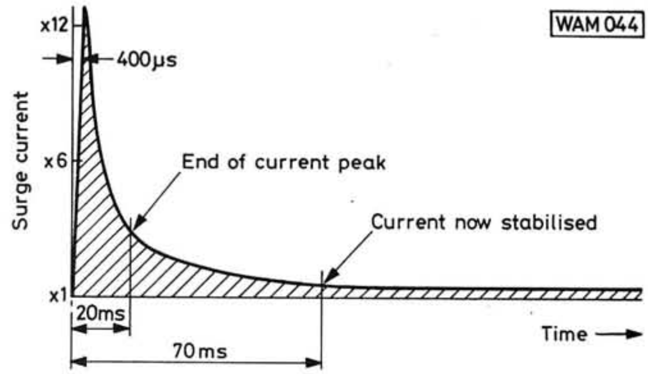


Fig. 7:

Surge Currents

These occur when motors, incandescent lamps and capacitors are initially energised. Starting surges in motors are due to the initial lack of back e.m.f. — only the inductance and resistance of the motor windings limit the current when a motor starts from rest. The filament of an incandescent lamp runs at some 2600°C. At this temperature the resistance of the tungsten filament is 9–20 times higher than at 20°C. The current in lamps and capacitors stabilises quite quickly, usually within a few tens of milliseconds in the case of a lamp.

Motor surges, however, can have a duration of hundreds of milliseconds or longer. Table 2 shows the duration and magnitude of typical current surges in lamps and motors. Fig. 7 is a graph of a typical lamp surge current. Note that the current does not rise to its maximum value instantaneously because of circuit and lamp inductance. A similar graph for a motor can usually be obtained from the manufacturer. The main difference is that motors usually have high inductance, therefore the surge current rises quite sluggishly. A peak motor surge current is also lower than that arising from lamps, but the surge duration is 10 to 100 times greater.

Table 2

Component	Typical peak current magnitude	Typical duration of surge
100W incandescent lamp	× 13	70ms
1000W incandescent projection lamp	× 18	100ms
Shaded pole motor	× 1·5	2 seconds
Series a.c.–d.c. motor	× 2·5	100–400ms
Split-phase motor	× 4–6	100–500ms
Capacitor start motor	× 4	100–600ms
Induction motor	× 7	750ms
Three-phase motor	× 3·5	170ms

Because these surges are *inherent and normal* in any circuit controlling lamps or motors, the surge current must not exceed the I_{TRM} rating of the device. This rating refers to surges of short duration only, however, and it is advisable in addition to check the I_{TS} rating of the device (Fig. 5). Sometimes a surge current graph is given in the data sheet; this is intended specifically for these conditions. The I_{TS} curve shows the maximum *non-repetitive* current against the duration of the current. In Fig. 8, the I_{TS} curve has been plotted for a 15A plastic triac. The I_{TRM} rating is also shown, together with the surge curves for 3 sets of 100W lamp arrays, consisting of ten, twenty and thirty lamps respectively. The thirty lamp (3000W) load exceeds the I_{TRM} and a triac controlling these lamps would rapidly fail. The 2000W lamp surge is below the I_{TRM} limit, but goes above the I_{TS} curve for 1ms (point A). This is not really satisfactory. The 1000W lamp load is well below both the I_{TS} curve and the I_{TRM} rating, thus the triac would handle this load quite happily. An examination of the graph will show that the maximum lamp load the triac can handle without the lamp surge curve encroaching on the I_{TS} curve is around 1500W, or 6·25A. This is approximately 50 per cent of the triac's $I_{T(RMS)}$ rating (15A).

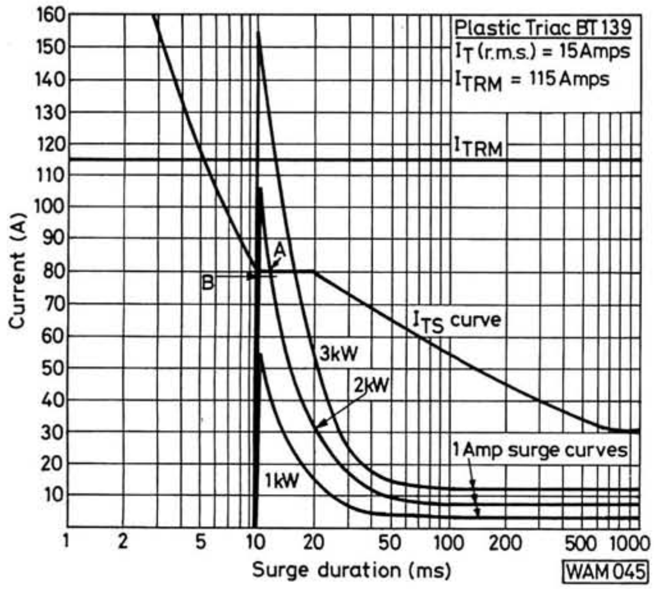


Fig. 8:

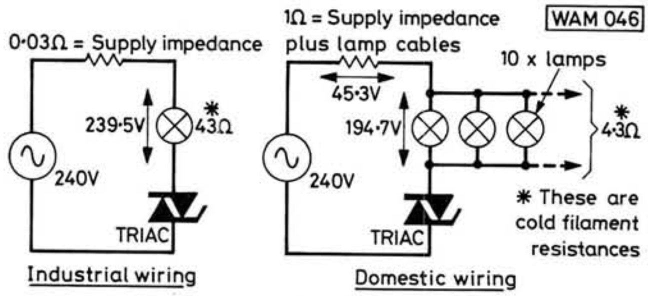


Fig. 9:

Thus we arrive at the rule of the thumb *"derate triacs or thyristors by 55 per cent for lamp loads."* However, it is always a good idea to check a triac's suitability by drawing a graph of the form shown in Fig. 8, especially when high-power incandescent lamps are to be handled.

The lamp surge curves in Fig. 8 give a conservative idea of the triac's capacity in many domestic applications. Fig. 9 shows why this is so. In industrial wiring systems, the supply impedance seen by the lamp is often very low because the control circuitry is likely to be wired directly into the mains, possibly close to a 100 or 300A distribution point. In this case, the impedance of the mains cables will be mainly resistive and will be possibly as low as 0·03Ω. The cold resistance of a 100W lamp filament is 43Ω. The total resistance is then 43 + 0·03 = 43·03Ω. Here the supply impedance will have a negligible effect on the surge current. However, domestic wiring may have an impedance of 1Ω and the effect on the lamp surge current can be significant, particularly when large currents are drawn.

If we connect ten 100W lamps in parallel, the total (cold) filament resistance will be 4·3Ω and the 1Ω supply impedance will then reduce the peak lamp surge current by around 20 per cent or 10A! If we take the impedance of connecting cables into account, the surge current will be reduced even more.

So far we have circumvented lamp surges by selecting triacs with suitable I_{TRM} and I_{TS} ratings. We can also use a thermistor to limit the lamp surge; this approach is com-

continued on page 52 ▶▶▶

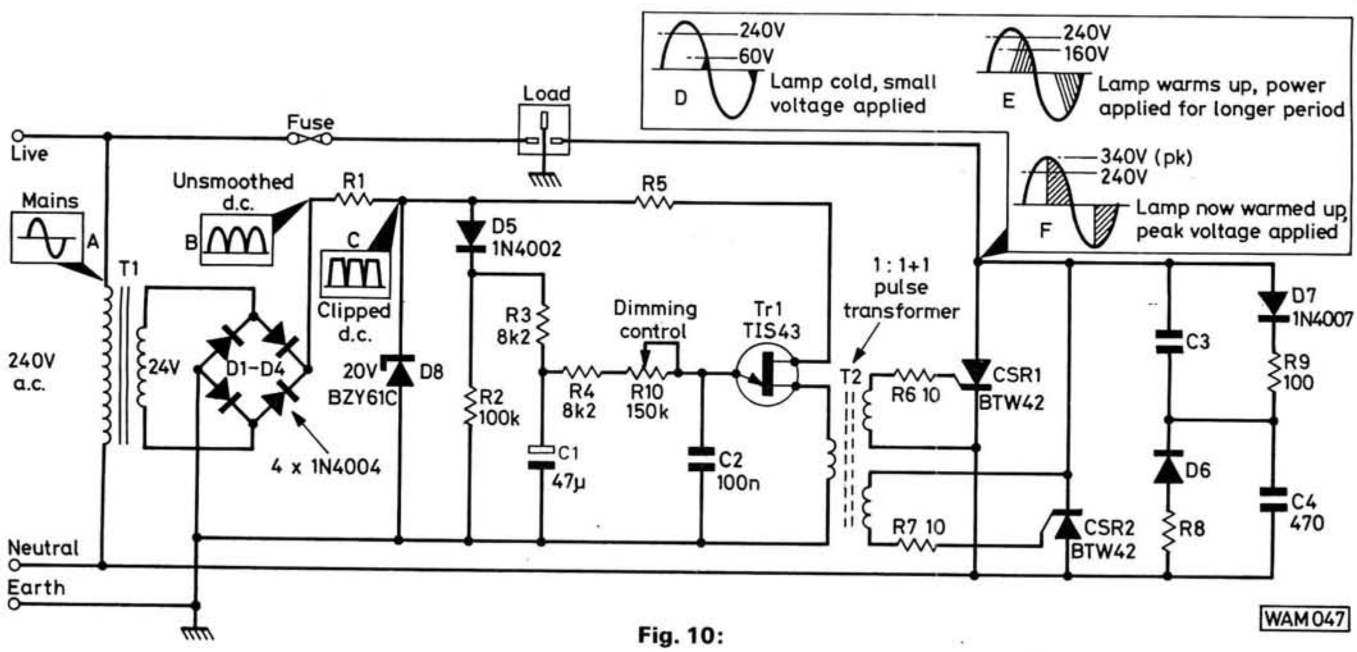


Fig. 10:

RADIO SHACK

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the YL COLUMN

Elaine HOWARD G4LFM

At least I can start this month's column with some good news (for me anyway). The result of the December RAE was favourable and I am now the proud owner of the call G4LFM, and a new 2m rig.

I was pleased to hear via Eric in "On the Air" in the April issue that the last YL Column was read by at least one other YL, so thanks for the encouragement. Writing the first column was easy, it's filling up the space the second time that proves difficult.

My call sign arrived the morning of writing this and whilst I was ripping open the envelope with the awaited news I was switching on my rig with the other hand. Not that I was eager to get on the air! It was just that over the past few weeks, since I bought the rig, everyone else has been trying it for me, to see that it operates properly. I wasn't sure whether anyone would be listening, it was rather early in the morning for most people, and if they were listening would I get things right. Fortunately all went well and my first contact was established.

Getting used to my own callsign is quite difficult, I can always think of everyone else's and not my own. Imagine being half way through a QSO and forgetting my callsign, I'd never be allowed to live it down in the office. So if I keep repeating it to myself eventually it should sink in. The fact that I passed the exam is only now beginning to register, it is hard to adjust to the idea that I actually passed, not the miserable failure that I was convinced would be the result.

After spending some time being unable to transmit, due to the lack of a licence, now it is perfectly legal I feel very guilty as soon as I start transmitting. Perhaps it will wear off in time, as I get more at ease on the practical side of the hobby.

I have heard of one new YL with a nice call sign, it is G8ZYL, I haven't actually worked her yet, I didn't have my callsign at the time. I would like to hear from any others who have new callsigns, interesting or otherwise. I am gradually compiling a list of YLs but the 1981 call book only goes as far as the G8Ws, so I would be grateful to hear from any others.

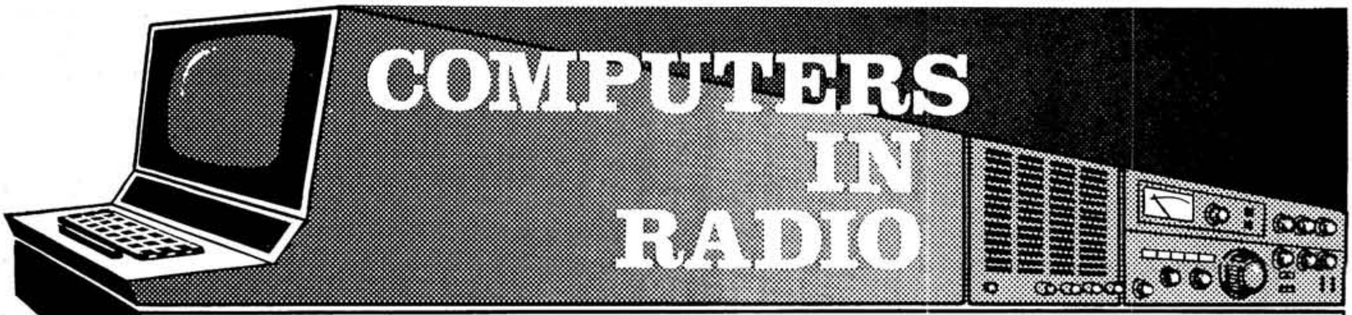
PW "WINTON" TUNER

As announced in our April issue, we have run into difficulties with this project due to the a.m. tuner module being discontinued by the manufacturer.

In drawing up the specification for this tuner, the aim was to provide a design with a similar high standard of performance and facilities to the *PW* "Winton" amplifier, yet capable of being put together by a home constructor without access to sophisticated test equipment. This meant that pre-aligned tuner modules were essential, but unfortunately the result is that we were of course dependant on the continued availability of the chosen modules.

The a.m. tuner head selected seemed to provide the best combination of performance and facilities of all those available. Enquiries have been made on a worldwide basis to try to locate any remaining stocks, but without success. The question of a suitable substitute has been investigated, but there is nothing else which could be used without a complete redesign of a large part of the *PW* "Winton" tuner. We have reluctantly come to the conclusion that this is not economically viable, but we are continuing to look for some other solution.

We apologise for the disappointment this delay will cause our readers. It is no less disappointing and frustrating for the author and ourselves, especially in view of the large amount of time and money which had already been devoted to the project.



INTRODUCING THE MICROCOMPUTER — 1

by Mervyn J. Axson BA G8WHG

From conversations heard over the air, a lot of radio amateurs are becoming interested in microcomputers. This is not surprising because they have a lot in common with radio and they can go together very well. No doubt there are a lot more people who would be interested if only they could penetrate the jargon. A lot of published material is not very helpful in this respect, for all too often you become enmeshed in binary arithmetic in the second paragraph and Boolean Algebra soon follows. This is not necessary at all. It is like starting a learner driver off by giving a talk on the theory of heat engines. You don't have to know what is happening inside a computer in order to use it. So we will adopt the "Black Box" approach and just accept that certain actions produce certain results.

There are three essential components in any computer system. These are: a means of getting information into it (input peripheral or i.p.), something to perform operations on the information (central processing unit or CPU) and some way of getting details out (output peripheral or o.p.). With microcomputers the i.p. is invariably a keyboard of some type and the o.p. is usually a c.r.t. screen known as a Visual Display Unit or VDU. These and the CPU may come in separate cases or they may all be packaged in one unit, it makes no difference. There can be other types of i.p. and o.p. devices in a complete system, but these are the essentials. We can deal with the others as the need arises.

How do we use a computer to solve a problem? You are sitting in front of the keyboard watching a little symbol flashing on the VDU. This is known as the cursor. Before you can solve any problem the computer must be programmed. Now there is more mystique about that simple word than almost any other. And yet there need not be, for a program is simply a list of instructions telling the computer what to do. The trouble arose because you have to use a very special language, known as machine code, to talk to the CPU. This varies from machine to machine and is always a very precise and complex code. It does take a great deal of experience and a lot of time to write successful programs in machine code.

Fortunately, the very clever people who made the first computers soon realised how this would limit their use, so they made good use of the power of the computer. They wrote a program which is stored inside the CPU which lets you type instructions in a recognisable form and which then translates these into the machine code. I said that they were clever! There are so many different ways that you can express instructions in English that some rules had to be made if these interpreters were to work properly. These rules form the basis of what is called a high-level language, and there are a number of these such as COBOL, ALGOL, FORTRAN, PASCAL, etc., but the most popular for microcomputers is BASIC. Some professionals criticise BASIC but for our purpose it is very good. Programs written in it are fairly easy to read, and it is an easy language to learn. By the time you have finished reading this article you will be able to write simple programs in BASIC.

Rather than just giving a list of the rules making up BASIC, we will write some simple programs so learning as we go. We have said that a program is a list of instructions, which are called Statements. BASIC requires that the Statements shall be numbered in ascending order, and they will be carried out or executed in that order. Note that the numbering does not have to be consecutive. It does not matter whether they are numbered 1, 2, 3 or 100, 200, 300. This is very useful in developing a program because if we want to add a Statement between two existing ones we simply give a number between and BASIC will put it between. For example, a later Statement numbered 150 will be inserted between 100 and 200.

Writing Programs

So to start writing. Let us make a simple program to carry out the calculations for Ohm's Law, $V = IR$. We need to tell the CPU what the values of I and R are, so the first two lines of the program are INPUT Statements.

```
4ØØ INPUT I
41Ø INPUT R
```

Now we have to tell it to multiply I by R to get the value of V. Note that the sign for multiply in BASIC is "*" and not "×". This uses the LET Statement.

```
42Ø LET V = I * R
```

Now we want it to give us the answer. Output is made with the PRINT Statement.

```
43Ø PRINT V
```

And that is the program completed! Type each line on the keyboard and you will see it displayed on the VDU. As you finish the line press the RETURN key. This tells the CPU that you have finished that line, which it then stores in its memory. When this has been done, the cursor moves down to the next line.

Having completed the entry of the program, we now have to tell the CPU to act on it and for this we use a COMMAND Statement. These are not numbered, and are not stored in the machine, but are acted on at once. So type RUN followed by the RETURN key, and the CPU will immediately ask for the input of I. It indicates this by printing a question mark on the screen. As soon as you have typed in a value, say 2, it will ask for R by printing another "?". Type in this value, say 4, and the CPU immediately prints the answer, 8, on the screen. So the program works. Alright, it is not really very useful at this stage, but we can do a lot to improve it. Any program that is of real use is made up of two parts. One that solves the problem and one that makes the program versatile and easy to use. For example, it is not very informative just to flash "?" on the screen. What input is required? INPUT Statements allow us to say what is expected, simply type the details between quote marks.

```
4ØØ INPUT "CURRENT IN AMPS"; I
```

Similarly for line 410 and also for the output

```
43Ø PRINT "VOLTAGE IS"; V; "VOLTS"
```

We can improve the clarity by spacing. A simple PRINT Statement will give a line space between the questions.

```
4Ø5 PRINT
```

We may want to carry out another calculation. We could of course type RUN again, but a GOTO Statement will send the CPU back to the start automatically. Of course it would then be neater to clear the screen. PRINT CHR£(147) will achieve this, and as we don't want it to happen before we have read the previous answer we put line 535 in to temporarily stop execution of the program.

It would also be nice to say what the program does and to start with a clear screen, so we add lines 100 and 110.

```
1ØØ PRINT CHR£(147)
11Ø PRINT "OHM'S LAW"
535 INPUT "TYPE 1 TO CONTINUE"; A
54Ø PRINT CHR£(147)
```

We now have quite a tidy program, but a glaring omission is that although called Ohm's Law it only deals with $V = IR$, what about $I = V/R$ and $R = V/I$? Obviously we can add more lines to cater for these, but we must also allow the user to select the desired formula. A neat way of doing this is to present a "menu" from which the user can make his choice. We can easily do this with a series of PRINT Statements.

```
2ØØ PRINT "MENU"
21Ø PRINT
22Ø PRINT "OPTIONS AVAILABLE"
23Ø PRINT
24Ø PRINT "1. GIVEN I & R FIND V"
25Ø PRINT
26Ø PRINT "2. GIVEN I & V FIND R"
27Ø PRINT
28Ø PRINT "3. GIVEN R & V FIND I"
29Ø PRINT
3ØØ PRINT "4. FINISHED WITH PROGRAM"
```

This is fairly straightforward, but we now have to decide how to tell the CPU what the answer is.

Fortunately our clever friends thought of all kinds of problems, and provided Statements which can be adapted to all needs. In this case it is an extension to the GOTO and is the ON -- GOTO ----. Firmly believing that an ounce of practice is worth a ton of theory, and that by now you are getting to grips with the way things work, let us do the necessary coding. After setting up the "menu" we proceed.

```
31Ø PRINT
32Ø INPUT "TYPE NUMBER OF YOUR CHOICE"; I
33Ø ON I GOTO 4ØØ, 5ØØ, 6ØØ, 7ØØ
```

We know we have the formula for case 1 starting in line 400, so we put the formula for case 2 starting in line 500, case 3 in line 600 and case 4 in line 700. Depending on the number chosen, the program will proceed directly to the appropriate formula.

We now have a simple program but it does have quite a sophisticated looking output. Exactly the same methods could be adapted to other types of problems involving the use of formula. Simply change the parameters and equations as required. Of course, programming can be more complicated, but the methods of solution are the same. A bit of logical thinking about the problem will reveal a possible solution. Flow charts are often a great help. Once this stage has been reached it is a fairly straightforward procedure to code the instructions in BASIC. With very little practice quite considerable skill is acquired. One warning, though, the process is addictive and may divert from all sorts of other things including Amateur Radio!

to be continued

```
Listing of Ohm's Law program.
Mervyn J. Axson BA G8WHG.  02.10.80.
100 PRINTCHR$(147)
110 PRINT"OHM'S LAW"
120 PRINT
200 PRINT"MENU"
210 PRINT
220 PRINT"OPTIONS AVAILABLE"
230 PRINT
240 PRINT"1. GIVEN I & R FIND V"
250 PRINT
260 PRINT"2. GIVEN I & V FIND R"
270 PRINT
280 PRINT"3. GIVEN R & V FIND I"
290 PRINT
300 PRINT"4. FINISHED WITH PROGRAM"
310 PRINT
320 INPUT"TYPE NUMBER OF YOUR CHOICE";J
330 PRINTCHR$(147)
340 ON J GOTO 400,500,600,700
400 INPUT"CURRENT IN AMPS";I
405 PRINT
410 INPUT"RESISTANCE IN OHMS";R
415 PRINT
420 LET V=I*R
430 PRINT"VOLTAGE IS";V;"VOLTS"
440 INPUT"TYPE 1 TO CONTINUE";A
450 PRINTCHR$(147)
460 GOTO 200
500 INPUT"CURRENT IN AMPS";I
505 PRINT
510 INPUT"VOLTAGE IN VOLTS";V
515 PRINT
520 LET R=V/I
530 PRINT"RESISTANCE IS";R;"OHMS"
540 INPUT"TYPE 1 TO CONTINUE";A
550 PRINTCHR$(147)
560 GOTO 200
600 INPUT"RESISTANCE IN OHMS";R
605 PRINT
610 INPUT"VOLTAGE IN VOLTS";V
615 PRINT
620 LET I=V/R
630 PRINT"CURRENT IS";I;"AMPS"
640 INPUT"TYPE 1 TO CONTINUE";A
650 PRINTCHR$(147)
660 GOTO 200
700 PRINT"FINISHED"
710 END
READY.
```

PW 'STOUR' TOP-BAND TRANSCEIVER

PART 1

David G. BARRELL G4BMC

Now that 160m has been confirmed as an amateur band at the 1979 WARC there seems to be an upsurge in activity using this band. The author required an s.s.b. transceiver for 160m to use in a caravan when on holiday in Wales. The commercial transceiver, which had been used for this purpose until recently, had several shortcomings.

Firstly, when in a farmer's field with very little man-made noise and a large $\frac{1}{2}\lambda$ antenna, it did not cope with strong signals as well as one would have liked. Secondly, the current drain was alarming. Although there are now commercially available solid state units that cover 160m it was decided to "have a go" at building a rig which was more economical on current consumption during receive, and possessing a larger dynamic range with good signal handling capabilities.

It must be stated at the outset that the author is not professionally qualified and neither is he weighed down by superb test equipment. A g.d.o., d.c. meter and test oscillator (not a commercial signal generator) represented all that was available.

As several other people had shown more than a passing interest in the project it was decided that the various circuits should be as repeatable as possible.

To this end, and after many preliminary trials with various circuits, it became clear that one of the problems was the varying gains between different transistors of the same type number. A standard broad-band amplifier is used in many situations with a large amount of feedback, including an un-bypassed emitter resistor. This was used throughout the transceiver designs and the results after this method of approach was adopted proved extremely effective. The un-bypassed emitter resistor in each stage was found to be an easy method of setting the various gains in each stage and it is strongly advised that they are strictly adhered to.

Initial tests of the *PW* Stour prototype were carried out by using a Yaesu FT101B as the main piece of "test gear", but grateful thanks go to G4CEN who performed the rather more stringent tests and whose figures are quoted at the end of this article.

Because of the limited test equipment, modular construction was decided on. All sections were built and tested in such an order that simple functional tests could be performed without additional test gear.

The original front end of the receiver consisted of a 40673 r.f. amplifier feeding a diode mixer. After two months and about six printed circuit boards, this idea was given up. The cross-mod performance was, at its best, only as good as the commercial transceiver.

A design was then found using a pair of v.h.f. transistors in a broad-band push-pull circuit. This was quickly knocked up, and the results obtained were greatly improved. Similarly, the original p.a. used tuned circuits and worked quite well using a single 2N5591. However, being converted to broad-band techniques by the receiver front end success, a much more stable p.a. was evolved by adopting a similar approach.

Diode switching was used wherever possible to save the inevitable bulk of wiring associated with relay switching. *Pin* diodes were used for this purpose and although various articles have suggested the use of silicon switching diodes as a cheaper alternative, the author cannot comment on their effectiveness as they have not been tried.

CONSTRUCTION RATING Advanced

BUYING GUIDE

All components required for the construction of this project should be available from suppliers advertising in the magazine. Buying information will be provided in subsequent issues as appropriate.

APPROXIMATE COST £185

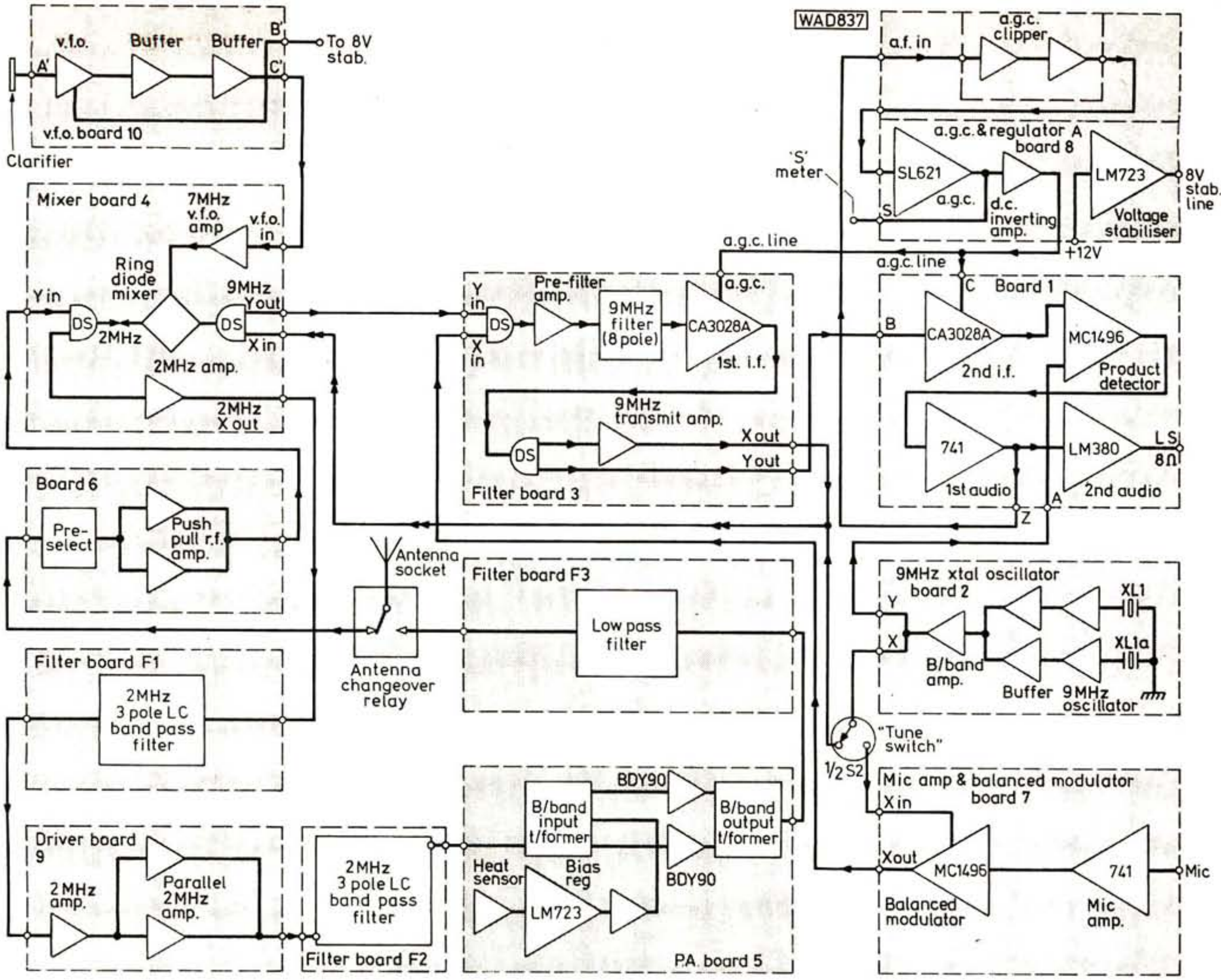


Fig. 1: The full block diagram of the *PW* Stour transceiver

Circuit Description—Receiver

(Refer to the functional block diagram of the transceiver shown in Fig. 1.)

The v.f.o. frequency is variable in the range 7–7·500MHz, with separate control of the receiver frequency available over a plus or minus range of 2–3kHz. The v.f.o. obtains its supply from an eight volt stabiliser.

Signals from the antenna are passed through a 2MHz filter and are then amplified by the push-pull front end before being fed to the mixer.

The v.f.o. output is fed to the mixer board where it is amplified by a broad-band amplifier before being fed to the doubly balanced diode mixer. This mixer uses HP2800 hot carrier diodes.

Mixed v.f.o. and amplified signals produce a 9MHz i.f. output from the mixer. The importance of terminating the mixer output correctly is paramount. The circuitry L5, C23 forms a parallel tuned circuit providing high impedance at the resonant frequency of 9MHz. At other frequencies a 50Ω terminating impedance is effected by means of the resistor R20. C24 and L6 are also series resonant at 9MHz. The mixer input and output are diode switched for transmit and receive functions.

The 9MHz i.f. signals are then passed to the filter board where a single stage of amplification is introduced before the filter. This amplifier is run at a fairly high current to minimise the effects of cross-modulation. Signals then pass through the 9MHz filter and on through a CA3028A 1st i.f. amplifier. Transmit and receive selection on this board is also accomplished by diode switching.

The 9MHz i.f. undergoes a second stage of amplification, again a CA3028A, located on board 1. From here, signals pass to the product detector which uses an MC1496. This receives its carrier insertion from the 9MHz oscillator board (board 2).

Readers who intend to operate the Stour should be in possession of the appropriate licence issued by the Home Office to those who have passed the City and Guilds Radio Amateurs' Examination. Details may be obtained from: The Home Office, Radio Regulatory Department, Amateur Licensing Section, Waterloo Bridge House, Waterloo Road, London SE1 8UA.

The audio so produced is amplified by a 741 op. amp. and then by an LM380 to give adequate loudspeaker volume.

Automatic gain control is accomplished by the use of an SL621 a.g.c. system preceded by a clipper.

A relay is at present used to switch the antenna, the 12V/0V supplies required for the diode switching and the d.c. switching. Transistor switches could be used for the latter, but it was felt that as a relay was required for the antenna the spare contacts might as well be used to switch the necessary d.c.

Although not yet tried the only requirement on receive to produce a receiver on any amateur band between 160m and 10m is a change in v.f.o. frequency and one filter, with possibly more r.f. amplification on the high frequencies.

★ specifications

GENERAL

Single conversion with 9MHz i.f.

Frequency Range:	Transmit 1·8–2·00MHz. Receive 1·5–2·00MHz.
Modulation:	A3J, upper and lower sideband (selectable). CW facility available.
Supply Voltage:	11·5–14V, 13·8V nominal.
Current Consumption:	500mA receive, 6A nominal peak transmit.
Frequency Stability:	Less than 100Hz drift in any 30 minute period. (After initial warm up period at normal room temperature.)
Size:	Case measurements 240mm deep × 190mm wide × 140mm high.

TRANSMITTER

Input Power:	45–55 watts } 12–13·5V
Output Power:	20–25 watts } 12–13·5V
Output Impedance:	50Ω
Microphone:	High impedance, dynamic type
Out of Band Spurious Radiation:	50dB down, on wanted signal at rated output. (80m output 50dB down, all other spurii >60dB down.)
Carrier Suppression:	45dB down relative to wanted signal.
In Band Ripple:	1·80–2·00MHz ±0·66dB.

RECEIVER

Input Impedance:	50Ω
RIT:	±2·5kHz
Preselector Range:	1·50–2·00MHz
Filter:	Centre frequency 9MHz.
Specifications:	8 Pole. Passband: 2·4kHz @ −6dB. 4·3kHz @ −60dB.
Audio Output:	1·5–2·00W (dependent upon supply voltage.)
Sensitivity:	0·3μV for 10dB S + N/N.
3rd Order Intercept:	−14dBm.
Loudspeaker Impedance:	8Ω

Circuit Description—Transmitter

Audio signals from the microphone are amplified by a 741 operational amplifier which feeds into the MC1496 balanced modulator. The microphone gain is controlled by means of a potentiometer located on the printed circuit board. Carrier injection, at 9MHz, is obtained from the carrier oscillator board and the output from the MC1496 modulator (double sideband suppressed carrier) is passed to the filter board.

The filter board acts in the same manner on transmit as it does on receive, with one exception. After the output from the CA3028A, and via the diode switch, the 9MHz single sideband undergoes a further stage of amplification through the broadband amplifier 3T2. The resultant signal is then fed to the mixer board.

9MHz s.s.b. signals are mixed and converted to 2MHz by means of the doubly balanced mixer. Switching required during transmit and receive is again accomplished by the use of a pin diode switch. The mixer board also contains one stage of 2MHz amplification via 4T2, a standard broad-band amplifier. This amplifier is the first in the 2MHz amplifier chain and the gain of the whole chain may be adjusted by altering the value of the un-bypassed emitter resistor. At the level at which it has been set however, no instability has been encountered and it is recommended that this resistor remains unaltered unless full output cannot be obtained. The low level s.s.b. at the output of 4T2 is then passed to the drive board via a band-pass filter F1.

The driver board uses three stages: first stage being in Class A and the other two being in parallel, operating in Class A. The output from this board is at approximately 1 watt, which is then transferred to a second band-pass filter F2 and finally to the p.a.

The p.a. consists of a pair of BDY90 switching transistors which operate satisfactorily at 2MHz. (They should, in fact, be OK to above 9MHz as they have an Ft of about 90MHz.)

These transistors are operated in class B at an input of approximately 50 watts. The broad-band transformers were wound using partly trial and error techniques to obtain the turns ratios eventually used. The BDY90s seemed fairly rugged devices and have sustained both short and open circuit loads under full output on more than one occasion without coming to grief. However, it is not recommended that this procedure is adopted too often! The output from the p.a. is fed through a low-pass filter and then to the antenna changeover relay.

General Constructional Notes

Due to the component density required for this project, the p.c.b. layouts must be rigidly followed. Most boards employ ground plane, double-sided techniques. Ensure adequate clearance for component leads as they pass through the copper ground plane layer. Countersinking of the holes is recommended, but do not countersink holes that are earth connections.

Components

Before purchasing the required components the lead-out spacings should be checked. The values of components should be exactly as shown: avoid using inferior quality types. The size of the 0·1μF capacitors must be reasonably small and the author had difficulty in obtaining the same size on a second purchase of both these and the silver mica capacitors.

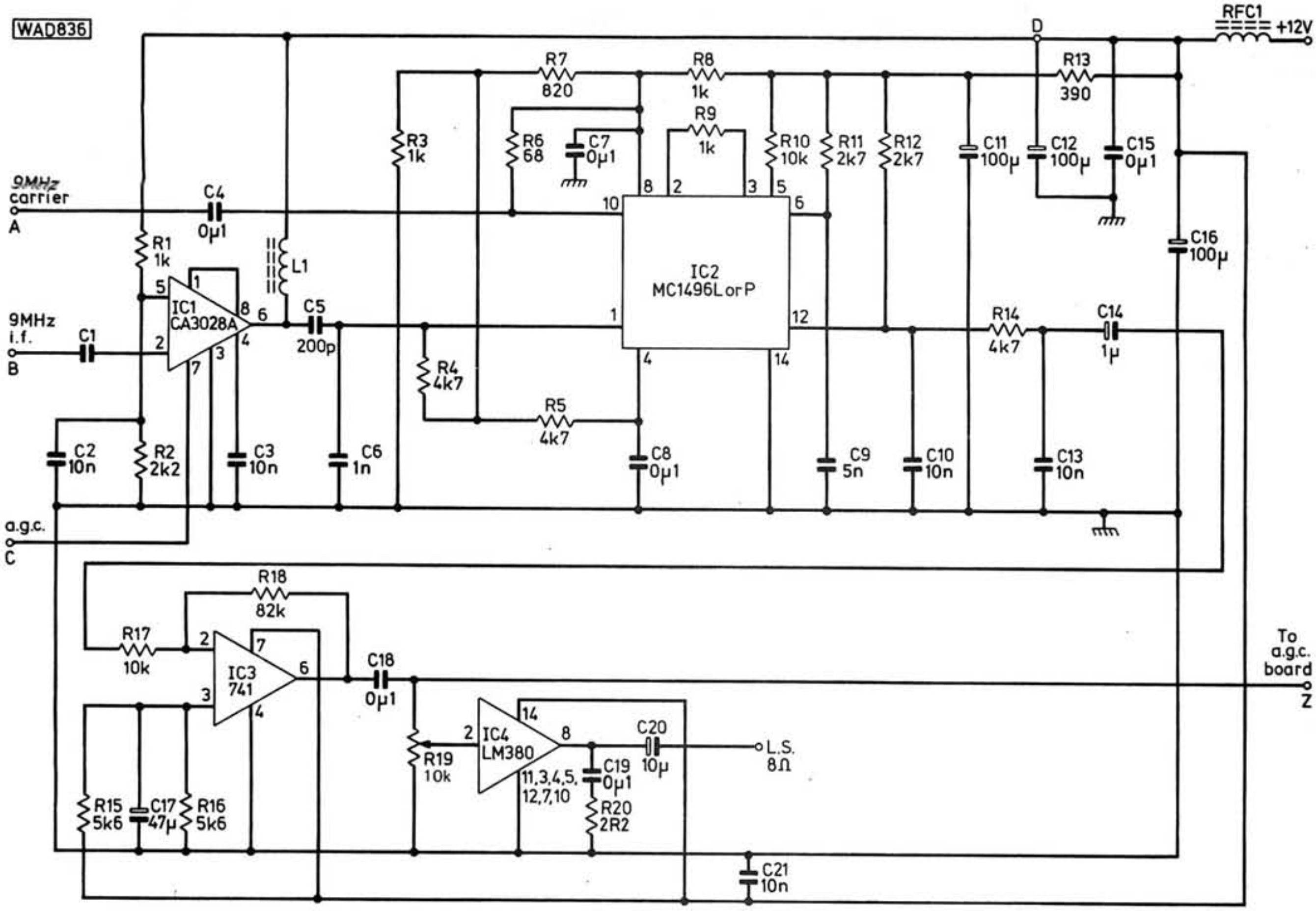
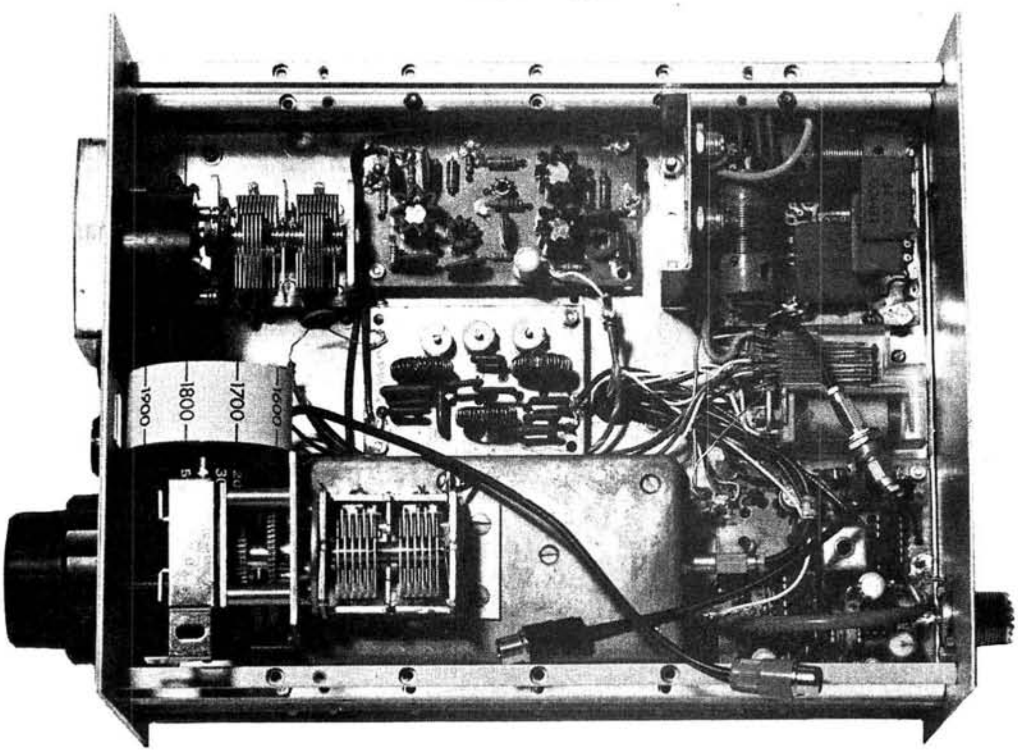


Fig. 2: Circuit diagram of board 1; i.f., product detector and audio stages. Below: Board 1 is located in the bottom right-hand corner of the prototype



The toroids in the broad-band circuits did not seem at all critical and other types would obviously work quite well. A high μ is however essential. The toroids associated with the filters however should not be substituted unless the filter is to be re-designed. The individual component lists will specify the correct grades, etc.

Wiring

It is essential that 50Ω screened cable is used where shown between boards. The miniature p.t.f.e. type of coax is ideal, but any cable with the correct impedance will suffice. The filters in particular will not be terminated correctly if other impedances are encountered.

Board 1—IF Product Detector and Audio Stages

Board 1 contains the following circuitry:

1. IC1, a CA3028A, 2nd i.f. amplifier.
2. IC2, an MC1496, product detector.
3. IC3, a 741, 1st audio amplifier.
4. IC4, an LM380, audio amplifier to provide loudspeaker drive level.

Circuit Description

A full circuit diagram of board 1 is shown in Fig. 2. Point B receives the 9MHz i.f. from the filter board (board 3). It is routed to pin 2 of IC1 via C1. This stage is operated in its cascode mode and has a typical power gain of 39dB at 10·7MHz. In conjunction with the preceding i.f. amplifier this would give a post filter gain of approximately 80dB. The output load to the CA3028 consists of the tuned circuit L1, C5 resonant at 9MHz, this inductor being slug tuned. The output is capacitively tapped into pin 1 of IC2 via C5 and C6.

IC2, an MC1496, makes an excellent s.s.b. product detector. According to the application notes on this device it has a sensitivity of 3μV and a dynamic range of 90dB when operating at an i.f. of 9MHz. The resistor between pins 2 and 3 controls circuit gain, sensitivity and dynamic range. Extra decoupling was found to be necessary which consisted of C11, R13. This cured any tendency towards audio instability and did not seem to reduce the overall gain of the device. The circuitry around IC2 is similar to that of the balanced modulator but has no facility for carrier null, this not being necessary on receive. The audio output appears at pin 12 and is routed to pin 2 of IC3 via R14, C14 and R17.

IC3, a 741 operational amplifier, is used here as the first audio amplifier with its gain set by the ratio of R18 to R17. Increasing R18 will increase the available gain. The audio output at pin 6 is fed via C18 and R19 to pin 2 of IC4. R19 is the volume control and is located on the front panel.

IC4, an LM380, is used as the audio power amplifier. This amplifier was chosen as it needed a minimum of components around it, is short circuit proof (essential at the author's QTH) and has internal thermal limiting. The voltage gain of this device is fixed internally at 50. The output power of 2 watts, appearing at pin 8, is fed to the 8Ω loudspeaker via C20. R19 used in the prototype was a 100k log potentiometer, but a value of 10kΩ was found to be a better proposition as IC4 had a tendency to latch on switch on. C19 and R20 were included to prevent any instability in the LM380.

Fig. 3 (above): Full size track pattern of the underside of board 1

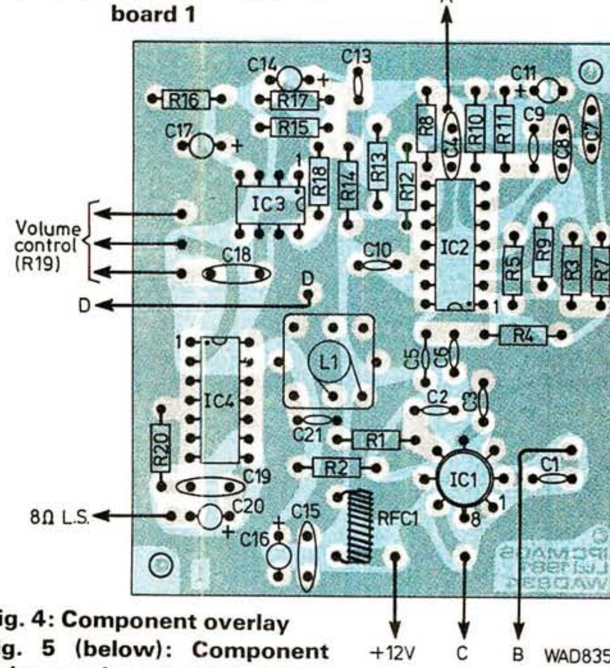
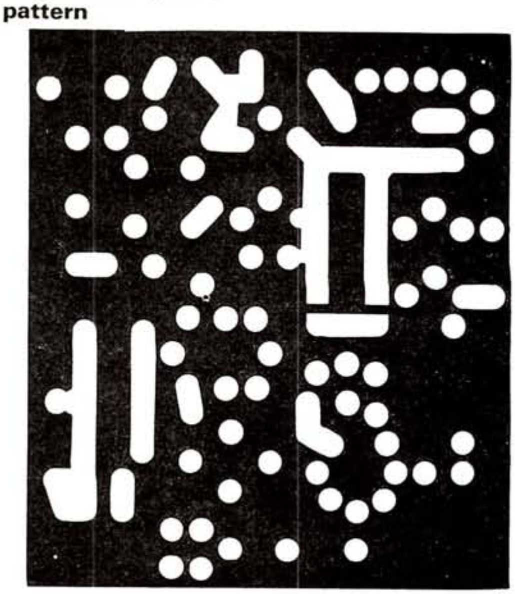


Fig. 4: Component overlay

Fig. 5 (below): Component side p.c.b. ground plane pattern



★ components

BOARD 1

Resistors
¼W 5% Carbon Film

2·2Ω	1	R20
68Ω	1	R6
390Ω	1	R13
820Ω	1	R7
1kΩ	4	R1,3,8,9
2·2kΩ	1	R2
2·7kΩ	2	R11,12
4·7kΩ	3	R4,5,14
5·6kΩ	2	R15,16
10kΩ	2	R10,17
82kΩ	1	R18

Potentiometer
Panel Mounting

10kΩ log.	1	R19

Semiconductors
Integrated Circuits

CA3028A	1	IC1
MC1496 LP	1	IC2
741	1	IC3
LM380	1	IC4

Capacitors
Resin Dipped Ceramic

1nF	2	C1,6
5nF	1	C9
10nF	5	C2, 3, 10, 13, 21

Sub-min Ceramic

200pF	1	C5

Disc Ceramic

0·1µF	6	C4,7,8,15,18,19

Tantalum Electrolytic

1µF	1	C14
10µF	1	C20
47µF	1	C17
100µF	3	C11,12,16

Miscellaneous
RFC1 20 to 30 turns of 32 to 38 s.w.g. wire on 28-002-27 toroid; L1 15 turns of 38 s.w.g. wire on Neosid inductance assembly type A6; printed circuit board.

The radio frequency choke and C15 provide r.f. decoupling to the board. This was found to be necessary when hooking the various boards together on the bench during preliminary tests on the receiver section.

The 9MHz carrier insertion enters at point A and, via C4, is routed to pin 10 of the MC1496. The a.g.c. voltage is applied to pin 7 of the CA3028 at point C. Point B is the 9MHz i.f. input to pin 2 of IC1.

To prevent any r.f. breakthrough during transmit the 12V supply is connected to this board during receive only via relay connections.

Constructional Details

The board is constructed on a double sided glass fibre p.c.b. and Vero pins are used for all external connections. It is important that the d.i.l. package is obtained for IC2 (this is also available in other forms). Similarly, the TO5 style package for IC1 and 14 pin d.i.l. package for IC4 are used.

R6, a 68Ω resistor, is connected between pins 10 and 8 of IC2 on the underside of the board.

A 100µF decoupling capacitor, C12, is included to ensure adequate audio decoupling. This capacitor is joined between point D (see component layout) and the earth plane on the top of the board.

Two holes between C13 and R8 are not used. A resistor was originally used between the input (point B) and earth, consequently there are two spare holes at this point also.

Connections to Board 1

Point A connects to the 9MHz oscillator on board 2, point Y. Point B connects to filter board 3, Y out. Point C connects to a.g.c. voltage, board 8 a.g.c. 0/9V. The +12V line connects to the +12V rail via relay contacts, during receive only. Point Z, the top of R19, volume control, connects to the a.g.c. board 8.

NEXT MONTH

The second part of this article will cover the construction of the 9MHz oscillators, filter and mixer boards.

BI-PHASE COMPARATOR

▶▶▶ continued from page 21

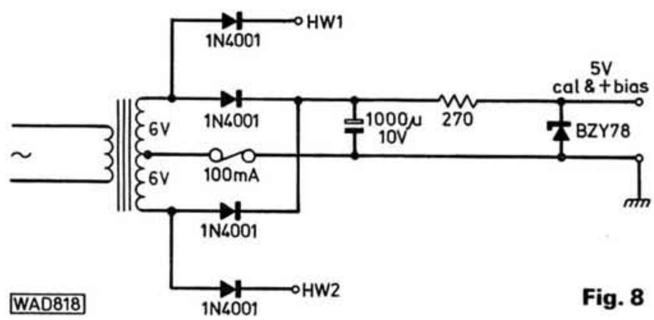


Fig. 8

For convenience, the bias controls are calibrated during construction using a multimeter temporarily wired for reference. Volts for valves, microamperes for transistors.

Practical Circuits

The valve versions of the bi-phase power supply and comparator are shown in Figs. 5 and 7 and that for transistors in Fig. 6. The valve power supply, Fig. 7, has provision for 6·3 volt heaters, negative bias and a stabilised voltage of 105 volts for the screen grids and calibration source. The transistor power supply in Fig. 8 has a 5·2 volt stabilised voltage for calibration and current bias source.

The two additional diodes in Fig. 6 are needed in the transistor comparator so that current in R1 or R2 is not diverted through the non-conducting transistor. ●

PRODUCTION LINES

ALAN MARTIN G8ZPW

Electronic Music

Over the last few years, Casio have entered the electronic musical instruments market and the latest additions to their range are real beauties.

I will describe the model in the middle of their electronic organ range, the Casiotone 301 which compares very favourably with similar products on the market.

The CT–301 keyboard covers four octaves (49 keys) which allows up to an eight note polyphonic sound combination to be played. Fourteen separate voices are available; they are organ, flute, oboe, clarinet, trumpet, violin, cello, piano, harpsichord, celesta, accordian, electric piano, funny and frog. Each of these voices can be effected by a vibrato and vibrato delay function, the vibrato delay being particularly applicable to creating the sensitive sounds of wind and stringed instrument voices.

The rhythm section features eight built-in rhythms from Rock to Mambo. Each rhythm has two variations and a Synchro Start function that can add that professional touch to performances. Also included in this section is an override Start/Stop switch, rhythm tempo control and rhythm-only volume control.

The CT–301 is housed in a woodgrain finished case, measures 796 × 326 × 116mm and weighs 12.3kg (27lbs). A built-in speaker is fitted, as is a preset Pitch Control ($\pm\frac{1}{4}$ tone).

External connections can be made via four rear panel jacks for headphones, output (line out), foot volume and sustain. Optional accessories for these functions are available.

The discounted price of the CT–301 is £245 and is obtainable, as are details of other instruments in the range, from: *Tempus, The Beaumont Suite, 164–167 East Road, Cambridge CB1 1DB. Tel: (0223) 312866/67503.*

New DFM

Holdings Photo Audio Centre consider that a unit they are importing will prove to be a real winner. It is the FC–841 digital frequency meter which covers the range 10Hz to 50MHz and up to 500MHz using a suitable prescaler.

Measuring only 120 × 100 × 32mm the unit is powered by internal batteries or external d.c. supply (8 to 11V). Sensitivity is claimed to be better than 30mV over most of the range (60mV on int. batteries), with accuracy of ±10Hz and resolution 10Hz/10kHz.

The basic price of the FC–841 is £39.99 including VAT and the total price which includes batteries, input lead, carriage and insurance is £43.58. Other optional accessories and further details are available from: *Holdings Photo Audio Centre, Mincing Lane, Darwen Street, Blackburn BB2 2AF. Tel: (0254) 59595.*

Useful Mini Drill

The "Reliant" 12V mini drill is available from TRI-tronic Marketing Ltd., together with a range of accessories which includes a versatile drill stand, mains to 12V d.c. power supply unit, drill bits and diamond burrs.

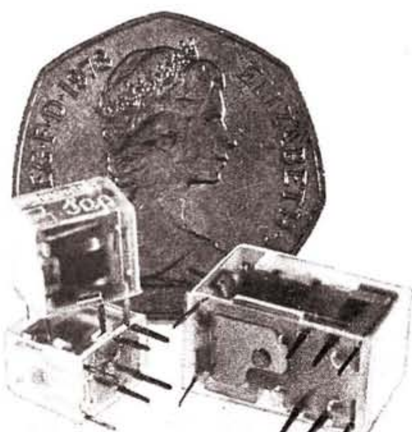
Measuring only 75mm long × 34mm diameter, the drill is powerful enough to drill up to 3mm holes in p.c.b. materials or sheet metal.

The basic price of the drill is £6.98 and further details are available from: *TRI-tronic Marketing Ltd., 9 Badby Leys, Rugby, Warwickshire CV22 5RB. Tel: (0788) 812895.*

Miniature PCB Relays

Ambit have recently introduced two p.c.b. mounting relays. The RBU series is a flux resistant relay with two-pole changeover contacts, each capable of handling 2A at 24V d.c. Stock types are provided with 10–12V d.c. 320 ohm coils, although any value from 3V to 24V can be accommodated to order. Life expectancy is a minimum of 10 million mechanical cycles, with 100 000 cycles for the contacts when run at maximum capacity.

The RCU relay is one of the smallest changeover relays available (excluding TO5 types). It is a single-pole unit, capable of switching 2A at 24V d.c. (or 2A at 100V a.c.). The "stock" coil is a 10–12V d.c. 320 ohm winding, although 3–24V is available to order. Life expectancy is the same as for the RBU relay.



Applications of both these relays include antenna switchover, remote control systems etc.

The RBU costs £1.85 and the RCU £1.65. Both are available from: *Ambit International, 200 North Service Road, Brentwood, Essex CM14 4SG. Tel: (0277) 230909.*

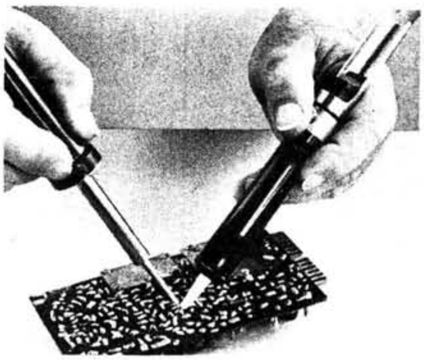
Low-cost Desolder Pump

Industrial performance at an economy price is claimed for OK Machine and Tool (UK) Ltd.'s DSP–1 desolder pump.

Suitable for general purpose industrial use and the hobbyist, the hand operated tool costs about £6 and is all metal with an easy to replace teflon tip.

Solder can be removed precisely from delicate circuitry without causing damage and the tool is self cleaning on each stroke.

Further details from: *OK Machine and Tool (UK) Ltd., Dutton Lane, Eastleigh, Hants SO5 4AA. Tel: (0703) 610944.*

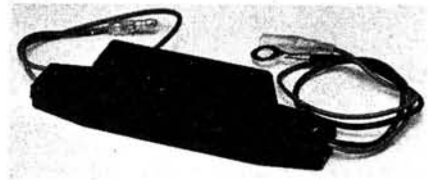


Noise Suppressor

A new noise suppressor for car audio systems has been introduced by Hitachi to minimise the interference created by a vehicle's electrical equipment which may be transmitted along the power supply cable.

The Hitachi NF2 is a dual suppressor and choke filter unit which fits simply between the power lead and the car radio or cassette player. It was designed and developed by Hitachi's own in-car audio specialists in the UK. This small device comprises an iron core choke and electrolytic decoupling capacitor, sealed-for-life in an epoxy resin encapsulation.

Costing £3.45 which includes VAT,

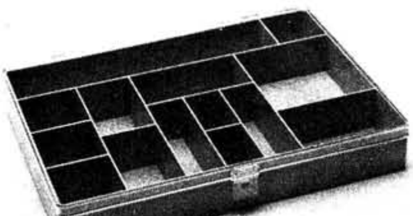


the NF2 suppressor is supplied complete with detailed fitting instructions and is available through Hitachi's extensive UK network of car audio dealers. Alternatively, full information can be obtained from: *The Sales Manager, In-Car Equipment Division, Hitachi Sales (UK) Ltd., Hitachi House, Station Road, Hayes, Middlesex UB3 4DR. Tel: 01-848 8787.*

Clear-up

Probably one of the most efficient ways of storing small electronic components is multi-compartment storage cases, two which would seem to fit the bill are available from Edward Roland Ltd.

Called "Space Misers", the largest is a 14, various sized, compartment case, measuring 349 × 241 × 51mm. The case is beige in colour and fitted with a crystal-clear hinged lid with a strong snap-shut clasp. This unit costs £5.75 which includes VAT.



The smaller unit has 10, equally sized, compartments and measures 267 × 140 × 32mm. Similarly, this case is beige coloured has a crystal-clear hinged lid and costs only £2.40 which includes VAT.

Both items are available by post (p&p free within the UK) from: *Edward Roland Ltd., 215 Putney Bridge Road, London SW15 2NY.*

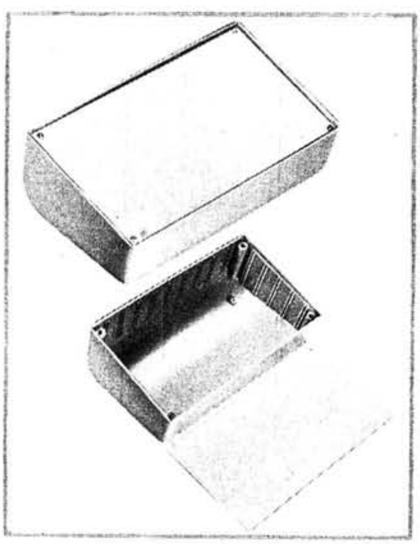
Small Desk Consoles

Recently introduced by Boss Industrial Mouldings Ltd., is a range of small desk consoles manufactured in ABS and fitted with a 1mm thick grey aluminium panel which sits recessed into the sloping front.

Available in two sizes measuring 161 × 96 × 58mm deep and 215 × 130 × 75mm deep, these Bimconsoles are moulded in orange, blue, black and grey and incorporate, not only slots on all four sides into which 1·5mm thick p.c.b.s can be fitted, but also 5mm diameter stand-off bosses for supporting small sub-assemblies, etc.

The front panel is supported on four corner pillars which also carry the brass bushes into which the panel fixing screws run.

Prices, which include VAT and p&p, are £2.48 for the smaller Bimconsole and £3.48 for the larger one. The enclosures are obtainable from: *Boss Industrial Mouldings Ltd., 2 Herne Hill Road, London SE24 0AU. Tel: 01-737 2383.*



Useful Receiver

Grundig's Party Boy 700 radio should prove very popular with people who do not possess the full use of their hands.

Without any conventional control knobs, the Party Boy 700 has a slide volume control and a roller tuner which suits people with handling difficulties.

It can be powered by mains or batteries and is capable of receiving l.w., m.w. and v.h.f. wavebands, with a built-in a.m. aerial and a telescopic antenna for f.m. (v.h.f.). It has an output of 1·5 watts.

The radio has a tone control, earphone socket and carrying handle.

Measuring 29 × 16 × 7cm, the Grundig Party Boy 700 weighs approximately 1·3kg and is available from Grundig dealers, in Black or Walnut finish at a typical selling price of £36 including VAT.

If you please

Please mention "Production Lines", when applying to manufacturers or suppliers featured on this page.

Assessing the new RAE

THE FIRST TWO YEARS

*Arthur HARADA M.Ed, Dip.SP.Ed, ACP, G4INX

In the light of much ill-informed and often heated argument heard on the airwaves nowadays concerning the new RAE, it is time to offer a sequel to my last article (*Practical Wireless*, Jan. 1980) on this important examination. By and large people don't enjoy taking exams, simply because we naturally avoid those experiences in life which will not only discover our weaknesses, but also point them out to others. However, if we can gain sufficient familiarity with the RAE, namely, what the questions seek to measure, how they are constructed and marked, etc., this new-found insight might prevent an apoplectic fit by some readers when reading the now famous slip from the City and Guilds of London Institute (CGLI) pushed through the letterbox in late August or January. From all accounts, there are as many complaints over not being awarded distinctions as there are about failing.

Each part of the two-part RAE consists of multiple-choice questions, some of which make a regular and generally unchanged appearance and endeavour to tap knowledge of specific basic facts. Coupled with them are newcomers constructed to measure more complex learning outcomes, and supplied by technical college staff amongst others, many of whom are licensed amateurs. All the questions are vetted by a small examinations committee reporting to the CGLI and not, as is popularly believed, to the RSGB. Theoretically, every question presents candidates with a task that is both important and understood, and can be answered correctly only by candidates who have mastered the desired learning.

A multiple-choice item in the RAE is sometimes in the form of a question or more often an incomplete statement (called a **stem**) followed by four suggested answers or completions (called **alternatives** or **responses**). Only one of these is correct (called the **key**), the wrong responses (called **distracters**) being plausible. It can happen that the alternatives are very similar to one another, and the candidate has to exercise considerable care, e.g.

> Q.5 The spelling of the word MEXICO using the recommended phonetic alphabet is:
> a) Mike Echo X-ray India Charlie Oscar
> b) Mike Easy X-ray India Charlie Oscar
> c) Mike Easy X-ray India Charlie Oboe
> d) Mike Echo X-ray Ireland Charlie Oboe
> (Paper 2, May 1980)

*Department of Professional Studies, Chester College of Higher Education

Not very often, but nevertheless candidates should be aware of the fact, the stem of an item can be expressed in a negative form, e.g.

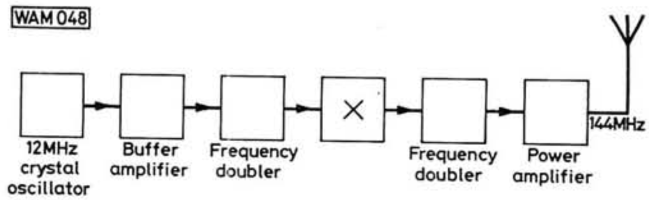
> Q.5 Entries in the Station log book need not include:
> a) date
> b) time of commencement of operation
> c) signature of the licensee
> d) time of closing down the Station
> (Sample items, 1979)

Using negatively-stated item stems can be a convenient way of overcoming the test constructor's frustrations and inability to generate a sufficient number of plausible distracters. This state of affairs is being quickly reached in Paper 1 where the scope for fresh items on Licensing Conditions and Transmitter Interference is somewhat limited, and might result in future papers containing what some might call very difficult items, e.g.

> Q.4. The holder of a Class B licence may use which of the following modes of operation in the frequency band 144-146MHz?
> a) A3, A3A, A3H, F3, P3E
> b) P3D, A3J, A1, F3, A3H
> c) F3, A1, A3J, A3, A3A
> d) A3, A3A, A3H, A3J, F3
> (Paper 1, May 1979)

If nothing else, this type of item warns you to learn every detail on the facsimile of the Licence printed in the majority of examination preparation manuals.

Despite every reasonable precaution, examiners can make mistakes and provide a list of alternatives none of which is correct, e.g.



> Q.37 The above figure shows a block schematic diagram of a c.w. transmitter for the 144MHz band. What is the purpose of the box marked X?
> a) linear amplifier
> b) frequency modulator
> c) frequency doubler
> d) buffer amplifier
> (Paper 2, Dec. 1980)

Correct answers in triplicate to the Editor, please!

Another version of the multiple-choice item is known as the best-answer form, in which more than one alternative is correct, but one is better than the rest, e.g.

> Q.8 Ohm's Law states that:
> a) a current of one ampere flows in a circuit having a resistance of one ohm when one volt is applied to it
> b) $I = \frac{E}{R}$
> c) when one coulomb of electricity passes between two points there is a potential difference of one volt then one joule of work is done
> d) the current flowing in a circuit is directly proportional to the applied e.m.f. and inversely proportional to the resistance of the circuit
> (Paper 2, May 1979)

In this last example it could well be argued that the choice between (a) and (b) is minimal, although neither are accurate on reading Ohm's Law in the original which states "The ratio of the p.d. (V) between the ends of a conductor, to the current (I) flowing in it, is always a constant provided the physical condition of the conductor is unaltered."

Yet another example of examiner error, or to put it another way, an illustration of the difficulty of avoiding the pitfalls of writing poor items may be seen in:

Q.3 An amateur licence may be revoked by:
a) a notice cancelling all amateur licences appearing in a newspaper published in London
b) a general notice cancelling all amateur licences being broadcast by the British Broadcasting Corporation
c) the Licensee transferring the Licence to another person without informing the Secretary of State for the Home Department
d) a letter from the local Chief Constable
(Paper 1, Dec. 1979)

Both (a) and (b) are equally valid if one takes the relevant clauses in the Licence separately.

In theory, it is by guesswork possible to stand a 1-in-4 chance of obtaining the correct answer in the RAE, but this technique is not advised as the right answer is randomly placed and, as a general rule, appears in each alternative position approximately an equal number of times throughout both papers. It could be strongly argued that the CGLI should use what is known as a "correction formula"—designed to penalise the candidate who guesses the answers, since the scoring system provides no larger penalty for guessing wrong than for omitting an item. Hence, the more daring and less conscientious class of examinee may enjoy an added advantage deriving from their personality type and not from their grasp of the subject matter being questioned. The CGLI's standpoint on this is:

"It is Institute policy not to apply a correction score for guessing. In theory, the expected guessing score is 25 per cent for a set of "1-from-4" items. However, in practice this score is not of great significance as:
(a) Pure guessing is a last resort, and likely to be confined to the poorest students, who are in any case likely to fail (the pass mark is well above the expected guessing score).
(b) Part-guesswork is a valid activity, as on average a student will gain a score reflecting his partial knowledge."

There are still some inaccurate claims made about the pass rate, not to be confused with the pass mark. It still remains at approximately 70 per cent in Paper 1 and 60 per cent in Paper 2. Clearly, this is because the RAE is standardised using a statistical technique known as item analysis, whereby poor items can be identified, rejected or re-drafted, and acceptable ones banked for future use. So, don't skimp in either initial study or revision; abstain from unreasoned guesswork as it might prevent your dredging the deep recesses of your mind for the right answer; tackle the items you're sure of first; and if you change your mind about an answer be sure to rub out the first mark. Finally, count yourself lucky if you aren't an overseas candidate—about 50 per cent of them fail. Without doubt this is because home candidates have excellent support from patient teachers of the RAE, and easy access to first-rate technical journals that pitch their contents so as to encourage practical experimentation in the reader's home. Good luck! ●

kindly note!

PW Sherborne, October 1980

In the circuit diagram Fig. 3, D41 adjacent to Tr15 should read D42. D42–47 then become D43–48 inclusive.

C29+ should be connected to the other side of S19b.

In the components list for the synthesiser the yellow l.e.d.s are D41, D44 and D45.

Mods. No. 5 Standard C 8800, April 1981

The new wire, shown in orange in Fig. 3, should connect pin 4 to pin 1, and not as shown. The additional resistor, R1, should be 10kΩ **not** as specified in the text.

PW Helford April 1981

In Fig. 30, page 39, R902 and R903 are not, in fact, resistors but the two regulated bias supplies as detailed in Part 4.

The transistors (Tr501–504) in the component placement diagram Fig. 23 Page 43 are shown with the collectors and bases transposed. These transistors should be fitted so that the tabs with the cut-away corners are towards T504 and T505.

MODS

IMPORTANT—The ideas presented here are suggestions only, and as they are untried by this magazine, we cannot accept responsibility for any resultant damage, however caused. Before alterations are attempted, care should be taken to ensure that any guarantee is not invalidated, and it should also be borne in mind that modifications usually have an adverse effect on resale prices. In cases where specialist skills or equipment are needed, most dealers will undertake the work for a reasonable fee.

Roger Hall G8TNT(Sam)

No. 6

Trio TR-2300

This month's column is devoted to the ever popular TR-2300. Bill, G8UNN, wrote to ask me if I knew of a reverse repeater mod for this set and so I contacted Steve, G8VEF, at Lowe Electronics, and he has supplied the following information.

First, take off the cover of the set on the loudspeaker side and locate the AUX switch, it has a brown wire and a white wire attached to its rear tags (Fig. 1). The original mod suggested removing these wires and tucking them back into the loom, and then adding new wires as in Fig. 1. Steve has pointed out that if the wires are cut approximately 25mm back from the switch at the points marked "X" in Fig. 1, they can then be used instead of two new pieces of wire. As Steve said, this means that you only have to make two soldered joints and not four, which in this instance is a good idea because there is not much room on this switch as there are many other wires attached to it, although for the sake of clarity they have not been shown in the diagram. When the set is operating on the REPEATER position of the bandswitch, this mod gives instant reverse repeater operation whenever the AUX switch is pressed.

Following on from this, Gareth, GW4KJW, has written in with what he calls a mod of a mod, and he says, although it does not contribute anything to the performance of the set, it does make use of something that is otherwise left unused.

When the set has been modified for reverse repeater, there is a small l.e.d. to the left of the AUX button that remains permanently off because it was originally designed to show that a crystal controlled channel had been selected,

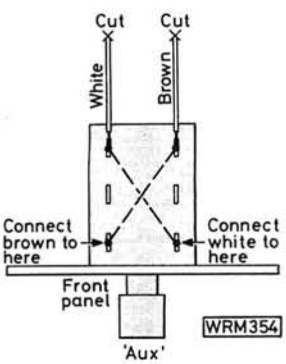


Fig. 1

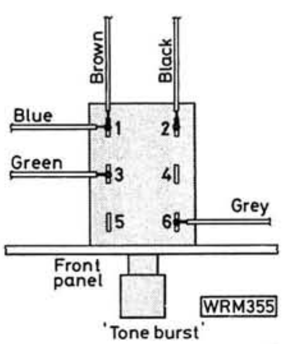


Fig. 2

but now that the AUX button has a different function, the l.e.d. has nothing to do. Gareth suggests using it as a toneburst indicator to give a visual indication that the toneburst is switched on.

To do this, the top cover should be removed and the blue wire unsoldered from the three-position dial light slider switch. This wire should then be fed back through the wiring loom and soldered to Pin 1, the rear left-hand pin of the toneburst switch (Fig. 2).

This mod lights the l.e.d. for as long as the toneburst is switched on, except on transmit, when the l.e.d. is off while the p.t.t. is depressed.

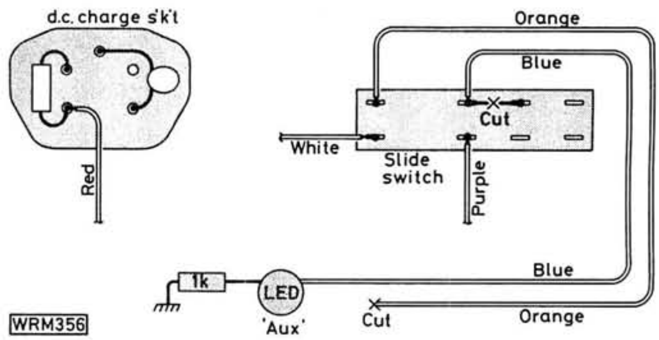


Fig. 3

The last mod this month was devised by G8JLE, but was given to me by Lowe Electronics. This mod makes use of the same l.e.d. as the last one but this time it is used to give a visual indication of battery charge, and needless to say, it is not possible to carry out both of these mods on the same set! Fig. 3 shows the original charge socket, and the original three-position dial light slider switch. Fig. 4 shows how the two have to be modified and interconnected. The orange wire has to be removed from the top left-hand pin and attached to the top right-hand pin and then cut some way away from the switch and that end soldered to the side of the l.e.d. that has a 1kΩ resistor soldered to it. The resistor is then cut off and not used.

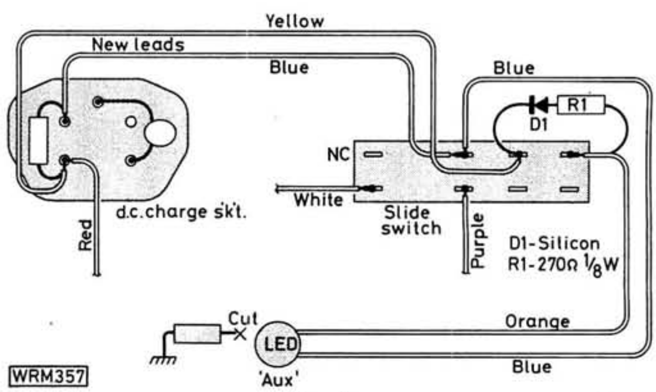


Fig. 4

Two new wires, blue and yellow, are run from the switch to the socket, as in the diagram, and the link on the switch is then cut. A silicon diode and a 270kΩ resistor are then connected as in Fig. 4.

When completed, this mod gives a visual indication that the batteries are receiving charging current when the charger is plugged in. If you have any mods, or requests for mods, please write to: R. S. Hall, *Practical Wireless,* King's Reach Tower (Hatfield House), Stamford Street, London SE1 9LS.

73's
Sam G8TNT

Next month in Your All Radio PW

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DX Listening and Viewing · Radio Control

plus The Latest Developments on the CB Scene

GETTING INTO MICROWAVES

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With this 10GHz wide-band f.m. transceiver you can enter the wonderful world of microwaves. Contacts over line-of-sight paths of 150km should be possible with this project, which has been designed with the beginner to microwaves in mind. Look out also for news of our parabolic dish offer

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Band II VHF Pre-Amp

and

USING REPEATERS

USING 2 METRES

J.M.FELL G8MCP

The 2 metre amateur band, since its availability to Class B licensed radio amateurs in the mid-60s has seen a continuous increase in activity and operating modes.

Readily available commercially designed and produced equipment, together with the readily manageable wavelength at this frequency, has encouraged many people into licensed amateur operation. Whilst the 2 metre band is used extensively by the newly licensed amateur, the band has much more to offer to all user levels, licence holders or s.w.l.s.

This article has been written to provide an indication of the extensive variety of modes available for operation and observation of this v.h.f. waveband.

The 2m Band Plan

In order to make the best possible use of the 2 metre band it is useful to be able to refer to a nominated band plan. Fig. 1 is a reproduction of the International Amateur Radio Union (IARU) Region 1 band plan, showing the current UK usage notations.

The band plan has been formulated between the Region 1 member countries. The interests of all UK amateurs are represented on the Region 1 sitting committee by the Radio Society of Great Britain.

Whilst, with the exception of the two spot frequencies, the band plan is a *recommended* guide to band use, by following this course of self-regulation the maximum use of the frequencies between 144–146MHz can be obtained by all.

A study of the band plan will reveal the variety of operations taking place, and a brief guide to these follows.

Moonbounce

Moonbounce, Earth Moon Earth or e.m.e. for short, is the name given to encompass the increasing number of experiments being conducted by radio amateurs, utilising the face of our natural satellite for the reflection of radio signals.

The 2 metre band contains the lowest practical frequency available to amateurs that will allow for the use of multiple, high gain or parabolic dish, steerable antenna systems.

Amateur operators in the UK have been successful in establishing contact with all continents using this technique, primarily using very narrow c.w. bandwidths, but in increasing instances via single sideband telephony.

Because of the large path losses introduced by the distances involved and the surface absorption of the transmitted signals on the face of the Moon, e.m.e. equipment represents the current state-of-the-art. Great attention must be paid to achieving very low noise figures in the receiver front ends in addition to high passive antenna gain. For this kind of operation to succeed it is vital that the allocated link frequencies remain free of other conventional forms of earthbound communications.

CW

Morse coded transmissions are permissible on 2 metres, as with all other amateur bands, but the use of this highly efficient narrow bandwidth means of communication is restricted to use by holders of the full Class A licence.

Valuable information can, however, be obtained by the s.w.l. and Class B licence holder from observations on the c.w. frequencies. The sheer scale of distances that are being worked on a daily basis has inspired many to the attainment of a full licence.

Meteor Scatter (MS)

This exacting mode of operation utilises the reflective nature of ionised patches of the upper atmosphere produced by the decomposition of meteorite debris. Due to the height above the surface of the Earth that this ionisation occurs, approximately 110km, signals may be propagated over paths of 2000km in length.

Main activity periods are coincident with known meteorite storms or showers, but several amateur operators maintain activity to enable contacts to be made via random meteorite action. All the information obtained is also of interest to the many space observatories and is eagerly sought out to enhance our knowledge of this phenomenon.

Once again, it is of vital importance to establish frequencies for this method of operation. Single sideband (s.s.b.) and c.w. modes are utilised, with separate subbands provided. A study of the band plan will show 5 minute and 1 minute time periods allocated for the random

Fig. 1: IARU 144MHz Band Plan with UK usage

CW only	144·000	Spot frequency (UK use forbidden)
	144·000 —144·010	Moonbounce
	144·050	c.w. calling frequency
	144·100 —144·110	Random c.w. m.s. (5 min)
	144·145 —144·150	Random c.w. m.s. (1 min)
SSB and c.w. only	144·200 —144·210	Random s.s.b. m.s.
	144·250	Used for GB2RS and slow Morse transmissions
	144·260±	Used by Raynet
	144·300	SSB calling frequency
All modes non-channelised	144·500	SSTV calling frequency
	144·540	Spot frequency (UK use forbidden)
	144·550	Data
	144·600	RTTY calling frequency
	144·600±	RTTY working (f.s.k.)
	144·650	AM calling frequency
	144·700	FAX calling frequency
	144·750	ATV calling and talkback
	144·800	Raynet
	144·825	Raynet
	144·850	Raynet
	144·875	Raynet
UK beacons	144·900—144·990	UK beacons
FM repeater inputs	145·000	R0
	145·025	R1
	145·050	R2
	145·075	R3
	145·100	R4
	145·125	R5
	145·150	R6
	145·175	R7
FM simplex channels	145·200	S8 Raynet
	145·225	S9 used by Raynet
	145·250	S10 used for slow Morse tone modulated transmissions
	145·275	S11
	145·300	S12 RTTY—a.f.s.k.
	145·325	S13
	145·350	S14
	145·375	S15
	145·400	S16
	145·425	S17
	145·450	S18
	145·475	S19
	145·500	S20 f.m. calling channel
	145·525	S21 used for GB2RS f.m. newscasts
	145·550	S22 used for rally/ exhibition talk-in
	145·575	S23
FM repeater outputs	145·600	R0
	145·625	R1
	145·650	R2
	145·675	R3
	145·700	R4
	145·725	R5
	145·750	R6
	145·775	R7
Satellite service	145·800 —146·000	Satellite service

NOTES

Operation on the two spot frequencies is not permitted in the UK by the terms of the Home Office licence. See licence footnote No. 4.

The beacon and satellite service bands must be kept free of normal communication transmissions to prevent interference with these services.

The use of the f.m. mode within the s.s.b./c.w. section and c.w. or s.s.b. in the f.m.-only sector is not recommended. Repeater stations are primarily intended as an aid for mobile working and they should never be used for DX communication. FM stations wishing to work DX should use the all-mode section, taking care to avoid frequencies allocated for specific purposes.

GB2RS is the callsign of the RSGB weekly news bulletin, broadcast on 144·250MHz u.s.b. and S21 f.m. For further details of times and coverage contact the RSGB.

operation. These times refer to the pre-arranged methods of calling and listening, essential in order to allow the flow of information to accumulate from the very short duration bursts of reflected signals.

Comprehensive details of m.s. operating procedure may be found in the RSGB *Amateur Radio Operating Manual.*

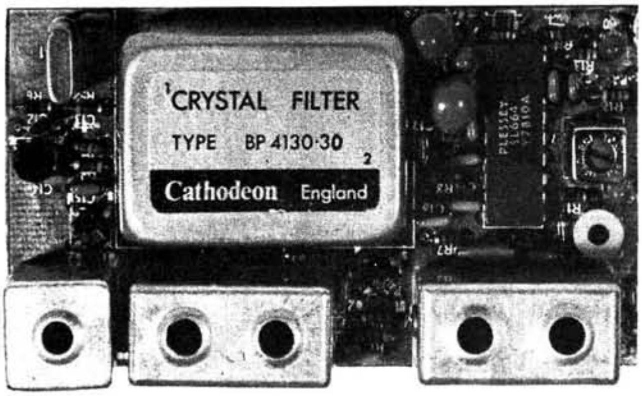
Amateur Television

Since the earliest pioneering days of commercial television, radio amateurs have paralleled with their own experimental services.

Several modes of TV operation occur on the 2 metre band with slow scan (SSTV) probably the most prevalent. The ability to transmit and receive audio and video information adds considerably to the enjoyment of stations equipped with the necessary hardware.

Facsimile—FAX

Facsimile transmissions utilise a process that converts graphic information into electrical signals. Initially, the equipment used relied heavily on ex-commercial, electromechanical devices, utilising the effects of passing current from a tracking stylus through electrolytic paper. By suitably decoding the variations in received signal level, corresponding density variations are produced on the paper in the form of the original material.



Constructional projects for 2 metres are popular with our readers. This 2m Monitor Receiver was featured in *Practical Wireless* April 1979

Interest in this form of communication has been stimulated recently by the advent of all solid-state devices that provide an output suitable for display on a v.d.u. The techniques used in this latest equipment are the same as those employed for the retrieval of weather satellite information.

Radio Tele Type—RTTY

The use of RTTY also represents a current growth area amongst radio amateurs, with plenty of activity on the 2m band.

Traditional electro-mechanical devices, still well established commercially, are being superseded by the latest electronic processing methods, again utilising v.d.u.s for the silent display of received information. There can be no doubt that a request to the XYL for permission to install the earlier oil-guzzling, all-singing-and-clanking, mechanical printers, has proved to be the proverbial last straw!

Separate frequencies are listed in the band plan to cater for audio frequency shift keying (a.f.s.k.), associated with a.m. and f.m. modes and frequency shift keying (f.s.k.), transmitted via single sideband.

The Trio TR-7800 is a versatile m.p.u. controlled f.m. transceiver suitable for use mobile or as a base station. Power output is 25W and programming is by key-pad

Fig. 2: A Selection of IARU Region 1 2m Beacons

Callsign	Frequency	QRA Locator	Location
GB3CTC	144.915MHz	XK64a	Redruth, Cornwall
GB3VHF	144.925MHz	AL52j	Wrotham, Kent
GB3NEE	144.935MHz	ZO12a	Burnhope, Tyne and Wear
GB3GI	144.945MHz	XO41j	Nr. Ballynahinch, N. Ireland
GB3LER	144.965MHz	ZU65f	Lerwick, Shetland Islands
GB3ANG	144.975MHz	YQ35c	Dundee
HB9HB	144.125MHz	DH66f	Switzerland
DLOUB	144.807MHz	GM47b	West Germany
PAOJTA	144.820MHz	CL03g	Netherlands
LA1VHF	144.860MHz	ET13c	Norway
LA2VHF	144.870MHz	FX43g	Norway
LA3VHF	144.880MHz	DS78f	Norway
OY6VHF	144.885MHz	WW76d	Faroe Islands
LA4VHF	144.890MHz	CU47a	Norway
EA3VHF	144.897MHz	BB41c	Spain
OH6VHF	144.900MHz	KW59f	Finland
DLOPR	144.910MHz	EO54c	West Germany
SK7VHF	144.920MHz	GP38c	Sweden
OE5XBL	144.920MHz	GI77b	Austria
OZ7IGY	144.930MHz	GP23c	Denmark
DM2ACM	144.935MHz	GL53g	East Germany
DLOUH	144.940MHz	EL68f	West Germany
SK1VHF	144.950MHz	JR41d	Sweden
DMOVHF	144.990MHz	FN29f	East Germany
ON4VHF	145.985MHz	CK23e	Belgium

Beacon Service

Within the frequency range 144·900–144·990MHz can be found the amateur 2m beacon service. These devices operate continuously transmitting c.w. Morse identification information from fixed locations, often employing directional antennas on a fixed beam heading.

An invaluable wealth of information can be obtained by both the licensed amateur and s.w.l. from the observation of signal propagation over these fixed paths. By maintaining a careful record of the received signal strength and variations in audible characteristics, detailed propagation profiles can be built up. The licensed amateur can also obtain information on the suitability of a given path before commencing transmissions, by locating a beacon on the same nominal beam heading and comparing this with the known path capability.

For the constructionally minded person, the presence of a continuously available signal source on a fixed frequency is invaluable for alignment purposes.

The amateur beacon service probably represents one of the few areas of activity for which there is no readily available commercial parallel offered to the general public, and it is known that their facilities are also utilised by many professional bodies. A selection of operational 2m beacons, within IARU Region 1, is given in Fig. 2. A complete list of Region 1 beacons is available from the RSGB headquarters.

Amateur Satellites

Two amateur satellites are currently operational in Earth orbit, financed and built by radio amateurs worldwide.

Both these satellites, code named OSCAR-7 and OSCAR-8 are equipped for linear talk-through operation, allowing the possibility of intercontinental communication between amateur stations. In addition to the transponder function, the satellites are equipped with beacons, operating in the same manner as their terrestrial counterparts. As the satellites are not geostationary, valuable information can be derived from observation of the Doppler effect frequency shifts, and also the effects on signal transmission due to the ionosphere layers.

A third experimental satellite project, code named UOSAT, is being constructed by the University of Surrey, and currently scheduled for launch on a NASA vehicle during September 1981. This device will provide a wide variety of beacon and data mode transmissions, not the least of which will be a narrow-band frequency modulated speech synthesised beacon on 145·825MHz.

In the case of the two operational AMSAT OSCAR series satellites, the 2m band contains either the uplink (transmit) or downlink (receive) frequency. As both these transponders employ highly sensitive receivers, the overall gain of which is controlled by the relative input levels, it is vital to avoid the use of frequencies within their input passbands.

Telephony

Most of the "specialist" modes of communication already covered rely on the use of a.m., f.m. and s.s.b. Telephony on 2 metres utilises all of these modes, specific frequencies being designated to prevent interaction.

Amplitude modulation (a.m.), initially the dominant mode for 2 metre telephony, is now the least used method. Several factors have contributed to this situation, the main ones being the higher possibility of TVI and the lack of available equipment, although several multi-mode transceivers are once again providing this facility.

Single sideband, A3J, telephony is the premier mode for DX working, allowing the maximum utilisation of available bandwidth.

The hand-held 2 metre portable transceiver is very popular with amateurs. The IC-2E from Icom is compact and convenient with an output of 1·5W

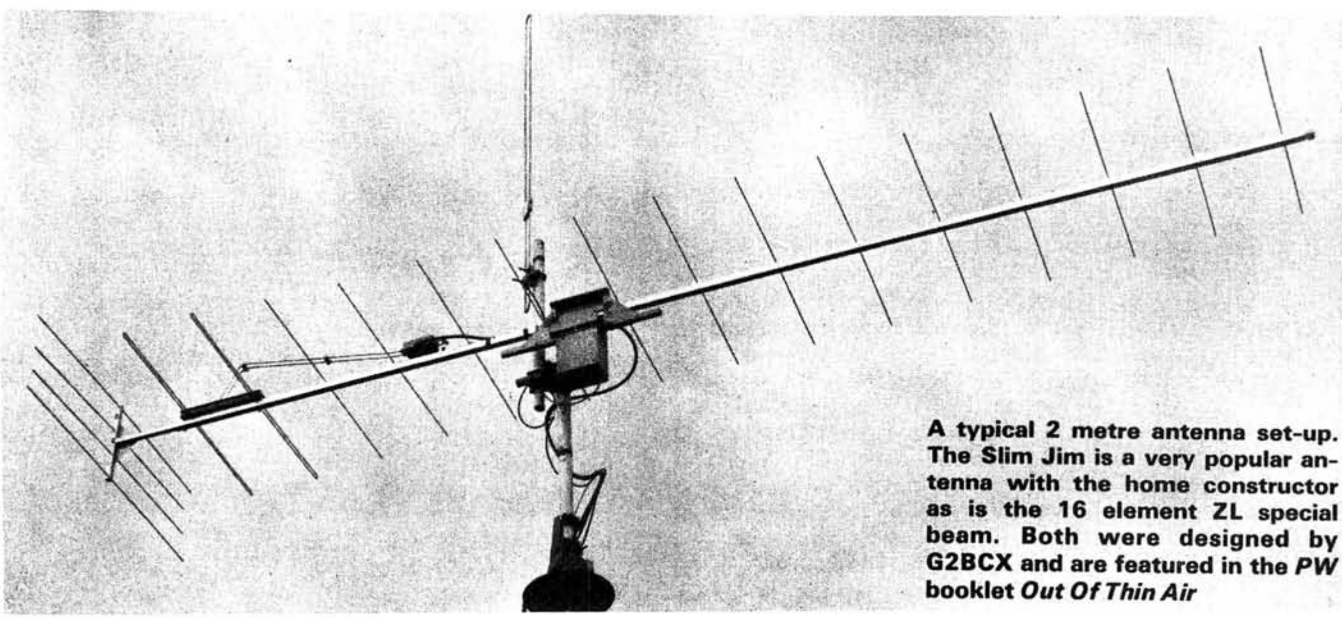
Frequency modulation, F3, is currently by far the most often used mode and this fact is reflected in the amount of bandwidth allocated for this system.

A study of the band plan will show that a "multi-mode" section exists between 144·500MHz and 144·875MHz. Within this sub-band, excluding the specifically designated frequencies, it is possible to use any of the licensable modes of transmission. It is this section of the band that should carry any spill-over activity during crowded "lift" conditions. Regrettably, either through ignorance or deliberate lack of consideration, operation using inappropriate modes or frequencies, still takes place.

Channelisation

Unlike the lower portion of the 2 metre band, the sub-band between 145·000MHz to 145·800MHz is divided into discrete 25kHz divisions, referred to as channels.

The amateur band specification for f.m. telephony on 2 metres restricts the maximum frequency deviation to ±5kHz from the nominal carrier frequency. In order to prevent adjacent channel breakthrough, the use of a 25kHz channelised system was introduced, providing a



A typical 2 metre antenna set-up. The Slim Jim is a very popular antenna with the home constructor as is the 16 element ZL special beam. Both were designed by G2BCX and are featured in the *PW* booklet *Out Of Thin Air*

Yaesu's 2 metre multi-mode transceiver—the FT480R enables the amateur to cover the whole of the 2 metre band including c.w., s.s.b. and f.m. modes. With 10W output interesting DX contacts can be made

theoretical 15kHz of isolation between adjacent channels.

In order to readily identify those channels, they are designated code numbers with letter prefixes. Channels used for single frequency transmission and reception (SIMPLEX) are designated prefix "S" and those used for repeater operation, with the necessity for separate transmission and reception frequencies (SEMI-DUPLEX) are designated prefix "R".

Simplex Operation

This single-channel working mode for f.m. transmissions normally occurs between 145·200MHz (S8) and 145·575MHz (S23). As mentioned previously, f.m. equipped stations may use the sub-band 144·500MHz–144·875MHz, with the exception of notated frequencies.

By agreement the UK f.m. calling frequency is located at 145·500MHz (S20) and should be used only for the initial establishment of contact. To maintain the calling channel for its primary use, stations should shift to an agreed working channel, or all-mode frequency.

Repeaters

No account of the 2 metre band could be complete without reference to the extensive amateur repeater system.

The 2m Repeater Datacard presented free with this issue indicates the extent of the network in the UK, up to February 1981. Two changes have occurred since the map was printed—GB3KR has become GB3KS and changed to channel R1, and the RSGB have found a hiccup in their computer program—GB3SB is on R0 not R2.

A repeater is a device designed, constructed, financed, and maintained by individual groups of radio amateurs primarily to assist with communication between mobile and portable amateur stations. The advent of repeater installations in the UK during the early 1970s heralded an enormous expansion in the number of licensed amateurs.

In the next article in this series, a full account of the history and operation of repeaters will be given.

PROTECTING THYRISTORS—1

▶▶▶ continued from page 30

mon when large and expensive lamps must be protected from the stress of their own surge, in projection gear for instance. However, thermistors which can handle projection lamp currents are expensive and unreliable components. A control circuit which can limit lamp surge current without using a thermistor is shown in Fig. 10. This is the "soft start" dimmer. In this circuit, an unsmoothed d.c. supply is provided by T1 and the bridge rectifier, D1–4 (Waveform B). D8 clips this (Waveform C), but note that the voltage still drops to zero at the end of every half cycle. When power is applied to the circuit, C1 will begin to charge. C2 will also charge, but more slowly, and will only have enough voltage on it to trigger the unijunction transistor (Tr1) towards the end of the first half cycle. The unijunction in turn triggers CSR1 and CSR2. The lamp surge will be very small, however, because triggering occurs towards the end of the mains cycle and the mains voltage is low and rapidly decreasing at this point (Waveform D). As the voltage on C1 rises, C2 is able to trigger Tr1 earlier in successive mains cycles. Simultaneously the lamp filament is heating up and with every cycle its resistance is increasing (Waveform E). By the time the peak voltage is applied (Waveform F), the lamp filament has attained its normal resistance. Thereafter R10 can be used to dim the lamp in the normal fashion.

If the circuit is switched on when the mains voltage is at its peak, the voltage across the thyristors rises from 0 to 340V very rapidly. It is possible that a triac's dv/dt rating would be exceeded in this circumstance. The triac would then turn on and the full lamp surge current would flow, which defeats the purpose of the circuit. Therefore thyristors have been used to give a high dv/dt capability. Also, RC networks with steering diodes C3, R8, D6 and C4, R9, D7 act to limit the dv/dt. The action of these RC 'snubber' networks will be considered later in the series.

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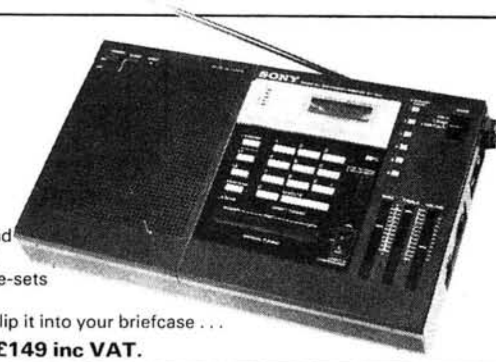

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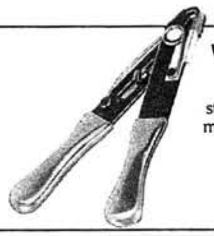

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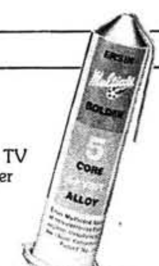

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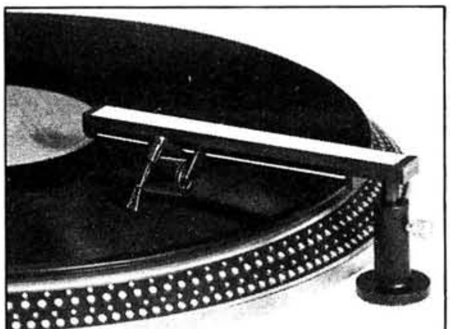

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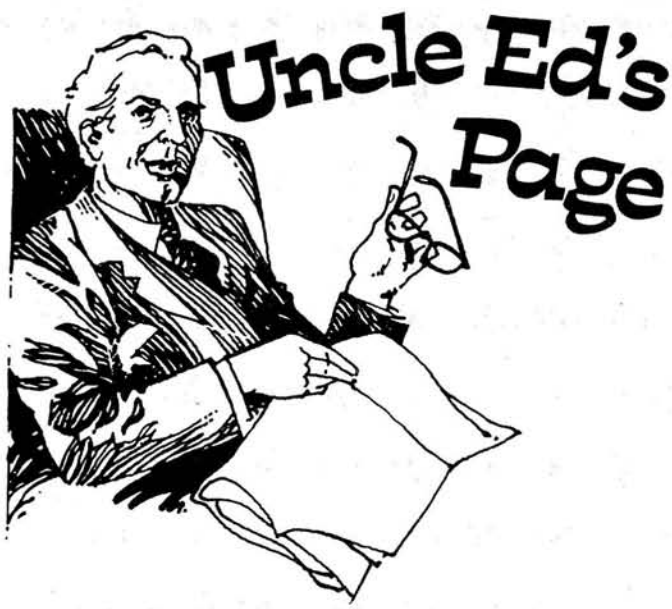


Uncle Ed's Page

A monthly look at some aspect of the radio/electronics hobby that seems to bug the beginner, or occasionally a more advanced topic seen from an unusual angle.

Mention the words "equivalent circuit" to a newcomer to radio or electronics, and you'll get either a blank look or a comment along the lines of: "A way of explaining a simple component by turning it into something more complicated." I think that's often an understandable attitude—in the case of a transformer, for example, the equivalent circuit adds nine components (*L*, *C* and *R*) to explain the various losses in the windings and core. An equivalent circuit which is very much simpler, and which is very, very useful is one worked out many years ago by a gentleman called Thevenin. It will help you to understand power supply regulation, "voltage" and "current" sources, and also attenuators.

Any-one who has played around with batteries and torch bulbs will have found that connecting a second bulb across a small battery will cause the first one to glow less brightly, especially if the battery isn't particularly fresh. If you were lucky enough to have a voltmeter or a multimeter, you would have discovered that the voltage across the battery terminals dropped when you connected the second bulb. On the other hand, if you left the voltmeter connected across the battery and removed **both** bulbs, the voltage went up. See Figs. 1 and 2.

If we ignore the current taken by the meter itself, which should be pretty small, the voltage reading across the battery terminals with no bulbs connected is the open-circuit voltage, also called the no-load voltage or the e.m.f. (electromotive force).

The reason the voltage at the battery terminals drops when a load is connected (a load is anything that consumes power, like our torch bulbs), is that any source of electrical power has some losses in it. The battery terminal voltage you measure when the load is connected is called the on-load voltage or the p.d. (potential difference). In fact, p.d. is a general term for the voltage difference between any two points in a circuit.

The difference between the off-load and on-load voltages is called the regulation of the supply, which you will often see quoted in the specifications for mains transformers or stabilised power units. It's usually expressed as a percentage. If, for example, you had a supply which measured 10 volts off-load, but dropped to 9 volts on full load, the regulation would be 10 per cent. (Just for completeness, I should mention that some people do the calculation the other way round, taking the rise in voltage from full-load to no-load, which produces slightly different figures.) If you connected a load which took only half the supply's rated current, the voltage would drop to 9·5 volts, illustrating that regulation is a linear relationship, in other words, doubling the current drawn will double the voltage drop.

If you go on trying to draw a bigger and bigger current, you will eventually reach a state where the supply voltage drops rapidly. This may be due to a component going up in smoke, or (hopefully) to a fuse or other overload protective device operating to safeguard the whole circuit. This applies regardless of whether you're talking about a battery, a power unit, or even the mains supply in your house.

If our 10 volt supply had a maximum rated load of 1 amp, and that was the current which we drew to cause the output to drop by 1 volt, then from Ohm's Law (R = V/I) we might guess that somewhere in the supply circuit there was a 1 ohm resistance sculling about. This takes us back to the beginning of this article, and to Mr Thevenin (you thought I'd forgotten about him, didn't you?), because this was exactly what he proposed in his theorem, on which he based his equivalent circuit.

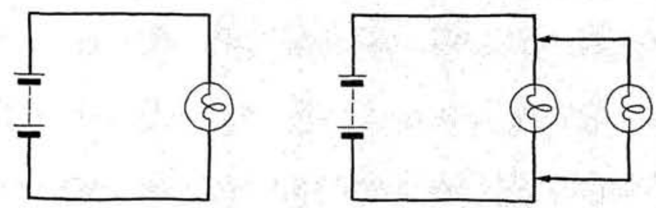


Fig. 1 Fig. 2

WRM353

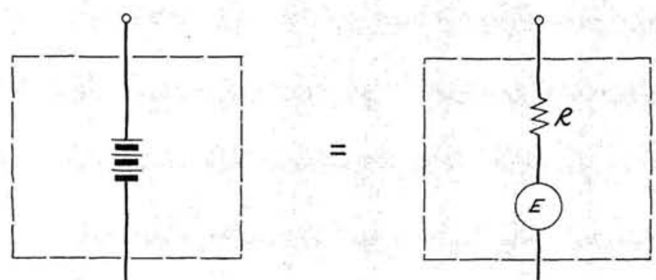


Fig. 3

In Fig. 3, I show the Thevenin equivalent of a practical power source, which is made up of a "perfect" electrical generator *E* (having zero internal resistance), in series with a fictitious resistor *R*, whose value defines the regulation of the supply in the way I described above. Of course, there isn't really a resistor there—it's just the equivalent of the various losses in supply, but it makes it less complicated to think of just one thing at a time.

When we use a power supply to drive something like an audio power amplifier, the current drawn is varying constantly, in sympathy with the audio signals passing through the amplifier. The regulation of the supply for rapid variations like these is not necessarily the same as for a "once-off" change, say from no-load to full-load. For rapidly-varying loads, we would replace the resistance *R* by an impedance (*Z*), which in simple terms is the a.c. equivalent of resistance. For simplicity, I shall treat them as being identical in value.

continued on page 64 ▶▶▶

ULTRA FAST STEREO PEAK INDICATOR

G. S. MACAULEY

One of the most frustrating things about tape-recording is knowing whether one has the correct recording level or not. True, most tape decks these days are equipped with VU meters, but in some cases these are unreliable in the extreme. The reason being that they are mechanical devices and cannot respond very rapidly to musical transients, which are often of high amplitude compared to the mean signal level and of extremely short duration. Even very high quality meter movements have a response time to changes in signal amplitude usually found to be tens of milliseconds.

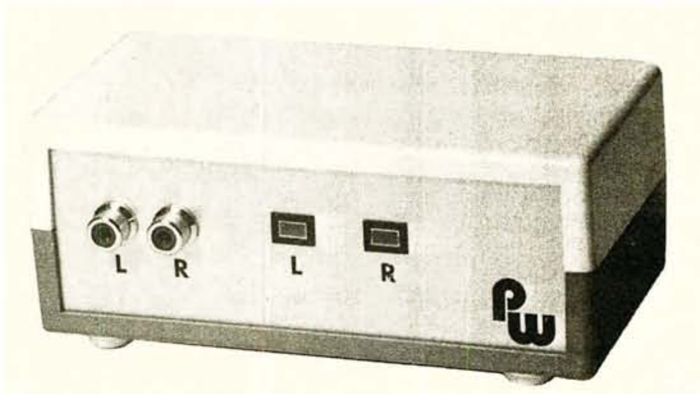
In recent years l.e.d. VU meters have been constructed which feature very fast response times. To cope with such extremely short transients the electronics required need to be fairly complex and such devices are expensive to construct. An alternative circuit, that is fairly simple and inexpensive to construct, is a peak level indicator. This device will give an indication only when a preset level is exceeded. It can be adjusted to any convenient point (within reason) by a simple preset control.

The circuit shown features an attack time of ten microseconds and holds the indicator on for a second each time the preset level is exceeded. A block diagram of the device is shown in Fig. 1.

The level detector comprises a fast comparator, whose non-inverting input is supplied with a constant voltage by means of a simple series regulator. This regulator is formed by R8 and D1 and the potential divider R1, R2 and R3. Input signals are fed into the inverting input via C1 and R4. When a large enough positive going input signal is fed into the circuit the inverting input becomes more positive than the non-inverting input. At this point the output of the comparator goes abruptly negative, triggering the monostable whose output goes positive for an externally set period of time—allowing current through to the l.e.d., which illuminates indicating the passage of the transient.

Circuit Description

Fig. 2 shows the circuit diagram of the peak indicator. The comparators are contained in a quad package, the LM339, and the monostables in a NE556 which is a dual version of the well-known 555 timer. Two 555s could be used instead of the 556 in this circuit, but the layout would have to be altered and in all probability more space would be required. The comparators have a very fast rise and fall time, typically one microsecond. In common with most in-



tegrated comparators the output stage is an *npn* transistor with an uncommitted collector. In order for these to operate properly it is necessary to refer the collector to the positive supply line. This is done here by R9 and R10, these two resistors also fulfil a second function in that they refer the trigger inputs of IC2 to the positive line.

Like the 555 timer, with which most readers will be familiar, the trigger inputs of the 556 have to be taken low to produce a monostable period. The actual length of the pulse obtained from this i.c. is dependent upon the time constant of the timing components. In this circuit the time constant has been set at one second, this allows all transients to be easily observed. The major factor that determines the attack time constant of the circuit is the high

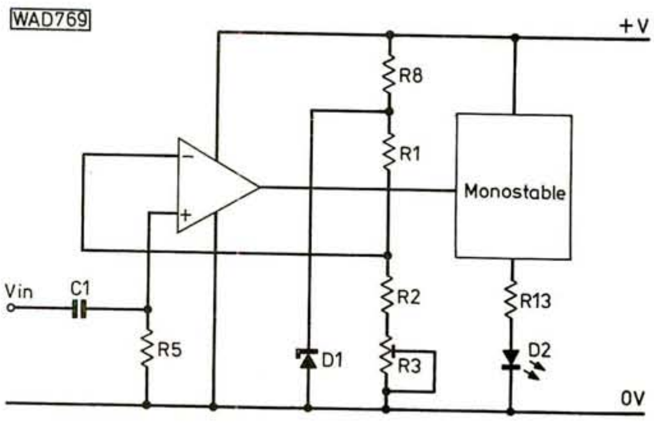


Fig. 1: Block diagram of one channel of the peak indicator

frequency response of the monostable. In other words the shortest negative going transient that will reliably trigger it. With this i.c. it is less than 10μs.

Since the output stage of each of the monostables will source 200mA, the limit of the current supplied is set by the available power supply and the maximum rating of the l.e.d.s employed. For practical purposes the current supply to the l.e.d.s has been fixed at 10mA, as this was found to give a sufficiently bright display.

Construction

Construction is quite straightforward, with all of the components being mounted upon the Veroboard panel shown in Fig. 3. Care should be taken when mounting the i.c.s and electrolytics to ensure that the correct orientation is observed. Also, the board should be checked to ensure that no bridges of solder have spilled across the tracks.

To check the operation of the circuit it should first be connected to a 9V battery. At switch-on both l.e.d.s should be extinguished. If not, switch off and check the wiring to and from the comparators. If, and when all is well, a piece of wire should be connected to the positive terminal of the battery and the other end touched onto both inputs in turn. When connected by the wire the l.e.d.s should illuminate for approximately one second and then extinguish.

With the components specified the sensitivity can be varied by the preset from 100mV to 2V, thus catering for the line input sensitivities of almost all available tape-recorders. This range can be extended by increasing the value of R4 and R6 so that the circuit can be used to monitor the output power across a loudspeaker system. A better method of increasing the range is to precede the cir-

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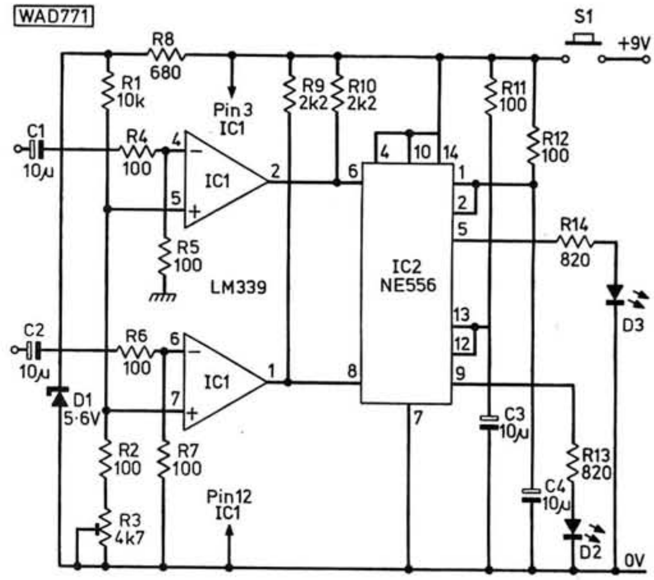


Fig. 2: Complete circuit diagram of the unit. Note that resistors R4,5,6,7,11 and 12 should be 100kΩ

★ components

Resistors

¼W 5% Carbon

100Ω	1	R2
680Ω	1	R8
820Ω	2	R13,14
2·2kΩ	2	R9,10
10kΩ	1	R1
100kΩ	6	R4,5,6,7 11,12

Sub-Miniature Skeleton Preset

4·7kΩ	1	R3

Capacitors

Axial Electrolytics 25V

10μF	4	C1,2,3,4

Semiconductors

Diodes

5·6V 400mW	1	D1
Red l.e.d.	2	D2,3

Integrated Circuits

LM339	1	IC1
NE556	1	IC2

Miscellaneous

Veroboard; PP3 battery; Battery clips.

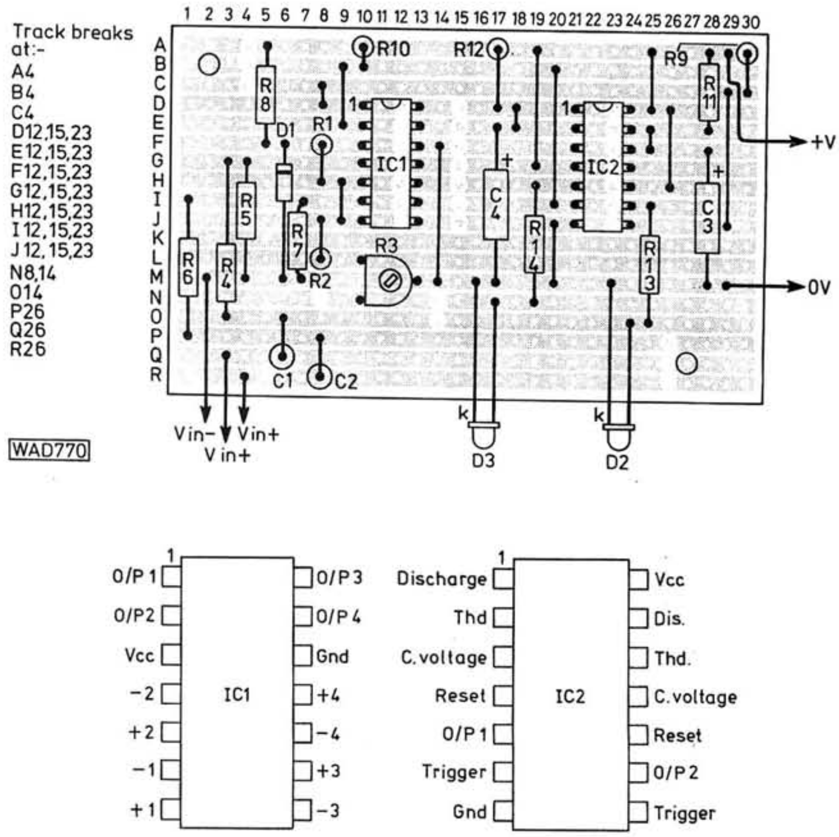
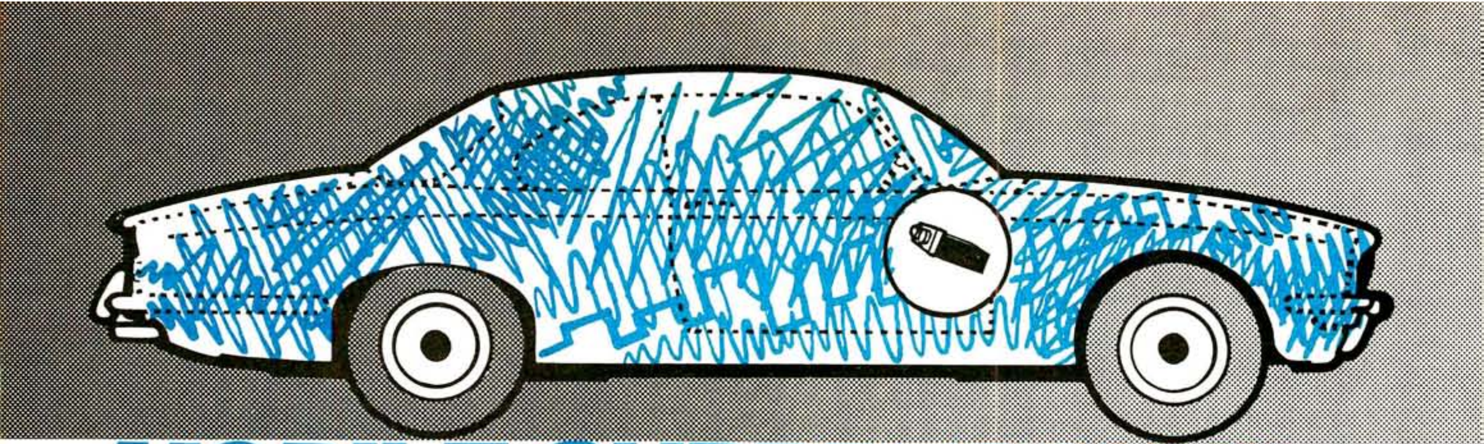


Fig. 3: Veroboard layout and integrated circuit pin connections



MOBILE SUPPRESSION TECHNIQUES PART 2

John M. FELL G8MCP

The first part of this article dealt with the suppression requirements of vehicle h.t. systems. This concluding part details the suppression requirements of standard electrical equipment and accessories.

Voltage Regulator

Associated with the charging system, the voltage regulator may be incorporated within the alternator body or contained in a separate module. The noise effect is a whine or crackle, only apparent some moments after starting the engine and generally not apparent at idling speed. Unlike ignition noise the level of interference stays constant with increase in engine revolutions. A test for this form of interference breakthrough consists of applying a load to the generating system, such as the headlamps and rear windscreen heater. If the regulator is the culprit the noise will diminish or stop. With Lucas ACR alternators, the cure is to connect a 1μF capacitor type LS627 from the warning light (IND) terminal to earth. Other types of alternator, with separate control box, require a 1μF capacitor fitting between the positive terminal of the control box and earth. **Never connect a capacitor to the field terminal.** With a d.c. (dynamo) system it is necessary to connect a 1μF capacitor between the control box "D" terminal and earth.

Instrument Stabiliser

Intermittent bursts of crackle, sounding like the tearing of paper or frying of eggs, are usually caused by the instrument stabiliser. This is an electro-mechanical device and is affected by vibration. A sharp "thump" on the instrument panel should provoke the noise, if this device is at fault. A 1μF capacitor connected from the feed terminal "B" to earth, and an in-line 3A choke in the feed and instrument supply leads, should clear the problem. In extreme cases, replacement with a purpose-built electronic version will be necessary.

Ancillary Equipment

Because the items within this category of equipment are used occasionally, interference from these sources will be apparent only when the specific devices are switched on. This makes the assessment of the suppression effectiveness relatively easy, unlike h.t. and generator system noise which is usually mixed together.

Windscreen Wiper Motor

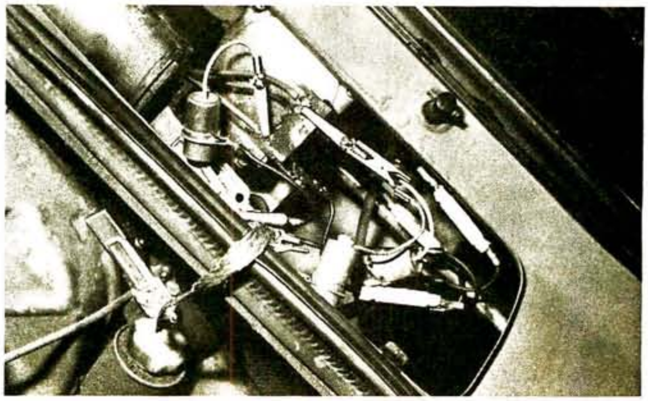
Characterised by an oscillating crackling noise, the wiper motor is a frequent source of interference in wet weather. The initial cure is to bond the metallic body to earth, as most devices "float" on rubber mountings. If the noise persists it will be necessary to fit 7A in-line chokes to all the supply leads, positioned close to the connector plug. In the case of two-speed motors, a total of five chokes are required, one in each lead.

Screen Washer Motor

Becoming a more popular fitting in modern vehicles this device can produce a high-pitched whine when activated. A 1μF capacitor from the positive supply terminal to earth should remove the noise, but in persistent cases, insert 7A in-line chokes in both supply leads.

Stop Lights

Operation of the brake pedal can produce "clicking". The switch element is either mounted in the brake pipe circuit and activated hydraulically or fitted behind the pedal and mechanically actuated. A 1μF capacitor from the supply lead to earth will stop interference from this source.



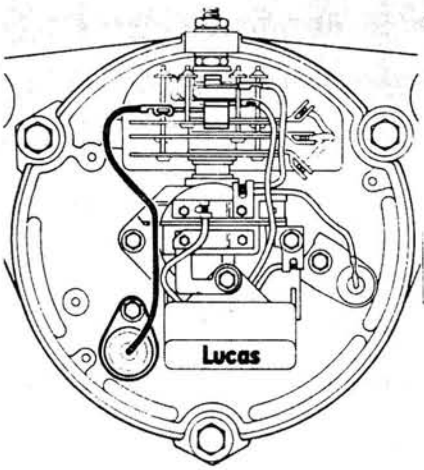


Fig. 10: Generator output; whine varying with engine speed. Fit capacitor between output terminal and earth. Lucas 15-16-17-18 ACR alternators—LS629. 20ACR—LS682. 23-25ACR—LS673. Dynamos—LS628.

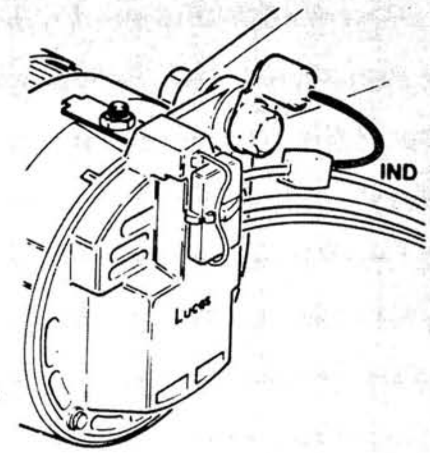


Fig. 11: Other alternators including Lucas, Delco, Bosch and Femsa equivalents. Fit 1µF capacitor between IND (warning lamp) terminal and earth.

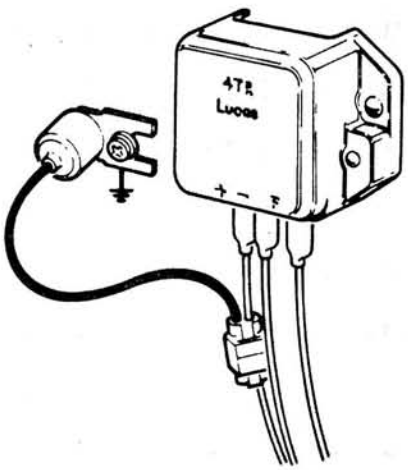


Fig. 12: Voltage regulator; whine or crackle only apparent some moments after starting: disappears when headlamps and heated rear screen are switched on. Generally not apparent at idling speed. Fit 1µF capacitor between + terminal and earth.

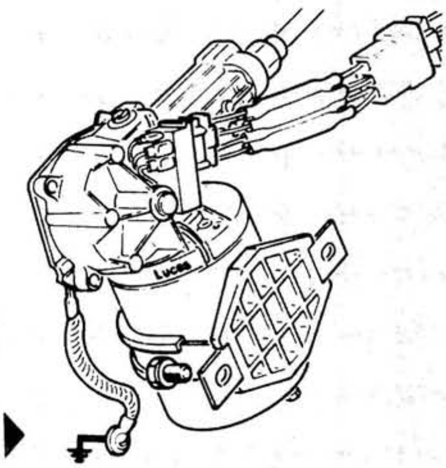


Fig. 13: Wiper motor; crackling when wipers operated. Bond body to earth with strap. If necessary connect LS639 chokes in each supply lead. For permanent magnet versions use LS641 choke assembly.

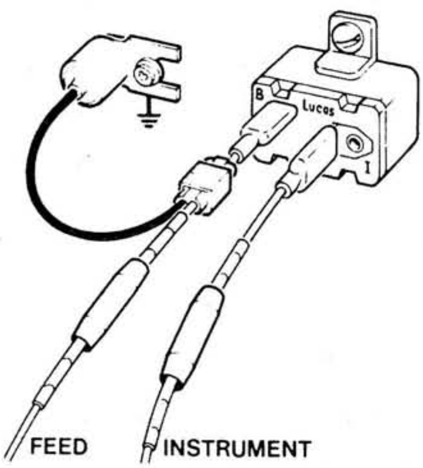


Fig. 14: Instrument stabiliser; intermittent bursts of crackle, provoked by tapping dashboard. Fit LS640 choke in feed, if necessary connect LS637 capacitor across B and E terminals (or B and earth) and LS640 in instrument supply lead.

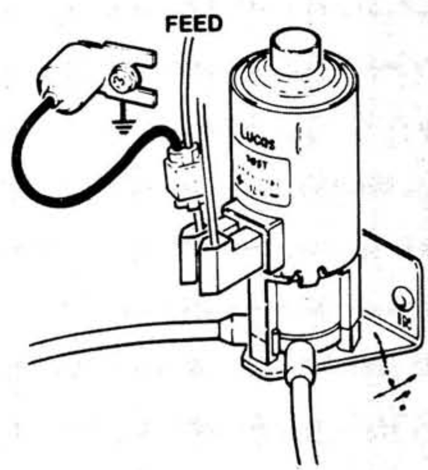


Fig. 15: Screenwasher motor; whine when washers operated. Connect LS637 capacitor between washer feed terminal and earth. Occasionally it is necessary to fit LS639 chokes to supply leads.

Electric Fuel Pump

Regaining popularity, the solenoid actuated, electric fuel pump is the cause of crackle or "ticking" when the ignition is switched on. The repetition rate will depend on the fuel demands made by the engine. The greater the demand, the higher the repetition rate. Once again, fit a 1µF capacitor between the feed input terminal and earth, including a 7A in-line choke if noise is not completely eliminated.

Motor-driven pumps may be suppressed by a 1µF capacitor between positive supply and earth, adding a 7A in-line choke to both leads if not completely cleared.

Heater Motor

Whines and crackles when in use are the typical effects produced by the heater motor. To cure, fit 7A in-line chokes in all the supply leads and, if necessary, a 1µF capacitor between each supply lead and earth.

Direction Indicator Flashers

The bi-metallic switching element can cause distinct "clicks" in the received audio when the indicators are in use. The cure is simple and requires the insertion of a 1µF capacitor between the "B" terminal and earth.

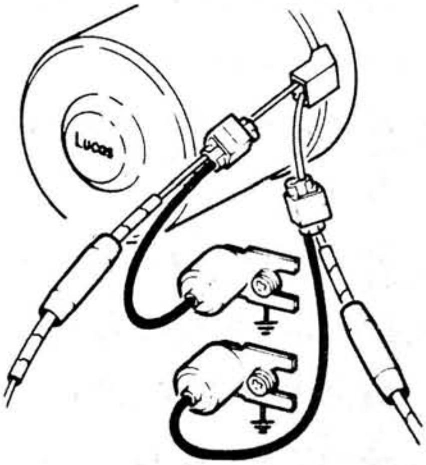


Fig. 16: Heater motor; whine or crackle when heater motor operated. Connect LS639 choke in series with supply leads. In persistant cases fit LS627 capacitor between each feed and earth.

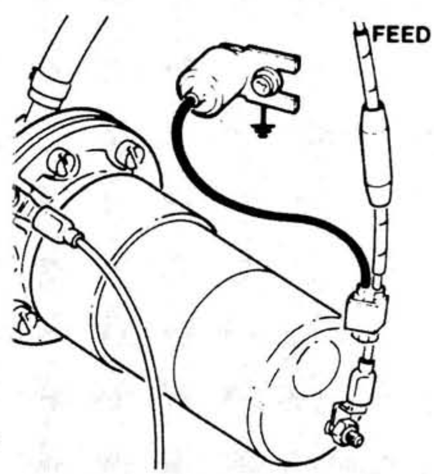


Fig. 17: Fuel pump; whine, crackle or ticking when ignition is on. Connect LS627 capacitor between supply lead and earth. If necessary fit LS639 choke in feed lead.

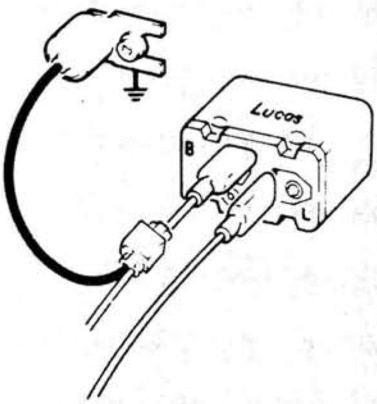


Fig. 18: Indicator flashers; clicking when flashers are operated. Connect LS627 capacitor between B terminal and earth.

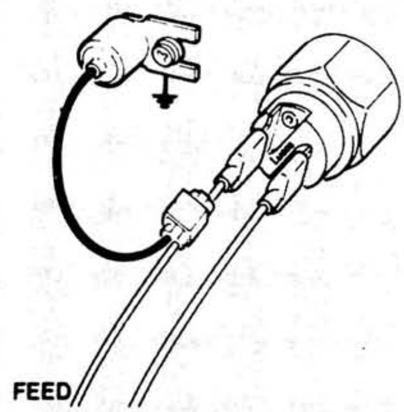


Fig. 19: Stop lamp switch; clicking when brakes are operated. Connect LS627 capacitor between feed terminal and earth.

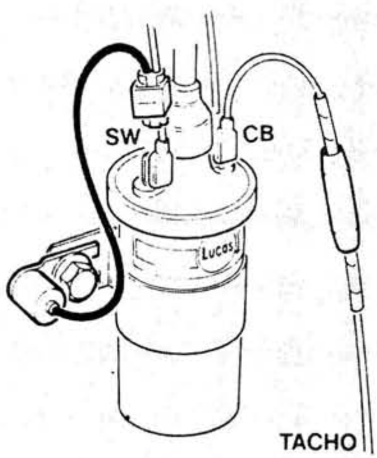


Fig. 20: Electronic tachometer feed; ignition crackle still present after normal h.t. suppression—confirmed by disconnecting tacho lead. Connect LS640 choke in take-off wire at coil/distributor end.

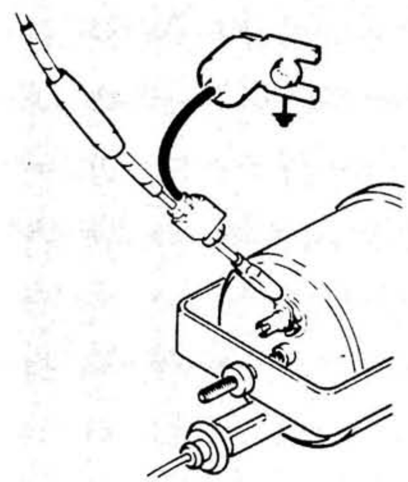


Fig. 21: Electric clock; regular ticking with ignition off. Connect LS627 capacitor between clock feed and earth. If necessary, fit an LS640 choke in supply lead.

Electric Clock

Analogue format electric clocks can produce a "regular ticking!", mainly noticeable when the ignition is switched off. A 1μF capacitor between the positive input terminal and earth should restore the silence. Again the insertion of an in-line choke will be necessary in persistent cases.

General Notes on Fitting

The sequence of suppression methods detailed in this article represent tried and tested approaches. When a single suppressor does not appear to make a worthwhile improvement **do not remove it** before trying a further device; their **combined** effort may be required.

The depth of suppression complexity can vary to a large degree and is related to the individual vehicle, signal strengths available, receiver design and operating frequencies. Whilst manufacturers will often recommend a list of items to be suppressed, large variations can even occur between examples of the same model.

Successful diagnosis and cure of interference can be time consuming and frustrating. However, it has been the writer's experience that a group approach to the problem is best. "Quick-fit" suppression items can be made up and fitted, the required items having been established you can then order the necessary parts and install permanently.

It is well worth repeating that optimum effects will be obtained by utilising the shortest possible lead lengths and locating suppression items close to the items being suppressed.

Lucas deliberately do not fit terminals to their general-purpose capacitors for this reason. From the financial point of view, try capacitors first, they are cheaper than chokes.

On certain vehicles, notably Italian and French, the gear box and steering column can radiate interference within the vehicle interior. All parts of the offending components must be bonded to earth using heavy braided cable, being careful to allow for normal movements.

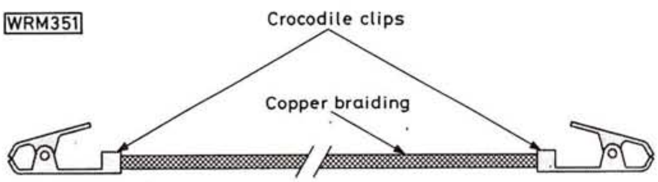


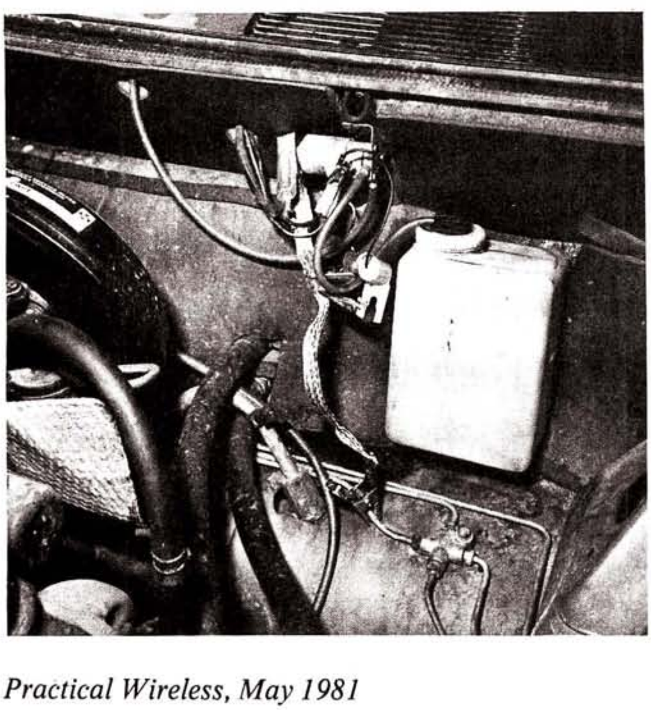
Fig. 22: Quick fit bonding strap.

Equipment Supply

The supply leads of transceiving equipment may be further filtered by the use of a suitably rated "pi" network line filter to prevent the entry of interference by this route. The current rating of the components will depend on the current consumption of the equipment to be used. Wherever possible, run separate supply leads directly from the vehicle battery to the equipment. Do not forget to use an additional, suitably rated, in-line fuse at the battery terminal.

Fibre-Glass Bodied Vehicles

The steel bodywork of conventional vehicles plays a large part in suppressing r.f. interference. With vehicles having a bodywork made from fibre-glass the suppression requirements become greater. Even these vehicles can be satisfactorily dealt with, usually involving the bonding of aluminium building foil or light gauge wire-mesh to the underside of all the bodywork. In this case frequent bonding of the foil to the main metallic frame and earth is required. Further improvements can also be made by spiral wrapping the wiring loom with foil and earthing. Carbon fibre reinforced bodyshells usually offer similar suppression characteristics to those with metallic bodywork.

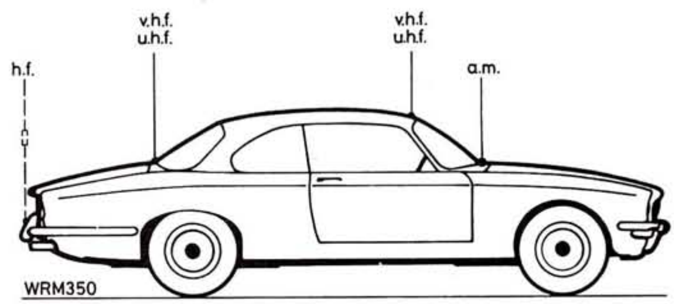


Antenna Positioning

Although not part of the suppression system, the antenna and its location, is of prime importance to a vehicle installation. In general terms the antenna should be mounted at a point on the vehicle that provides the greatest practical distance between it and the engine compartment.

For l.w. and m.w. installations mounting the antenna onto the front wing or roof is recommended. This has the combined advantage of bodywork screening and maintenance of minimal feeder length. Losses introduced by the use of extension cables often reduce the available signal to very low levels and thus makes the receiver more prone to local interference pick-up. Vertical antennas for the h.f. bands tend to be physically large and usually need to be mounted at the rear of the vehicle for mechanical stability. This location will also afford the lowest levels of direct emission but attention must be paid to secondary emissions from non-earthed items such as the exhaust pipe.

The smaller antennas used for v.h.f. and u.h.f. are ideally located on the roof of the vehicle, allowing the utilisation of the natural ground plane. Boot lid mounting is also a preferred method but ensure that the mounting base is provided with a good earth. (One Japanese car actually uses the boot lid as an antenna.)



Sources of Components

The largest manufactured range of specialist suppression components in the UK is marketed by the Audio Systems Division of Lucas Electrical Ltd. Items from their range are available from most reputable motor factors. If difficulty is experienced in obtaining items, Lucas has a network of 300 distribution centres throughout the UK, listed under "Garage Services" in *Yellow Pages,* who are able to provide any items from stock within four days.

The Sparkrite h.t. leads shown in the illustrations are manufactured by Electronic Design Associates and are also available through all normal sources.

When ordering parts the part number and description of the device should always be quoted to avoid confusion between similar items.

Acknowledgments

The author is indebted to Lucas Electrical Limited and to Electronic Design Associates, for their permission to allow publication of details from their suppression range. Personal thanks for their invaluable technical advice and assistance go to Mr D. W. Morris, C.Eng, MIEE, G3AYJ, Mr John S. Davenport G8SOO and Mr Barrie Orme G8OFE.

Further information about the Lucas range of suppression components and recommendations for specific vehicles may be obtained from Mr J. S. Davenport, Audio Service Manager, Lucas Electrical (Parts & Service Division) Limited, Great Hampton Street, Birmingham B18 6AU. ●

RADIO SPECIAL PRODUCT REPORT

TONO Θ-7000E

COMMUNICATIONS COMPUTER

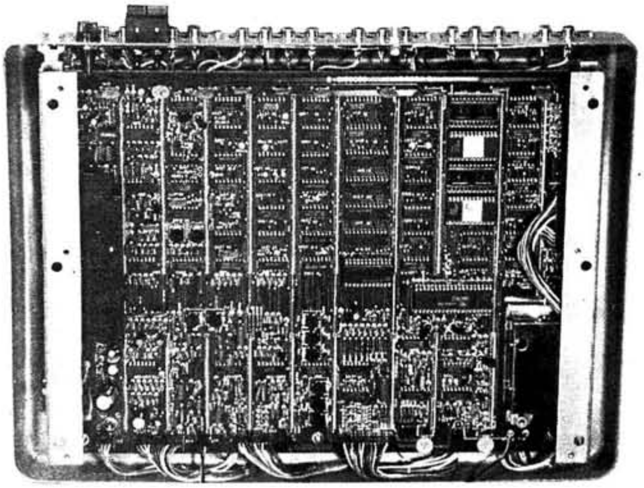
The Tono θ-7000E is a communications computer which will transmit and receive in c.w. (Morse), RTTY (Baudot) and ASCII, and display the messages on the screen of a v.d.u. or u.h.f. TV set, or as hard copy on a dot matrix printer.

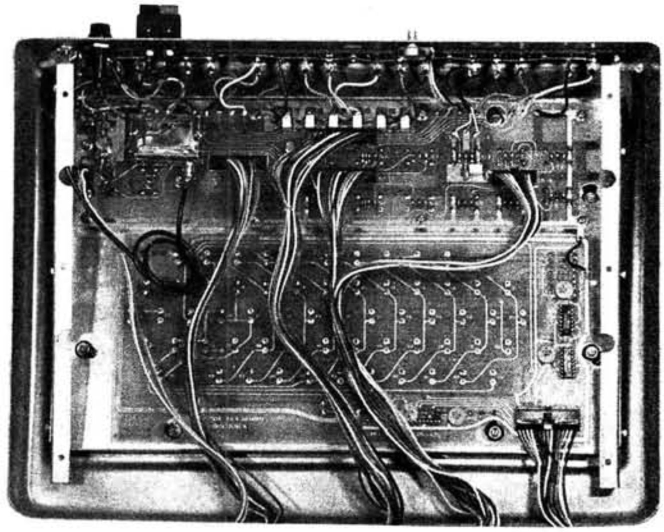
Your reviewer is competent in c.w. operation and typing, but has had no previous experience of the RTTY mode. Therefore, the manufacturer's instruction manual, in conjunction with the RSGB *Amateur Radio Operating Manual* and the recent *PW* series *Introducing RTTY,* had to form a primer in RTTY operation generally.

As will be seen from the specification table, the θ-7000E incorporates a very comprehensive range of features indeed. The instruction manual advises practice with a TV set before using with a transceiver, and this proved very necessary. In fact, most of the test periods were spent that way, and even after a couple of months of intermittent use, new features were still being discovered and explored. The instruction manual is written in "Oriental English" which although adequate in straightforward items, does get rather lost in the more sophisticated features, of which there are quite a few.

The most frustrating feature at first was that after following instructions for, say, entering copy into one of the memories, the machine would just sit there, defying all attempts to make it do what it was supposed to do, until it was eventually discovered quite by accident, that the Space bar acted as an "Execute" key, and caused the beast to spring into action when depressed. So far as I am aware this is not a normal feature of RTTY nor computer operation, but perhaps my lack of previous experience is letting me down here. Certainly there is no mention of it anywhere in the instruction manual.

The θ-7000E is housed in an attractive sheet steel cabinet which provides adequate screening so far as our tests showed, both **from** an adjacent 100W h.f. transmitter, and





The computer/control circuitry is housed on one large printed circuit board (left), while the switches and keyboard are mounted on two more (right)

to an adjacent h.f. communications receiver. All input and output connections are at the rear of the unit: spring terminals for the nominal 12V d.c. supply, ¼in jack for headphones, multi-way connector for the printer, and "phono" sockets for the rest.

Within the brief space of this review, I cannot hope to describe all the features of this very versatile unit. The Instruction Manual takes 30 pages to do so, regrettably somewhat inadequately. The Specification table summarises the main points, and the following notes add some detail:

Characters: "QBF" (Quick Brown Fox) and "RY" test messages are pre-programmed. The keyboard follows the standard typewriter layout.

Input: The required a.f. input level from a receiver is 50mV–1V. An anti-noise circuit eliminates garbled display in no-signal conditions.

AF Input Frequency: Accurate tuning of the incoming signals to the a.f. filters is aided by l.e.d. indicators.

Remote Control Keyer: Provides Transmit/Receive control of associated radio equipment, and can be automatic or manual.

Number of Characters and Pages: The first page can be divided in two. The lower half displays received signals, the upper half messages to be transmitted. These can be edited whilst receiving. A word-wrap-around function prevents the last word on a line being split in two in receive mode.

Battery Backed-up Memory: The messages put into Channels 1–6 can be repeated from 1–9 times at will. The message put into Channel 7 can be subdivided into four parts.

Buffer Memory: For composing and editing messages for transmission. Can be used whilst simultaneously receiving.

Output for Oscilloscope: Provides "cross" tuning pattern. Output level 1·2V p-p into 1MΩ minimum.

AF Output: The internal loudspeaker is muted when headphones are plugged in.

For anyone trying to learn or improve their Morse Code, the θ-7000E can also form a useful tutor/exercise aid. It will produce individual characters at various speeds at the press of a key. It will decode Morse from a receiver or tape to provide a simultaneous visual readout. It will act as a "listener/decoder" to Morse which you send to it by means of a key plugged into the back of the unit, producing clean copy on the TV screen if you have a good "fist", or gibberish if you don't (well—I never did think my sending with a mechanical bug-key was very good!). It will even play back to you, in perfect Morse, what it thinks you just sent to it. I don't suggest you go out and buy one just for this purpose, but if you want it for RTTY, then you get that lot thrown in, as it were.

Note that under the terms of the current UK Amateur Transmitting Licence, Morse (c.w.) operation is not permit-

★ specifications

Code:
CW (Morse), RTTY (Baudot Code), ASCII

Characters:
Alphabet, Figures, Symbols, Special characters

Communication Speed:
CW receiving: 25–250 Characters/Min. (Automatic follow)
CW transmitting: 25–250 Characters/Min.
Weight: 1:3–1:6
RTTY and ASCII: 45·45, 50, 56·88, 74·2, 100, 110, 150, 200, 300 Baud (Fine adjustment available)

Input:
AF Input: CW, RTTY, Input Impedance 500Ω
ASCII, Input Impedance 100Ω
TTL Level Input (common to CW, RTTY, ASCII)

AF Input Frequency:
CW: 830Hz
RTTY: Mark: 1275Hz (Low Tone), 2125Hz (High Tone); Shift: 170Hz, 425 Hz, 850Hz and Fine Tuning (or reverse)
ASCII: Mark: 2400Hz, Space: 1200Hz (or reverse)

Output:
Keying: CW Keying (positive) 100mA, 300V
CW Keying (negative) 100mA, 300V
FSK Keying 100mA, 300V
FSK Keying (ID) 100mA, 300V
AFSK Output Impedance 500Ω (common to CW, RTTY, ASCII)
TTL Level Output (common to CW, RTTY, ASCII)

AFSK Output Frequency:
CW: 830Hz
RTTY: Mark: 1275Hz (Low Tone), 2125Hz (High Tone); Shift: 170Hz, 425Hz, 850Hz (or reverse)
ASCII: Mark: 2400Hz, Space: 1200Hz (or reverse)

Display Output:
UHF, Output Impedance 75Ω
Composite video signals, Output Impedance 75Ω

Interface for a Printer:
Centronics parallel compatible

Remote Control Keyer:
Capacity: 300mA, 50V

Number of Characters and Number of Pages to be displayed:
512 characters (32 characters × 16 lines)/page × 2 pages (Total 1024 Characters)

Battery backed-up Memory:
64 characters × 7 channels

Buffer Memory:
53 characters

Output for Oscilloscope:
Output Impedance 200kΩ

AF Output:
150mW, Output Impedance 8Ω

Power Supply:
DC +12V, 1A

Dimensions:
400 × 300 × 120–57mm

ted by Class B licence-holders, and this restriction applies even to the use of a device such as this.

Results

Stability and reliability proved excellent, and we used the review unit for the somewhat unusual task of decoding and displaying a message for visitors to our stand at Breadboard '80 Exhibition. The message was recorded in Morse on a standard Compact Cassette, and replayed more or less continuously for over nine hours a day for five days, without a hiccup by the computer. Tests on the air proved highly successful once the basics had been mastered. My appreciation to several amateurs, especially G4GTH, who bore with me so patiently in my tests. The unit's ability to extract and decode a signal beset with QRM on the h.f. bands was at times quite amazing. Similar results were obtained with weak signals on 2m f.m. We understand that the θ-7000E is widely used on commercial h.f. links, which obviously says much for it.

The θ-7000E provides, in conjunction with a v.d.u. or TV receiver, a versatile telegraphy terminal unit, with dedicated programming for operation in the three modes, with auxiliary symbols and functions, and some user-programmable memory for brief standard messages. A similar range of functions could probably be obtained from a micro-computer plus a range of software and interface hardware at a comparable overall cost. Which solution is most attractive will depend very much upon the circumstances and requirements of the individual user.

The Tono θ-7000E is available, price £640 including VAT, from **Thanet Electronics, 143 Reculver Road, Beltinge, Herne Bay, Kent, telephone Herne Bay (02273) 63859,** to whom we offer our thanks for the loan of the review unit. ●

UNCLE ED'S PAGE

▶▶▶ *continued from page 55*

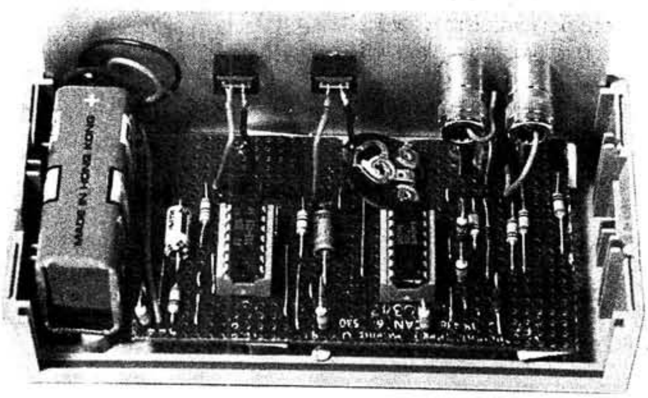
In most circuits, we want a supply whose **voltage** stays as steady as possible with variations in current drawn. This implies a power supply impedance as low as possible. Such a supply is termed a voltage source, which is short for constant voltage source. Sometimes we need a supply whose **current** stays as steady as possible when the resistance of the load connected to it varies. Such a supply is termed a current source (short for constant current source), and its terminal voltage will vary according to the resistance of the load.

I know that these shorthand terms often baffle beginners, who argue that a power supply has both voltage and current, and you can't separate the two. I hope it will become a little clearer when they realise that the word "constant" has been left out in each case. One other point that may help the beginner. We say that a *load* (our bulbs, for example) *puts a load* on the supply (in other words, draws a current from it). When we say we are going to put a lighter or smaller load on, we mean one that takes a smaller current. It will therefore have a higher resistance value. On the other hand, a load with a lower resistance will take more current, and is called a heavier or bigger load. Confusing, isn't it?

Next month, I shall talk some more about voltage and current sources, and simple ways in which we can make them. For now, I leave you to puzzle over the following, and see if you can work out why it should be. For a (constant) current source, the internal impedance of the supply must be as high as possible.

STEREO PEAK INDICATOR

▶▶▶ *continued from page 57*



Internal view of the completed unit, fitted into a Verobox Cat. 202–21049A

CONSTRUCTION RATING **Beginner**

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cuit with a stereo linear potentiometer with a value of 100kΩ wired as a volume control.

To set up the circuit one requires a source of alternating voltage and an a.c. voltmeter. The most convenient source of a.c. is from the secondary of a low voltage mains transformer, with a potentiometer of around 10kΩ across it. The output at the slider of the potentiometer is monitored by an a.c. voltmeter and R3 adjusted until the l.e.d. just extinguishes. This procedure is then repeated for the other channel and the circuit is then ready for use.

The power source for the circuit should not exceed 15V, and this must be regarded as the absolute maximum. For this reason the prototype is powered from a 9V battery and housed in a small plastic box. Since the board is small the circuit can be mounted by means of the l.e.d. clips. Maximum current consumption is some 25mA and for this reason a PP3 is used to power the prototype, this will last for several months with normal use. ●

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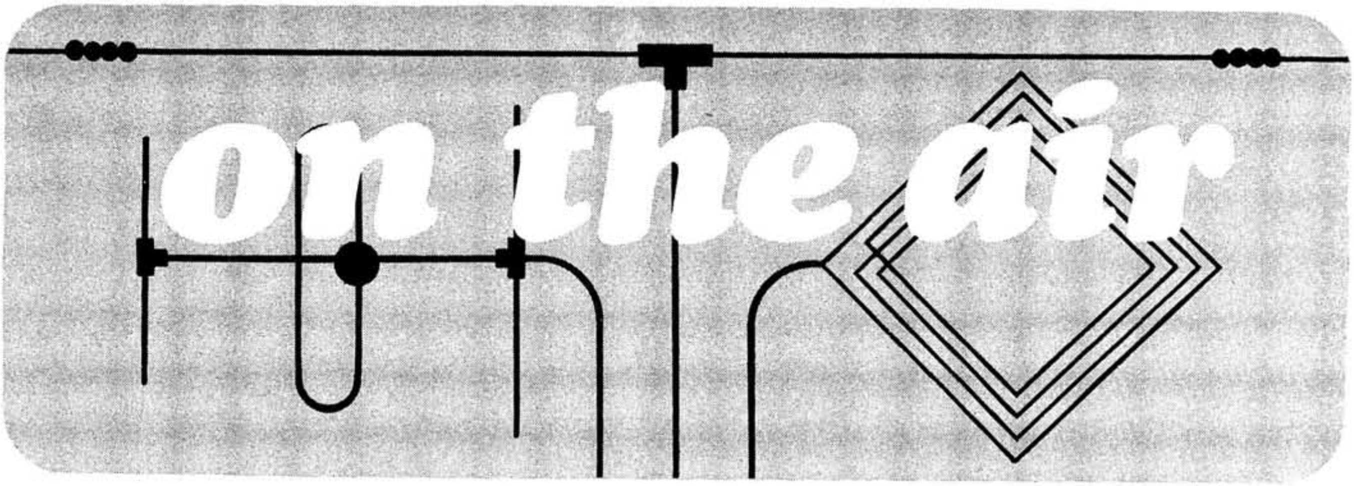


Amateur Bands

by Eric Dowdeswell G4AR

Reports to: Eric Dowdeswell G4AR
Silver Firs, Leatherhead Road,
Ashtead, Surrey KT21 2TW.
Logs by bands in alphabetical order.

I am frequently asked by readers of this column for my views on this or that piece of equipment being advertised, which is calculated to remove or reduce the interference (QRM) that afflicts most amateur bands today, or seems to. At first sight this may seem to be a relatively easy way of getting rid of a very difficult and persistent problem. In the event the audio filters, for that is what most of these devices are, often prove ineffective or are disappointing, especially as some of them are far from being cheap.

It is sometimes like fitting twin carburettors and a head conversion kit to a clapped-out old banger and expecting a major improvement in performance from it. In other words, the receiver must be a reasonable performer in its own right before any added gadget can hope to work properly. I am in no way condemning the many filters on the market, as I'm sure they will all work as claimed, but only when given a chance by being connected to a decent receiver.

Where most communication receivers fall down in performance is in the r.f. and mixer stages, and, strangely enough, the price tag doesn't necessarily mean a better set in this respect. When two or more powerful signals are passed through the r.f. tuned circuits to a transistor amplifying stage, then the device by its very nature will operate in a non-linear manner and that means one thing, intermodulation. The two signals may be many kilohertz apart, or even outside the amateur bands, but if they both appear at the transistor then there will be trouble.

Nothing, but nothing, is going to improve matters once those signals have passed the r.f. circuitry, least of all any form of audio filter. Receiver manufacturers today fit all kinds of gadgets to the r.f. stages, with an equally bewildering variety of names, in order to reduce the signal input to the transistors themselves. All of them, in the end, are what we have always called them, r.f. gain controls. A simple 1kΩ carbon potentiometer across the antenna and earth terminals will do the job just as well.

All kinds of solid-state devices have been developed, particularly the f.e.t. series, in an effort to prevent this intermodulation effect, without a great deal of improvement. The same effect and the same problems arise with large signal levels in audio equipment and it is significant that some hi-fi manufacturers are turning to the old-fashioned thermionic valve. And why not? Valves have virtually no problems with non-linearity at high signal levels and if they can do a better job in this particular application why not use them?

The usual excuse of heavy heater consumption and heat problems is really nonsense as far as receivers are concerned. Long before transistors were thought of miniature valves were common, with 1·4V filaments run from a single cell if necessary, and, indeed are still advertised for sale in our radio magazines. Some had wire leadouts making them ideal today for p.c.b. mounting, while others had the standard 7-pin glass base.

The first communications receiver manufacturer that decides to forget solid-state devices in the front end of his sets, and uses or develops valves for the purpose, will find his product performing better than even the most expensive solid-state set available to the amateur today.

It is very shortsighted to decry the valve just because it came before the transistor. As someone reputedly remarked not long ago: "If the valve had come after the transistor it would have been hailed as a great new development," or something like that.

So, before fitting that filter to sort out the signals, make sure the QRM is really being caused externally and not being generated inside the receiver itself.

On the Air

Not much doubt this month as to which of the bands has sent the blood racing through the veins of the ardent DXers. Take a look at this lot: AP2ZR, DA8BE/TA1, FG0FOK, FK8CR, HI8EJH, HP3FL, H44SH, KL7Y, KP4AAQ, OA4AWP, YB0UR, ZL1JC and ZL4AP and many others logged by **Mike Howard** BRS44755 of Chadderton, Oldham, on the 80m band with his DX160 and loaded ground-plane for 40, 80 and 160m. Mostly after midnight although the H44SH was caught at 0950 GMT. Only catch of import on 40m was VK9NS, but the 20m dipole found FR7OY, HS1AMM, JW5IJ, ZE1EK and 9Q5NB, while 15m produced A22ZM, D4CBS, 5H3KS, 5N9GM and 5Z4CH. Mike suggests that anyone wanting a 3X station should look for VK3NIC/3X on 15m around

2200 GMT, and QSL via K4FRU. Some of the comparatively new prefixes on 160m s.s.b. copied by Mike included UA9RYN, UA0ACW, UL7ECW and UL7MNA.

Unusual one for **Basil Woodcock** BRS44266 of Leeds was LA1EKO on 80m from the Ekofisk oil rig in the North Sea. Others have also been reported so it's time there was a Worked All Oil Rigs award! Also on 80m Basil logged KP4AAQ, OA4AWD and PY5RR, with FG0FOK, 6W8IJ on the 10m range of his SRX-30. Two nice ones for 15m were HP1XRK and VP1CBT with 20m showing up with DU9RG, VK9GC, ZD7SD and ZD8TC. An a.t.u. has been added to the 40 metre-long wire to help Basil log 186 countries in his first year of listening.

"Phew! What a month" was **David Coggins'** reaction from Knutsford, Cheshire, not surprising with a pair of phased verticals on 20m also used on other bands like 10m for FG0FOL/FS. YS1ECB reputed to be using old-fashioned a.m., and 5N6RED with catches like TG4NX, UK0QAA (rare Zone 19), VE8YQ and VK9NS on Norfolk Is. Catch of the month must be ZL3NR/C on 80m s.s.b. working into Europe, plus OA4AWD, VK7AE, and 7X4MD. For 160m a loop or 5 metre-tall vertical was used to find the usual Europeans on c.w. (a pleasant change!) noting UK2KDX, OZ7YY and UA3ALO in particular. On s.s.b. it was several VEs and lots of Ws all around 0600–0700 GMT.

Bill Rendell, down in Truro, comments on the very sudden disappearance of stations on 10m at the beginning of February with VP8PP going from 57 to zero in three minutes, while on the 8th he heard a 59 signal from VU2USE working G3IIY in Bedford, who was 55 and far beyond the normal ground-wave and sounding like a long-path signal. Bill surmises it was a round-the-world echo and I imagine he is right. Bill was suitably aghast hearing that KL7EBK had a 53 metre-tall steel tower with friend KL7EKB boasting a 46 metre tiltover job!

Down to the nitty-gritty from Bill and his HRO with FK8CR, HI8EJH and ZL4QE on 80m, VK2WC, ZL1AMO and ZL4AV on 40m, C5AR (two-letter suffix unusual, says Bill), J6LOU, PY0ZZ on Fernando de Noronha Is., VP8PP, ZD7SS, ZD8RH, 1A0KM (de Bill, where's that?) but as he said QSL I0MGM it doesn't seem worth worrying about, 5T5AY, 6W8AR and 9X5PP all on 20m. The 15m band revealed C5ACO, DU7RLG, TA2AK, VK4NIC/3X, VP1WP, VP2SAM, VP5GT on Grand Turk and ZD8RH who'd like cards via G4DBW. Finally on 10m C5ADS, J3AH, KG4ET and KG4WM (QSL WB1COR), PY0ZZ, TR8CN (QSL to W5RU), VP5TCI also on G. Turk, ZD7BW, 3B8AE/3B9 and 5N6RED.

Towards the end of January a very fine catch was made by **Allan Stevens** (Crowthorne, Berks) with his Trio 9R59DS and just a TV downlead as an antenna, namely JT0YFU on the 7MHz band who was audible most of the night. Others heard in the same session were EA8AK, UK0SAW and YV4BMV. On the 3·5MHz band or to be more precise around the top end at 3900kHz or so, EA8XS, HI8AL, KP4R, OD5MR, VP2AZG, YL6LV (seems to be a new prefix) and 4Z4ZB. At the moment Allan is getting the parts together for the *PW* Active Antenna project. Code practice is another interest when time permits.

From Birmingham **Dennis Court** reports on the findings of his Collins R390A receiver fed with a 40 metre-long wire on the 80m band like AP2ZR, VO2CC, XE2AX, N2BV/LX, CT2FL and a nice one in 5T5JD of Box 477, Nouakchott, Mauritania, with 7X5AL to end with. In Earl Shilton, Leics, **Dennis Sheppard** is still clearing the muddle resulting from his move of QTH but at least he has his RTTY gear going well judging by 4X4MR, 5N0DOG, and 5Z4RT on 10m, 1A0KM said to be in Malta (Bill Rendell please note!), JA1ACB, LU3EQ, VK2SG and XE1VV on the 15m band. Not neglecting the s.s.b. mode Dennis logged HI8PGG on 10, JE6QUJ, YZ9CRM and 6W8AR on 15 with a good catch in VP2SAV on 40m. A later note from Dennis mentioned that 10m was wide open in mid-February with 28·080 to 28·100kHz full of RTTY stuff. A Siemens T100 printer is being commissioned as soon as the necessary gears are to hand.

Another 9R59DS, in the hands of **David Warr** (Weymouth), helped by a G5RV antenna and a ZL Special on the 21MHz band brought good DX on all bands, with 7MHz in particular shining with such as TG9AL, FK8CR, H44DX and 6W8AR in the log. David heard stations working the FK8 on the 80m band but was unable to copy him for sure so didn't count it. However OA4AWD, OH0NE, XE2AY and ZL4AP did show up on that band, with well-reported FG0FOK on 10m plus JW5IJ and FR0FLO. The FG0 and HK0FBF came up on 15m for a couple of good ones. David is busy with CSE and "O" level problems, so wisely is not worrying about the RAE for the time being.

In General

Barry McCarthy, a welcome new correspondent from Croydon, Surrey, never believes in rushing things! He decided to sit the RAE when he was just 14 and finally got down to it 22 years later! However he did manage a distinction and a credit and is now after the code test. Dare I quote his comment: "No second-class licence for me"! His view on the RAE? "Nothing less than a comprehensive crib sheet"! I may be a bit slow but I have never heard of a satisfactory explanation of why there are "Pass", "Credit" and "Distinction" with the RAE since any are good enough to get a licence. It might be a good idea if these varying permutations were linked to different grades of licence with, say, two passes earning a limited novice licence and so on, with another exam for a higher class or grade.

A. M. Chapman BRS43503 of Grimsby wrote about a Beverage antenna some 152 metres long that he intends to erect, and recommends the book on *80m DXing* by ON4UN as an invaluable guide to the subject, although I have not yet acquired a copy myself. Judging by the few photostat pages sent to me I feel I have missed out on something good.

Another to pass the RAE and awaiting his call is **John Everingham** of Bristol, also a newcomer to this column, who has spent some time modifying and, hopefully, improving a present received in the shape of a Heathkit CG-1U Mohican receiver. Anyone interested should write to me in the first instance.

Yet another writing in for the first time is **Barry Harper** from Wednesbury in the W. Midlands, who started in amateur radio about five years ago and is at last "knuckling down" to studying for the RAE. At the moment an ex-Army 19 set is in use after various missing bits and pieces had been replaced. Antennas being played with include a helical one on a broomstick (no, OM, we won't laugh! We've all tried something like that at one time or another) and a 18 metre-long wire. Logs are threatened in the near future.

A writer who wishes to remain anonymous would like to see some praise for Ernie Burke G3VOZ who runs RAE classes at the Dacorum College, Hemel Hempstead, whose six pupils sitting the December RAE all passed as did no less than 18 at the May 1980 exam. Just hope this little appreciation doesn't result in the classes being overwhelmed!

Club Time Again

Looking at the pile of newsletters and the like it seems just about every club in the land has reported in this month! So entries may be a bit brief, but, hopefully, adequate.

Chiltern ARC. New secretary Peter Stears, 127 Hughenden Avenue, High Wycombe, Bucks, says club meets last Wed of month at the factory of John Hawkins & Sons, Victoria Street, High Wycombe at 8pm with visitors and prospective members assured of a warm welcome.

Hull & District ARS. A note concerning the rally at the University of Hull at midday on Sunday May 31, with trade stands, XYL stalls, films and cartoons for the kids and a bar and refreshments. Talk-in facilities will be operating, says Heather Cunliffe, club sec, at 12 Pearson Avenue, Hull.

West of Scotland ARS. Weekly Morse classes at 7pm on Fridays at 22 Robertson Street, Glasgow run by Willie Goldie GM4GIH and George Allan GM4HYF has meant 15 members qualifying for their "A" tickets in recent times (the QRM!) after which the regular meetings get going. Nightly meetings on 28 400kHz cater for SWLs and GM8s with c.w. sessions, but Ian McGarvie GM4JDU at 3 Kelso Avenue, Paisley will tell you more.

Yeovil ARC. Every Thursday, 7.30pm, Building 101, Houndstone Camp, Yeovil with activity from club stations G3CMH and G8YEO plus lectures and amateur radio library facilities. May sees start of RAE course for December exam, run by G3MYM. Club sec is D. L. McLean G3NOF, 9 Cedar Grove, Yeovil or Yeovil (0935) 24956.

St Helens & District ARC. Change of meeting place! Now every Thursday, 7.45pm, at the Conservative Rooms, Boundary Road, St Helens, instead of the YMCA. The larger premises should offer better facilities for club activities as well as being more attractive to prospective members and visitors. It is Paul Gaskell G8PQD, 131 Greenfield Road, St Helens, Merseyside, or St Helens 25472.

Stevenage & District ARS. Some 16 candidates should be taking the May RAE, with five out of the seven making it last time. These classes are "blamed" for the increase in membership in a year from 35 to 72 which includes 39 licensees! Try the first and third Thursdays at 8pm at the staff canteen, British Aerospace Dynamics, Plant B, Gunnels Wood Road, Stevenage. Respectful silence please on April 16 when club chairman Stephen Clarke G8LXY will address the assembled multitude. Might also mention Mike Barraclough talking on s.w. broadcast DXing (ugh!) on May 7, in case your June *PW* does not arrive on time. Trevor Tugwell G8KMV, 11 The Dell, Stevenage, Herts, will fill in with anything I've missed.

Sutton & Cheam RS. Meetings held at both the Sutton College of Liberal Arts, Cheam Road, Sutton, Surrey and the Banstead Institute, High Road, Banstead, so contact G. Brind G4CMU, 26 Grange Meadow, Banstead for more precise details. The second venue sees the AGM on Friday April 24 if you like that sort of thing. You are more likely to meet just about everybody from the club on that occasion.

Cheshunt & District RC. Every Wed at 8pm in the Church Rooms, Church Lane, Wormley, near Cheshunt, Herts, says Jim Sleight G3OJI, 18 Coltsfoot Road, Ware, Herts, also (0920) 4316. New code course starts soon for potential "A" licence candidates with a class for complete beginners in the art in April, lasting 12 weeks.

Braintree RC. Janet Storey, publicity officer, sent me the club's monthly communication, consisting of several pages of very well produced information to suit all interests in amateur radio. Meetings first and third Mondays at the Braintree Community Centre, Victoria Street, Braintree, next to the bus station. 7.45pm would be about right. Contact Janet at 33 Redwood Close, Witham, Essex.

Exmoor RC. Patricia Jemmison says notes on club have resulted in several enquiries from the area, obviously interested in the special projects organised for the younger members. Meetings 7.30pm every Thursday at Loughrigg, East Street, South Molton. If interested contact Pat at Homedale, Brayford, near Barnstaple, N. Devon which is Brayford 327.

Grafton RS. Don't forget the club now has a new QTH at the Five Bells, East End Road, Finchley, London N2 at 8pm second and fourth Fridays with new members and visitors threatened with a warm welcome. John Thomson G8SYD, 70A Deans Lane, Edgware, Middx.

Chesham & District ARS. Possible change in club venue in the wind for the near future so first of all contact Andy G8PUC, 8 Lynton Road, Chesham, Bucks. Otherwise normal meetings on second Wed with informal gatherings on remaining Weds.

Wirral ARS. First and third Weds at 7.45pm, at the Sports Centre, Grange Road West, Birkenhead. April 1 welcomes G8VPF on "navigating in a car rally" at which I'm assured the speaker is very experienced, as well as being the club's Hon. Sec. April 15 is another jolly jape, namely a sale of surplus equipment. So says the excellent newsletter but more details from the aforesaid Hon. Sec. G. O'Keeffe-Wilson G8VPF, 20 South Drive, Upton, which is 677 1531.

Ipswich RC. Note, again, new QTH at Rose & Crown, 77 Norwich Road, Ipswich, second and last Weds at 8pm. RAE and code classes and many other items for your delectation plus first-class club magazine *QUA* to read when away from the club. Jack Toothill G4IFF, 76 Fircroft Road, Ipswich, is the man to contact for more info.

Crawley ARC. Has decided to carry on calling its newsletter *The CARC Newsletter* in spite of other suggestions. Well done! Informal meetings are held at various members' homes with the next on April 8, so contact Dave Hill G4IQM on Crawley, Sussex 882641 for details. Otherwise meetings are held at the Trinity United Reformed Church, Ifield, on the last Wed of the month.

Newsletter editors please ensure magazine has **full QTH** of Hon. Sec. or other contact and times and place of regular meetings.

All letters, newsletters, etc., by the 15th of the month please.

the things people say

"It wasn't a very good QSO. I couldn't hear him and he couldn't hear me."

. . . Brighton & District RS Newsletter

"I should be stronger now. I have a power meter in the antenna."

. . . heard by G4BYV

Medium Wave Broadcast Band DX

by Charles Molloy G8BUS

Reports to: Charles Molloy G8BUS
132 Segars Lane, Southport PR8 3JG.

Last month we looked at the advantages of tuning a loop, and how interference between two stations on the same frequency (co-channel QRM) can be reduced or eliminated. This time we will have a look at other problems that a loop may help to solve.

Static

Static (QRN), sometimes called atmospherics, is caused by thunderstorms often some considerable distance from the DXer's QTH. When severe, static produces a "frying" type noise in the loudspeaker. If it comes from all directions then there will be a reduction in the total amount picked up if you use a directional antenna such as a loop, as nothing will be picked up from the directions of the nulls. If static comes from one direction only, as may occur in summer from tropical thunderstorms to the south, then the static can be nulled-out by the loop just like an unwanted station, leaving DX from other directions such as North America in a static-free background. A loop is invaluable for summer DXing.

Adjacent Channel Interference

If you are trying to listen to a weak station close to a strong one, then peak-up the loop on the wanted one and rotate the loop until the interference is reduced or it disappears. Used in this way the loop is a substitute for additional receiver selectivity, but of course it only works if the wanted station and the QRM are in different directions.

There are several undesirable effects that occur as a result of adjacent channel QRM. One is overloading. A very strong signal applied to a receiver can produce spurious responses, cross-modulation, etc. A loop will often bring about an improvement, leading to a cleaner, better-quality audio signal. There is also the advantage that the wanted signal will not be weakened along with the QRM, which would occur with an aerial attenuator.

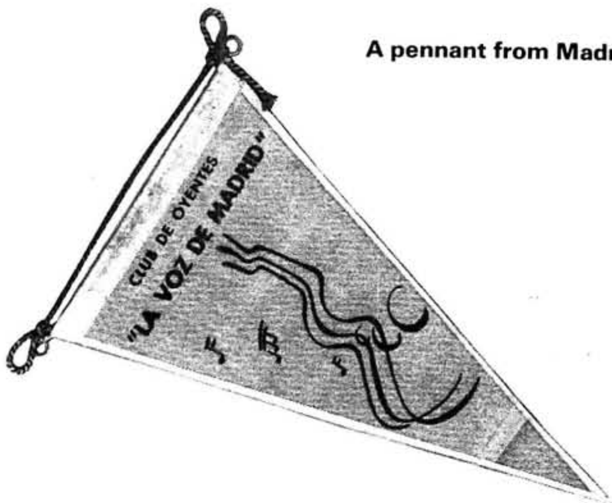
Sideband splatter occurs when a strong station spreads out to swamp nearby weak stations. Monkey chatter is another name for the inverted speech produced when one of the sidebands of the unwanted signal modulates the carrier of the wanted one. Receiver selectivity cannot cure these problems as the QRM is spread over the wanted station, but a loop will often bring about an improvement.

When two stations are separated by only a few kilohertz then there will be an audio tone (heterodyne) equal to the frequency difference between them. If you are listening to DX from North America or from other parts of Region 2 where the channel spacing is 10kHz, then a heterodyne of 1kHz, 2kHz or 3kHz can occur from broadcasts on a Geneva Plan channel which will spoil your DX signal. A tuneable audio notch filter will remove the heterodyne but so will a loop if it can null-out the unwanted station. You can try this out on 981kHz where there is a 1kHz heterodyne between Radio Sweden and Algiers on 980kHz which has not (yet) moved from its pre-Geneva channel. It is quite easy to separate the two with a loop and remove the heterodyne.

Next time we will look at the limitations of a loop antenna. What it cannot do and why it will not work with a portable receiver.

Iberia

Spain and Portugal between them provide interesting though contrasting DX. Spain has several chains of low-power local radios spread right across the country, many sharing the same frequency, rather like local radio in the UK but on a larger scale. In Portugal there are a number of low-power outlets that offer a challenge to the DXer. Both countries allocate callsigns to privately-owned stations, the Spanish prefix being E while the Portuguese is CSB. The two countries lie to the south of the UK so a loop is very useful for reducing interference from the remainder of Europe, QRM that comes mainly from an easterly direction.



A pennant from Madrid

A QSL card from Barcelona

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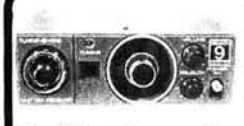

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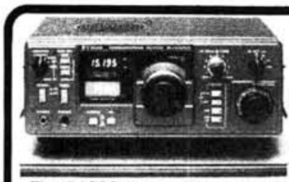

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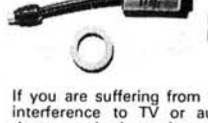

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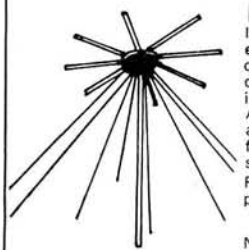

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Spain

In Spain the official Radio Nacional Espana (RNE) high-power broadcasts are at the l.f. end of the band, the most conspicuous being Madrid 585kHz, Seville 684kHz, Oviedo 727kHz and San Sebastian 774kHz. It is the low-power locals that provide the interest for the DXer, and these broadcasters are distinguished by the slogan "La Voz de—" with the call letters ECS or EFE, "Radio Juventud —" with EFJ, "Radio Popular —" with EAK and "Radio —" which uses EAJ.

Listen for EAK14 Radio Popular Pamplona on 1134kHz, EAJ17 R. Murcia on 1179kHz, EAJ10 San Sebastian 1260, ECS10 R. Centro Madrid 1314, EAJ34 R. Gijon 1359, EFJ15 R. Juventud Barcelona 1395, EFE22 La Voz de Asturias 1413, EFE57 LV de Navarra 1503, EAJ40 R. Pontevedra 1521, EAJ47 R. Valladolid 1539, EAJ35 R. Panades 1584, EAJ20 R. Sabadell 1602 and many others on the same channels. Also conspicuous are EAJ5 R. Sevilla on 792kHz and EAJ7 R. Madrid on 810kHz.

It is at sign-off time between midnight and 0100 that the real catches are made. As a dominant station goes off, its place on the channel is taken by a less conspicuous occupant, which may in turn be replaced by a third as the night progresses.

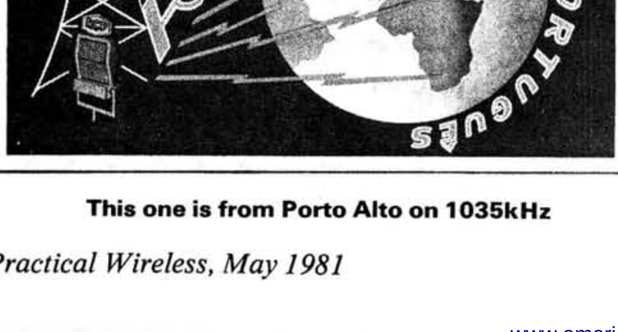
Portugal

The official Radiodifusão Portuguesa (RDP) outlets carry three separate programmes on the medium waves and a fourth on v.h.f. only. RDP1 comes from Lisbon on 666kHz and from Norte on 719kHz; RDP2 Lisbon is on 756kHz and Norte on 1062kHz while RDP3 is transmitted from Porto on 782kHz and Porto Alto on 1035kHz. All come in well after 2300 but can be heard earlier with a loop. These programmes are also carried by a number of low-power local stations. Look for Castell Branco on 828kHz, Covilha 1562kHz and Lisboa/Canidelo 1579kHz all with 1kW.

Listen for Radio Club Beiras which transmits on 1485kHz with the call CSB20, for Radio Renascenca which has CSB30 on 1170kHz located at Porto and a new outlet CSB5 on 594kHz located in Lisbon to replace CSB3 on 1287kHz.

QSLs

Spanish and Portuguese stations are good verifiers even to a report in English but do not forget to send an International Reply Coupon or unused stamps of the country concerned. A comprehensive list of station addresses is given in the *World Radio and TV Handbook* but a letter sent to El Gerente (manager) followed by the station name (La Voz de Asturias, for example) and the town or city should reach stations in Spain.



This one is from Porto Alto on 1035kHz

Readers' Letters

"Q Radio" which is CJYQ on 930kHz located at St John's in Newfoundland was monitored regularly in St Andrews by **Dr Eric Duncan** between November 7 and December 30 last year. The receiver is a home-brew superhet with long wire and a.t.u. Reception was never later than 0100 and the only blank night was on November 24 when the Post Office removed the antenna along with some old telephone wires. I wonder where the long wire was fixed?

The Director of Q Radio was surprised to learn that his station was being heard regularly in Scotland, but if you look at a Great Circle map you will see why it should be. Newfoundland is no farther away than Cairo, with the advantage that the path is over water, and it is only QRM that prevents regular reception of broadcasts from this area. Listeners in favourable locations in the British Isles, in parts of Scotland or on the west coast of Ireland ought to be able to pick up the maritime provinces of Canada easily. Can anyone confirm this?

Congratulations to **Mark Hattam** who is now G4KGA. He is still active on the medium waves and uses a Realistic DX160. Best DX recently includes WGY Schenectady NY on 810kHz and KDKA Pittsburg on 1020kHz. Mark connected his loop to the A1 terminal of the DX160 leaving A2 floating, and joined the other lead from the loop to the GND terminal. The DX160 has an internal antenna for m.w. reception.

DX Heard

"Radio Bilbao 990kHz relayed by R. San Sebastian 1260kHz are broadcasting an international programme Sundays 0000 to 0100, with music and information about the Basque country in Spanish, English, French and German," writes **Roy Patrick** from Derby, who goes on to say that: "San Sebastian gives a nice clean signal, Bilbao is hopeless with QRM from Beacon Radio and Berlin." Roy also heard Radio Globo Brazil on 1220kHz at 0100.

Reader **David Hyams** (Finchley) reports hearing the Faroe Islands on 531kHz some two hours before sunset (in winter), before high-power Europeans and North Africa come in. A nice catch David. Other DX logged included the BBC relays on Cyprus 639kHz and Oman 1413kHz plus Saudi Arabia on 1521kHz.

Short Wave Broadcast Bands

by Charles Molloy G8BUS

Reports: as for medium wave DX, but please keep separate.

Back to antennas again with a query from **Dr P. W. Allen** of Harpenden concerning the impedance and directional pattern of the dipole. This can be a confusing subject, but it need not be so if it is remembered that a half-wave dipole is cut for one band only, and the impedance and directional pattern only apply when the antenna is used on this band.

Half-wave Dipole

The half-wave dipole antenna consists of a length of wire slightly shorter than half a wavelength, which is cut in the middle and terminated there with an insulator. The impedance at this point is about 70 ohms but only at the resonant frequency (i.e. the frequency to which it is cut). If 70 ohm feeder is used to connect the antenna to the low-impedance antenna input of a receiver, then an antenna tuning unit is not required, since there is already a good match and maximum transfer of signal will occur. This only happens at the resonant frequency.

The half-wave dipole is also directional. At the resonant frequency the direction of minimum pick-up is along the wire and the maximum is broadside-on. At other frequencies the pattern may be different.

The formula for calculating the overall length in metres, of a half-wave dipole for the 49m band, taking 6·075MHz as the mid-band frequency, is $142{\cdot}6 \div 6{\cdot}075 = 23{\cdot}47$m, which is the resonant length for the 49m band.

Since the impedance of 70 ohms and the standard directional pattern are valid only at the resonant frequency, the dipole is a single-band antenna. The impedance is also 70 ohms at multiples of the resonant frequency but the international s.w. bands, unlike the amateur bands, are not harmonically related. This feature is therefore not relevant for broadcast band DXing, except that a 49m dipole should perform reasonably well on 16 metres.

Practical Considerations

So much for theory: how about the practical side of it? The Aerial Data Chart presented with the November 1979 *PW* gives constructional details for dipoles and the only problem left is that you have a centre-fed antenna. All right if you live in a house with space all around. You can put up a mast on either side in any direction you like and take the lead-in from directly overhead. In my case a half-wave dipole for the 49m band would have to be in a SW/NE direction, with a lead-in from a point some 11·6 metres from the house. Not convenient and the direction would give poor reception from South America and the Far East.

Inverted V Antenna

You could have the mid-point of the dipole at the chimney and terminate the ends at ground level, making the antenna into an inverted "V" which performs like a half-wave dipole. Not every XYL though will be happy with an antenna fixed to the front fence!

My personal preference is for the end-fed antenna, usually called the long wire by DXers. It is non-directional and need not even be in a straight line. Since it is non-resonant you need an antenna tuning unit to match it to the receiver. This type of antenna performs well and is easy to erect. If, however, you are particularly interested in one band and if the direction permitted by available space is right, then put up a half-wave dipole or inverted "V". You can use it as a "T" antenna on other bands by joining the two wires of the lead in together at the receiving end, using an a.t.u. for matching the "T", and you can do the changeover quickly and easily by means of a switch.

CBC Northern Service

The Northern Canada Service which broadcasts in English/French/Eskimo/Cree Indian has attracted some attention recently. **Colin Watson** (Cumbernauld) has been listening to the programme on 11 720kHz in the 25m band at 2300 hours. Unfortunately this service no longer QSLs, but a programme schedule is obtainable from Radio Canada International, PO Box 6000, Montreal, Quebec, Canada H3C 3A8.

Reader **Trevor Corns** of Sheffield also picked up the Northern Service on the same channel from 2200 to 2300 with his FRG 7700, 9 metre-long inverted "L" and a.t.u. He says the programming is aimed at Northern Quebec and Labrador via a Canadian domestic satellite link and part of the programme is in local languages.

Radio Free Grenada

This broadcaster has been heard with a fairly good signal on 15 102kHz in the 19m band by **Adrian Childs** of Dorchester, using his Murphy MS3200 stereo music centre (which has short-wave bands) and the rooftop two-element antenna used for v.h.f. reception. The signal faded

Card marking the 35th Anniversary of Radio Canada International

in at 2030 with a relay of the domestic service. Fourteen-year-old **Andrew Chadwick** (Bury), who is a newcomer to DXing, also picked up R.F. Grenada at 2040, and he wonders what address to write to for a QSL. **Anthony Cross** (Bath) picked up the station at 2030 using his FRG-7000, long wire and a.t.u., and he wonders if the station will QSL. Try PO Box 34, Morne Rouge, St George's, Grenada.

This station was heard by **Steve Browne** in Birmingham using a home-brew receiver with *Q* Multiplier, Crystal Filter and Audio Notch Filter, along with an a.t.u. and 24 metre-long wire. Where could you buy a receiver like that?

Tropical Bands

"A Trio R-1000 used with a Mizuho Sky Coupler (a.t.u.) and 30 metre-long wire performs especially well on the Tropical Bands," writes **Stephan Rogalson** of Birmingham who pulled in Radio Anhangueara Brazil on 4915kHz at 0130, R. Sutatenza Colombia on 5095kHz at 0152, the domestic service of Radio Nigeria on 4770kHz at 2142 and Radio Diffusion de Mauritania on 4845kHz at 2215. From Natal in South Africa comes a note from **Robert Mowrey** regarding the report in the December issue about the station on 3250kHz in the 90m band, which is not Radio RSA but a local commercial broadcaster called Radio 5. It is on 3250kHz between 0300 and 0545, and again from 1535 to midnight, also on 9620kHz in the 31m band between 0550 and 1530.

A 30 metre-long wire and AR88LF are in use at St Leonards-on-Sea by **Harold Brodribb.** His 60m DX covers Radio Uganda 5026kHz, Radio Kabul 4760kHz, Tirana 5057kHz (with 5th harmonic at 25 285kHz), Yerevan 4990kHz at 1855, Kiev 4940kHz and, on 3277kHz in the 90m band, faint Indian music at 1600. **David Hyams** (Finchley) used his DX160 and long wire to pull in Benin on 4870kHz at 0600, Cameroon 5010kHz at 2130, three from Colombia: R. Super 4875kHz at 0500, R. Colosal 4945kHz at 0620, R. Santa Fe 4965kHz at 0630, La Voz de Nicaragua 5948kHz (49m band) at 0435, South Africa 4880kHz at 2000, Yemen 4853kHz at 1845 and from Venezuela, Ecos del Torbes 4980kHz at 2320, R. Lara 4800kHz at 2335, R. Juventus 4900kHz at 0340 and R. Reloj 5030kHz at 0400.

Radio Algiers

Reader **Paul McKee** of Belfast would like to know the frequency and times of English broadcasts from Algeria. They are on the air daily in English at 2100 on 254kHz long waves plus frequencies in the 13, 19 and 25m bands though they do move around a bit. Try 11 740, 15 365 or 21 632kHz. The address for an up-to-date schedule is Radiodiffusion Television Algerienne, 21 Boulevard des Martyrs, Algiers.

DX Heard

Radio Bras (Brasilia) is reported on 15 125kHz in the 19m band by Steve Browne at 1900, by Adrian Childs also at 1900, and by **Andrew Byte** (Holywell) who gives the mailing address as Radio Nacional do Brasil, PO Box 04-0340, Brasilia, Federal District of Brazil.

Eleven-year-old **Peter Manson** of Glasgow, who must be our youngest reporter, has a Grundig Melody Boy 1000 with which he logged the Voice of Greece at 1245 and Radio Sweden at 1240 both in the 25m band. **John A Walker** (Birmingham) used a Selena portable with telescopic antenna to pick up Radio Korea at 1605 on approx 44 metres (6580kHz), Radio Turkey with DX programme at 2320 on 30·5m (9515kHz).

Havana in Cuba on 7135kHz was heard in English at 2200 by **Roy Patrick** of Derby, plus Radio Clarin in Santo Domingo on 11 700kHz with station identification and jingles music at 2330, which means that this 5kW outlet is active again.

VHF Bands

by Ron Ham BRS15744

Reports to: Ron Ham BRS15744
Faraday, Greyfriars, Storrington,
Sussex RH20 4HE.

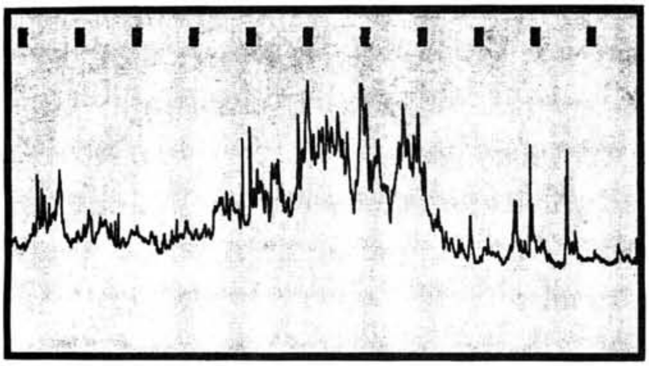
While my radio telescope was recording signals from the active sun, and the trace on my barograph was high and steady, there was little doubt in my mind that this month's postbag would be as fascinating as ever.

Solar

Both **Cmdr. Henry Hatfield,** Sevenoaks, and I recorded a variety of small bursts of solar radio noise, at 136MHz and 143MHz respectively, on January 22, 25, 27, 28 and a mild noise storm on the 29th. A prolonged solar event began on February 5 and lasted until the 16th, during which time we recorded several large bursts amid a noise storm on the 5th to the 8th (Fig. 1) and small ones on the 9th to the 11th. A variety of bursts were again recorded during a mild noise storm on the 12th (Fig. 2), and several strong, short-duration bursts were recorded on the 15th and 16th. The solar noise was so extensive on the 7th that **Harold Brodribb** heard it in the 10m band. No doubt this solar activity was responsible for the 10m band being dead when I checked it at 0845 on the 7th and 0920 on the 9th. **Ted Waring,** Bristol, counted 14 sunspots on January 25, 24 on the 30th, 35 on February 1, 34 on the 10th and 23 on the 13th.

Aurora

With all that solar activity recorded I was not surprised when **John Branegan** GM4IHJ, Saline, Fife, told me that he logged GMs and LAs during an aurora between 1640 and 1910 on February 5. During another aurora between 1640 and 2030 on the 6th, John said that the 2m band was full of "wall to wall" signals from DK, EI, F, G, GI, GJ, GW, LA, ON, OZ, PA and SM. He also received strong tone-A signals from the 2m beacons in Cornwall GB3CTC, Northern Ireland GB3GI, Wrotham GB3VHF and Germany DL0PR. Although John could hear some amateur signals on 4m there was very little European f.m. heard around the band at the time. During the event, **George Grzebieniak** RS41733, London, heard GM3WOJ



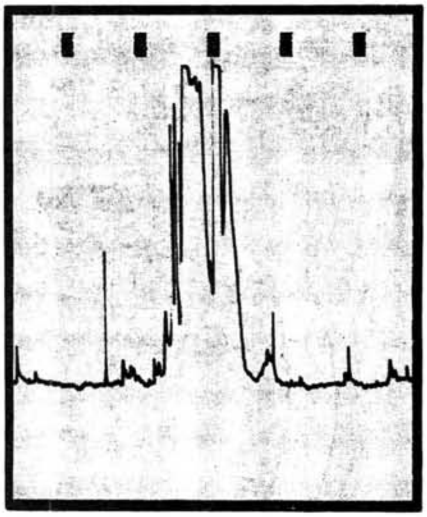


Fig. 1: A solar burst within a noise storm recorded by the author at 143MHz on February 6

Fig. 2: A typical individual solar burst recorded by the author on February 12 ▶

on 4m, and **Roy Banister** G4GPX, Lancing, and G4JGJ/MA (Maritime Anchored), Brighton, heard auroral c.w. on 2m. "I have been in telephone contact with GM4ILS who regularly monitors for aurorae and have arranged to be a link in the warning chain," writes **Phil Hodson** G8RBY, Melton Mowbray, who is prepared in turn to telephone up to five people. Anyone who wants to be included in this should write to Phil, QTHR, and include their phone number and an s.a.e.

The 6m Band

Congratulations to **Peter Turner,** Brighton, using the callsign GW4IIL/A, on receiving an Americam 6m award for his cross-band work. For the 10m band, Pete uses an FT-200, and to receive on the 6m band he has a Microwave Modules converter into a TS-120V receiver. So far he has worked some 50 stations with this set-up. John Branegan had a cross-band QSO with VE1AVX on January 14 and writes: "GB3SIX, Anglesey, is excellent strength here by meteor scatter, pity they have to switch it off during TV hours."

The 10m Band

Generally speaking, propagation on 10m has followed the same pattern as in previous months, with Russian signals predominant in the early morning and North Americans at midday. There were of course exceptions. At 0930 on January 27, I received a very strong signal from a VK4 while he was working an SM, and around 0850 on the 28th I heard strong JAs and a VK working SM and HK. Signals from Japan were also heard between 0800 and 0900 on February 1, 3, 4, 5, 6, 8, 11, 12, 16 and 17. Among the more interesting QSOs was a very strong signal from a JA near Tokyo airport working many European stations around 1000 on the 6th, and at 0947 on the 12th I received an "armchair copy" QSO between JA2APA and LX1SI. At 0930 on the 10th I received a 58 signal from ZL2BFU when he was working OH2TI, a club station at the Technical Institution in Helsinki.

Steve Bowler RS46105, Newton Bar, has been listening on 10m with a Trio R-1000, a Mizuho a.t.u. and a long wire antenna. Everything is DX when you are new at the game Steve, keep it up, ten is a fascinating band. "It has been 'VE DAYS' again here," writes Ted Waring from Bristol, who continues to monitor the Canadian beacon VE2TEN and has received a QSL card (Fig. 3) and a log sheet from the beacon-keeper Serge Freve for his efforts. During the 29-day period between January 20 and February 17, I received signals from the beacons in Bahrain A9XC on 26 days, Bermuda VP9BA 10 days, Cyprus 5B4CY 24 days, Germany DL0IGI 27 days and DK0TE 7 days. In addition to the Canadian beacon, Ted often receives signals from the beacons in Florida W4ESY, Mauritius 3B8MS and South Africa ZS6DN and ZS6PW.

RTTY

Until I purchased my MM2000 and fed the signals into an Ultra 12in TV, I did not realise just how much enjoyment there is in reading amateur RTTY signals. There is a lot of activity around 14 090kHz and I have so far logged signals from stations in Austria, France, Germany, Italy, Poland, Spain, Switzerland and Sweden. The MM2000 almost operates itself once its tuning lights are responding to the twittering RTTY signals coming from my FR-101. At 0912 on January 24 I received good copy, both ways, from SM7EVV working DL0CI. The SM was using a Yaesu FT-707 and a PET CBM3008 for RTTY, and the DL was operating from a club station. My best DX so far

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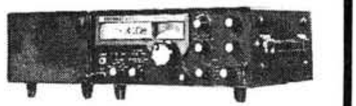

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came at 0934 on February 9 when I received good copy from VK2ZN, Sydney, who was working F6EXG. On February 10 a German station was type-testing with "the quick brown fox jumps over the lazy dogs back".

My first RTTY signal on v.h.f. came during the tropo opening, near midnight on January 29, when I received good copy from Phil Hodson G8RBY on 144·6MHz. At 1318 on the 30th, Phil, who has a solid-state message recorder on his VDU, replayed the message he received from the station he was working in Cologne. Phil's biggest bit of pleasure from the opening came when he worked G4ABM, Cleveland, in ZO square at 2128 on the 27th, and at 0049 on the 28th he was called by GD3YEO and had an enjoyable natter. At 1307 on the 30th Phil had a 45-minute QSO with DD3KM/A who was making his first RTTY contact with G, and later in the afternoon Phil worked ON1APE, ON7MQ and PA0SQE. During the lift at the end of January, **Tony Phillpott** G4IMP, Folkestone, tuned his FT-221R to 144·6MHz and, running just 10W to a 10-ele Yagi, had an hour or so RTTY contact with DB8EB. Tony uses an old Creed 7B teleprinter and an ST5 terminal unit.

Anyone wishing to become a member of the British Amateur Radio Teleprinter Group should write to Mrs I. D. Double, 89 Linden Gardens, Enfield, Middx. Ted Double G8CDW would like to remind readers about the BARTG 2nd Spring VHF-UHF Contest which takes place from 1800 on the 18th to 1200 on the 19th of April (GMT). Further details and log sheets from Chris Plummer, G8APB and G8CDW, QTHR.

Tropospheric

At midday on January 20 the atmospheric pressure rose sharply from 29·9in (1012mb) to 30·3 (1026) by midnight, rising a little more to 30·4 (1029) by noon on the 22nd, and reaching 30·6 (1036) by midday on the 28th. It hovered there until noon on February 2 and then fell rapidly to 29·9 in less than 24 hours. As expected, this long period of high pressure increased the range of v.h.f. and u.h.f. signals, and true to form, a few days before the pressure fell, an extensive tropospheric opening occurred. Band II was badly affected and a major victim of this event was the EBU concert to commemorate Mozart's bi-centenary, during the evening of January 29. This programme was so important that the BBC re-arranged their schedule and many people I spoke to during the previous week were looking forward to it. This could have killed the layman's confidence in stereo v.h.f.

"I believe the EBU concert over BBC Radio 3 was somewhat a shambles and I can imagine how disappointed listeners were," writes **Simon Hamer,** Presteigne, who heard a variety of programmes from France, BBC Radios London, Manchester, Sheffield and Solent, and ILR Capital between 1955 and 2100 on January 20. He also heard many French stations during the evening of the 21st and 22nd, and BBC London, Medway and Solent and ILR Capital, LBC and Thames Valley on the 23rd. During the evenings of the 25th, 26th and 29th he added pop music and adverts from Italy, football results from Belgium, and opera and rugby results from France. **Reg Moores,** Brighton, heard strong French stations in Band II during the evening of the 25th, and **Eric Arnold** G4JDJ, Brighton, found continentals interfering with the BBC stations on the 27th. "The high atmospheric pressure produced a very long period of exceptional French reception," writes Harold Brodribb, St Leonards-on-Sea, Sussex. On most days he logged 18 French stations and 5 editions of BBC Radios 2, 3 and 4, and on February 2 he heard 16 French and 5 Dutch stations.

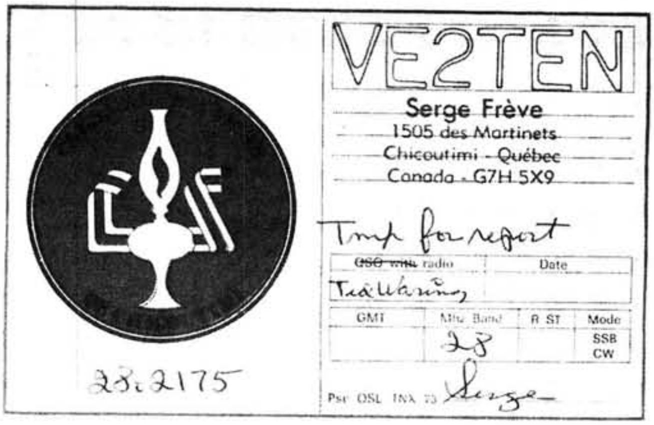

Fig. 3: A QSL card for the Canadian 10m beacon, received by Ted Waring

Needless to say, the amateur bands were full of DX and while the repeater channels were stacking up several deep some operators were not sure which one they were working through. While listening to the Buxton repeater GB3HH R4, predominant in Sussex, I heard one operator say it was Bedlam, which just about summed the situation up. "Some of the 2m signals were colossal strength." said **Cyril Fairchild** G3YY, Brighton, who heard several EAs on 2m f.m. During the evening of the 30th both **Alan Baker** G4GNX, Newhaven and first-timer **Deryck Arnold** G8OUK worked G8URE/A in Plymouth via the Brighton repeater, GB3SR R3. At 1300 on the 30th, Alan worked G8SEE/M Redruth, both using 10W, via GB3SR and followed this with a simplex contact. During the evening of the 29th Alan worked G3XDY, Ipswich and a DJ on s.s.b. and a PA0 on c.w., on the 30th four French stations on s.s.b. and one on c.w., and on the 31st he had c.w. contacts with three PA0s, an ON and a DJ. "There were many continental repeaters up," said Alan, who at times was receiving signals from the Cornish beacon, GB3CTC, at 559 and the Paris beacon, FX0THF was sending his meter over the stop.

Mark Evans G8CTN, Burgess Hill, using 10W from a Trio TR-9000 to a 4-ele quad, worked stations in Northern G, Cornwall, Somerset, PE, F and ON, heard a GM on s.s.b., and worked an ON using horizontal f.m. **Bob Hodge** G8TYW, in nearby Hurstpierpoint, Sussex, using a home-brew rig giving 5W to a 5-ele Yagi, worked stations in France and Holland, and both Mark and Bob worked their fellow Mid-Sussex club member, Jonathan Wymer G8URE/A in Plymouth. Outside the main event Mark has worked G4FRZ in Abbots Langley, who uses 500mW to a dipole. At 1243 on February 2, **Adrian Boyd** G8NNY/M, Horsham, using a TR-2300 giving 1W to a Microwave Modules 25W linear and a $\frac{7}{8}\lambda$ gutter-mount aerial on his car in Eastbourne town centre, worked PA3BFB/M in the town centre of Rotterdam. Later, from Beachy Head, Adrian worked PE1FBR, near Rotterdam.

At 2217 on January 31 **John Parry** GJ8RRP, St Saviour, was mobile on the north coast of Jersey and had a QSO with G8OQT, Wembley. Between January 24 and February 1, George Grzebieniak heard stations in Northern G, GM, France and Holland on 2m, Devon, GW, DJ and PA on 70cm, and ON and PA on 23cm. George also keeps a daily record of atmospheric pressure, temperature and the weather charts from his newspaper to compare with his 2m and 70cm log. For most of the 30th and 31st I was receiving signals from the Sutton Coldfield beacon, GB3SUT, at 569-599 with only a dipole feeding my 70cm receiver. "My most enjoyable moment on 2m s.s.b.," writes Phil Hodson, "was hearing Bill, G8YYO in Ilfracombe calling CQ. I gave him a call and we got chatting. Bill was 650ft a.s.l. near Ilfracombe, running 100W, and we were colossal signals with each other. For a laugh, I asked Bill to give me a report on 5W and he came back, 10 over 9! He then dropped to 6W and likewise was 59 plus with me. I dropped to 1W and still got 59, then down to 100mW and received 45, and on 40mW a report of 33." I congratulate the pair of you on a most interesting v.h.f. experiment over a 175-mile path.

During the 70cm contest on February 8, George Grzebieniak heard G3XMG, Lancs, GD2HDZ and GW8AAP/P. The atmospheric pressure was again doing the right things on the 8th, because at 1900 I heard that an EA was worked from London on 2m, **John Cooper** G8NGO, Cowfold worked 12 French stations, Alan Baker worked F6GDX and George Grzebieniak heard F6GDX at 630km.

News Items

Congratulations to Deryck Arnold, Hove, on passing the December RAE and getting Dad's (now G4JDJ) old call-sign G8OUK. Deryck uses an ICOM IC-2E and is often heard working through the Crawley repeater GB3BP R6. At times, under Dad's supervision, he has worked VK5ARZ on 20m.

Now that the BBC World Service programme *World Radio Club* has finished, **Ian Galpin,** Poole, reminds us that another BBC programme, *Waveguide,* is of similar interest and is transmitted at 1709 GMT Thursdays and 0439 and 2154 on Fridays.

For those of my readers who are interested in vintage radio I can recommend a new book called *Early Wireless* by Anthony Constable, published by Midas Books. Many readers will know Anthony as the founder of the British Vintage Wireless Society.

We regret to report the sudden death of **Ern Hoare** G3RZD. Throughout his life, Ern made a great contribution to many aspects of amateur radio and was one of the partners in the famous "Two Erns" microwave team. We extend our deepest sympathy to his family and his many friends.

TV

by Ron Ham BRS15744

Reports: as for VHF Bands, but please keep separate.

"I set the five spare tuners on our Mitsubishi receiver to Crystal Palace for BBC1, BBC2 and ITV, and Sandy Heath for Anglia ITV and BBC1 East. Past experience has shown that they appear every time the atmospheric pressure is high and then a wider range of programmes is available for the family," writes **Simon Hamer,** Presteigne, Wales. This is a marvellous idea Simon, you now have your own DX detector and I bet it paid off during the last week in January.

Tropospheric

Obviously the big tropospheric opening, described in *VHF Bands,* must take pride of place in this month's column. On January 30, **Steve White,** Huntingdon, Cambs, received full u.h.f. colour pictures from a Dutch station showing English adverts with sub-titles. This was followed by a quiz game where a car was won, and an announcer with the station ID AVRO above his right shoulder. This is a very interesting report, Steve, especially as you are using a standard Philips CTV with a set-top antenna in a location surrounded by trees.

One French station that **Cyril Fairchild** G3YY worked on 2m, told him that he was receiving perfect pictures from BBC u.h.f. television for several hours. At around the same time, **Adrian Boyd** was receiving French TV in Horsham, on Channels 21 and 30 using the loop antenna on the back of his set. Further north in London, **George Grzebieniak,** using a 91-ele Yagi, received pictures from Germany on Chs. 27 and 35 on January 30 and Holland on Chs. 28 and 55 on the 31st. One of the German programmes George saw was about Africans, followed by an adventure programme called *DEREK.* **George Garden,** using a 10in Sanyo CTV at the top of a block of flats in Bracknell, watched the close-down of Tyne Tees TV from Bisdale, Ch. 29, on the 29th, and the German station ZDF giving details of the week's programmes and a clock from the Belgian station RTB F1 on the 31st. I received pictures throughout the event from the IBA transmitter at Lichfield on Ch. 8. **John Thompson,** Gillingham, Kent, using a JVC 3040 plus an Antiference XG14 antenna and rotator, also checked Band III and on January 30 saw a Charles Bronson film, in English, from BRT-1 Belgium on Ch. E10. For most of the time between the 27th and 29th, **Sam Faulkner,** Burton-on-Trent, received test cards and programmes from Ireland, RTE1 Ch. IH and RTE2 Ch. IG, in Band III. Sam also saw Southern Television's *Day-by-Day* programme, on Ch. 42, being interfered with by a French station. Like Steve White, Sam saw the Tele Bingo Quiz from Holland in addition to an English film with Dutch sub-titles. During the event he saw a discussion programme, the American series *Vegas* and *Televieze Magazine* from Holland on Ch. 29, and on Ch. 35 a YL announcer appeared with the station ID, ZDF. "Unidentifiable pictures occupied Ch. 48, and generally the whole of the lower u.h.f. spectrum, which under normal conditions is crowded here, was simply chaotic," said Sam.

During January 29, 30 and February 1, John Thompson received pictures from Anglia TV on Ch. 59, Tyne Tees TV on Ch. 29, Nederlands 2 on Ch. 31, and test cards from the German u.h.f. stations NDR, WDR and ZDF. On January 26, Simon Hamer, using his own TV176 and the family Mitsubishi CTV, watched *Nationwide* from Crystal Palace on Ch. 26, *About Anglia* from Sandy Heath on Ch. 24, and *Look East* from Sandy Heath on Ch. 31. Although on this occasion the signals were only fair, it was the start of the event and as time went on these signals were soon bumping in. On the 29th he added pictures from France on Chs. 27 and 29, and on the 30th he saw the closing programme from Thames TV, London, in good colour.

Down in Folkestone, **Nicholas Wythe** is getting very good results from a modified Bush TV183D dual-standard receiver incorporating switching for the French system, supplied by Hugh Cocks, and can normally receive FR3 (Fig. 1) from Dunkirk. During the opening Nicholas received many Belgian, Dutch and German signals (Figs. 2, 3, 4) and saw test cards, a documentary and programmes about rock music and Dr. Snuggles. Another very important observation Nicholas made was to try for DX on his parents' Baird Teletext receiver, and although

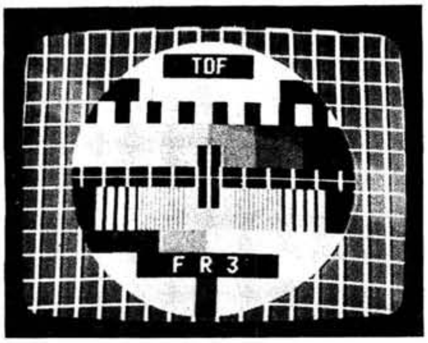

Fig. 1: A test card signal received from Dunkirk

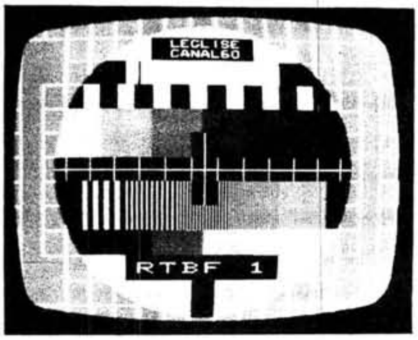

Fig. 2: A test card from Belgium received on Ch. 60 on January 29

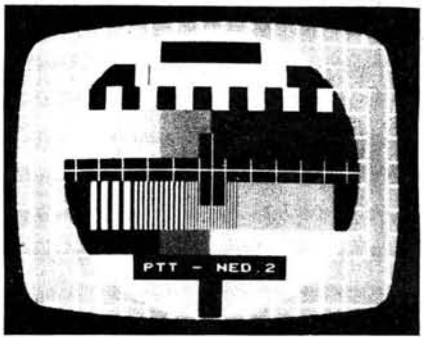

Fig. 3: A test card from Holland received on Ch. 32 on January 29

Fig. 4: Programme details from ZDF received on February 1

Figs. 5 and 6: Two Teletext pages received from Belgium BRT Egem on Ch. 43 on January 30

The pictures shown above were all received by Nicholas Wythe in Folkestone, Kent

the antenna was pointing in the wrong direction he received Teletext pictures from Belgium BRT Egem on Chs. 43 and 46 (Figs. 5, 6) in excellent colour on the 30th. Like the others, **T. Ampi** RS46056, London, enjoyed the event, and among the many u.h.f. pictures he received from Belgium, Germany and Holland, he saw a Schools programme from Holland *Russian for Beginners,* Sport from Germany and a variety of announcers at work. His real prize came some days later, at 1230 on February 9, when he received pictures for the first time from RTL Luxembourg on Ch. 21.

At 1810 on January 30, **S. A. Spiller,** Sutton, Surrey, watched a cartoon programme, *Scooby Doo*, with Dutch sub-titles, and was among those who saw the Tele-Bingo quiz from Holland on Ch. 28. During the event, Mr Spiller used his VCR to record some of the DX in good colour.

Aurora

"Both sporadic E and auroral conditions seemed present on January 21," writes Sam Faulkner. "I heard an SM station on 6m, 4m/10m crossband say he was copying auroral signals on Ch. R1 49·75MHz. I immediately tuned and logged TSS Russia with BPEMR news and other programmes between 1720 and 1830." Sam also received flickering pictures during that time on Chs. E2 48·25MHz, E3 55·25MHz and R2 59·25MHz. **John Branegan,** Saline, Fife, received pictures from Arctic TV on Chs. E2 and E4 during an aurora between 1400 and 1600 on January 26, again between 1640 and 1910 on February 5, and from Norge Melhus on Ch. E2 during the aurora on the 6th.

SSTV

"Despite poorer SSTV conditions on 10m, east coast USA activity has been seen here almost daily," wrote Sam Faulkner on February 9. On January 24 he logged pictures from WA0PQD, WB0QCD, WD0ADZ and K0LSW, at 1300 on the 25th V0IBL, at 0900 on February 1 17PQD and at 1745 on February 3 HK3DBQ.

F2

Although, like John Branegan, I had not received pictures via F2 since early in January, there was an event between 0845 and 1045 on February 17. It began as usual with weak sync pulses, audible on Ch. R1, gradually getting stronger until smeary pictures filled the screen. Although mainly unidentifiable, the outline shapes of announcers were periodically seen and there was evidence of a news programme.

BATC

The British Amateur Television Club has been going now since 1949, and its members are involved with all aspects of DXTV. The club is affiliated to the RSGB and has a representative on the Society's VHF Committee. Readers who wish to join or require further information should write to: B. Summers, 13 Church Street, Gainsborough, Lincs.

New! Sinclair ZX81 Personal Computer.

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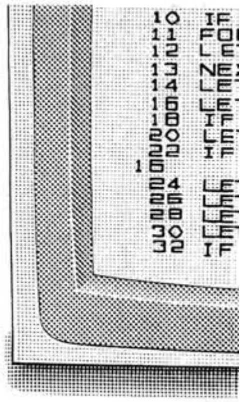

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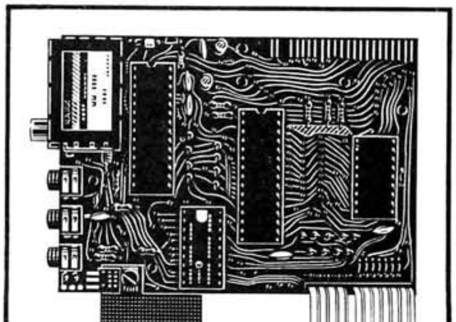
The picture shows dramatically how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.



Proven micro-processor, new 8K BASIC ROM, RAM – and unique new master chip.

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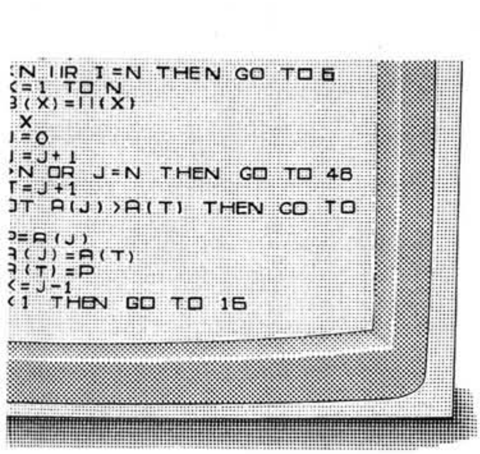
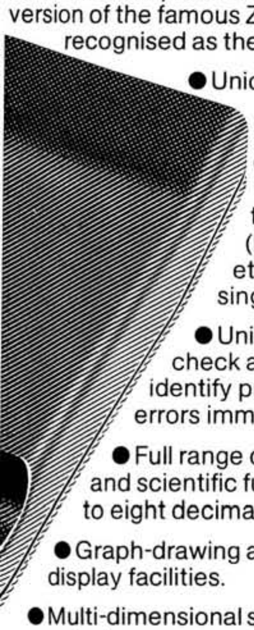


New, improved specification



- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
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Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

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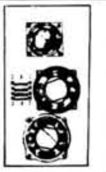

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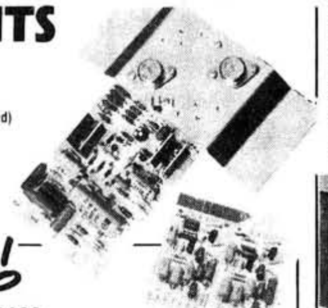

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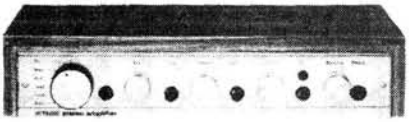

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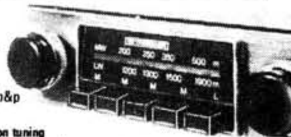

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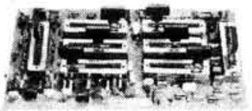

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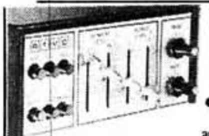

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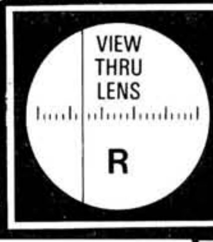

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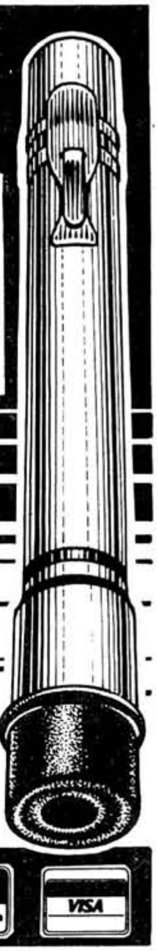

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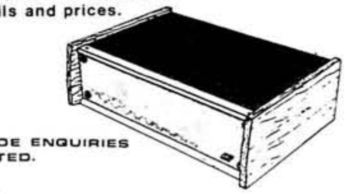

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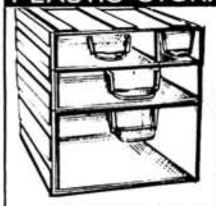

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BC108	0.10
BC108C	0.10
BC109B	0.10
BC140	0.31
BC141	0.25
BC142	0.21
BC143	0.24
BC147	0.09
BC148	0.09
BC149	0.09
BC157	0.10
BC158	0.09
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BC160	0.28
BC170B	0.10
BC171	0.08
BC172	0.05
BC173B	0.10
BC182	0.09
BC183	0.09
BC184LA	0.09
BC212	0.09
BC212L	0.09
BC213	0.09

BC213L	0.09
BC214	0.09
BC214L	0.09
BC237	0.09
BC238	0.08
BC307	0.09
BC327	0.10
BC337	0.10
BC461	0.30
BC478	0.20
BC547	0.10
BC548	0.10
BC549A	0.08
BC557	0.07
BC558	0.07
BD131	0.32
BD132	0.35
BD133	0.40
BD135	0.30
BD136	0.30
BD137	0.28
BD138	0.30
BD139	0.32
BD140	0.30
BD144	1.20
BF115	0.35
BF167	0.24
BF179	0.34
BF180	0.29
BF183	0.29
BF194	0.11
BF195	0.11
BF196	0.11
BF197	0.11
BF198	0.10
BF199	0.14
BF200	0.30
BF257	0.28
BF258	0.25
BF259	0.26
BF336	0.34
BFX29	0.30
BFX84	0.26
BFX85	0.28
BFX86	0.30
BFX88	0.25
BFY50	0.21
BFY51	0.21
BFY52	0.25
BFY90	0.73
BU105	1.22

BU108	1.69
BU205	1.30
BU208	1.39
BU208A	1.52
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R2010B	1.70
R2540	2.48
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TIP29C	0.42
TIP30C	0.43
TIP31C	0.42
TIP32C	0.42
TIP41C	0.45
TIP42C	0.47
TIP47	0.65
TIP2955	0.84
TIP3055	0.60
TIS91	0.20
2N3054	0.59
2N3055	0.59
2N3702	0.12
2N3703	0.12
2N3704	0.12
2N3705	0.12
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30 VOLT RANGE (Split Sec)
Sec Voltages available 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30V or 12V-0-12V or 15V-0-15V.

Ref.	Amps 30V	Amps 15V	Price	P&P
112	.5	1	**2.90**	1.00
79	1	2	**3.93**	1.00
3	2	4	**6.35**	1.20
20	3	6	**7.39**	1.44
21	4	8	**8.79**	1.60
51	5	10	**10.86**	1.60
117	6	12	**12.29**	1.72
88	8	16	**16.45**	1.96
89	10	20	**18.98**	1.84
90	12	24	**21.09**	O.A.
91	15	30	**24.18**	O.A.
92	20	40	**32.40**	O.A.

50 VOLT RANGE (Split Sec) Pri 120/240V
Sec 50V Voltages available 5, 7, 8, 10, 13, 15, 17, 20, 33, 40 or 20V-0-20V or 25V-0-25V

Ref.	Amps 50V	Amps 25V	Price	P&P
102	.5	1	**3.75**	1.20
103	1	2	**4.57**	1.20
104	2	4	**7.88**	1.44
105	3	6	**9.42**	1.60
106	4	8	**12.82**	1.72
107	6	12	**16.37**	1.84
118	8	16	**22.29**	2.20
119	10	20	**27.48**	O.A.
109	12	24	**32.88**	O.A.

MAINS ISOLATORS (SCREENED)
Pri 0-120; 0-100-120V (120, 220, 240V) Sec 60-55-0-55-60 twice to give 55, 60, 110, 115, 120, 125, 175, 180, 220, 225, 230, 235, 240.

Ref	VA	Price	P & F
*07	20	**4·84**	1.20
149	60	**7·37**	1.20
150	100	**8·38**	1.44
151	200	**12·28**	1.72
152	250	**14·61**	2.04
154	500	**22·52**	2.20
155	750	**32·03**	O.A.
156	1000	**40·92**	O.A.
157	1500	**56·52**	O.A.
158	2000	**67·99**	O.A.
159	3000	**95·33**	O.A.

*Pri 0-240V Sec 115 or 240V
State sec. volts required.

CASED AUTO TRANSFORMERS
240V cable in 115V USA flat pin outlet

VA	Price	P & P	Ref
20	**6·55**	0.95	56W
75	**8·50**	1.20	64W
150	**11·00**	1.44	4W
250	**13·39**	1.44	69W
500	**20·13**	2.04	67W
1000	**30.67**	2.20	84W
2000	**54.97**	O.A.	95W

60 VOLT RANGE (Split Sec)
Pri 120/240V. Voltages available 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 or 24V-0-24V or 30V-0-30V.

Ref	Amps 60V	Amps 30V	Price	P&P
124	.5	1	**4.27**	1.20
126	1	2	**6.50**	1.20
127	2	4	**8.36**	1.60
125	3	6	**12.10**	1.72
123	4	8	**13.77**	1.96
40	5	10	**17.42**	1.84
120	6	12	**19.87**	2.04
121	8	16	**27.92**	O.A.
122	10	20	**32.51**	O.A.
189	12	24	**37.47**	O.A.

12 OR 24V OR 12-0-12V
Pri 220-240 volts

Ref	Amps 12V	Amps 24V	Price	P&P
111	0 5	0 25	**2·42**	0.95
213	1 0	0 5	**2·90**	1.00
71	2	1	**3·86**	1.00
18	4	2	**4·46**	1.20
85	0 5	2 5	**6·16**	1.20
70	6	3	**6·99**	1.20
108	8	4	**8·16**	1.44
72	10	5	**8·93**	1.60
116	12	6	**9·89**	1.60
17	16	8	**11·79**	1.72
115	20	10	**15.87**	1.84
187	30	15	**19.72**	2.04
226	60	30	**40.41**	O.A.

SCREENED MINIATURES

Ref	mA	Volts	£	P&P
238	200	3-0-3	**2·83**	0.50
212	1A, 1A	0-6, 0-6	**3·14**	1.00
13	100	9-0-9	**2·35**	0.50
235	330, 330	0-9, 0-9	**2·19**	0.60
207	500, 500	0-8-9, 0-8-9	**3·05**	0.95
208	1A, 1A	0-8-9, 0-8-9	**3·88**	1.20
236	200, 200	0-15, 0-15	**2·19**	0.60
214	300, 300	0-20, 0-20	**3·08**	1.00
221	700 (DC)	20-12-0-12-20	**3·75**	1.00
206	1A, 1A	0-15-20	**5.09**	1.20
203	500, 500	0-15-27	**4.39**	1.20
204	1A, 1A	0-15-27	**6.84**	1.20
239	50	12-0-12	**2·88**	0.50
234	500	6-0-6	**2·19**	0·44

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Voltages available: 105, 115, 190, 200, 210, 220, 230, 240, for step up and step down.

Ref.	VA (Watts)	£	P&P
113*	15	**2.73**	1.00
64	80	**4.41**	1.20
4	150	**5.89**	1.20
53	350	**10.00**	1.44
67	500	**12.09**	1.84
84	1000	**20.64**	2.20
93	1500	**25.61**	O.A.
95	2000	**38.31**	O.A.
73	3000	**65.13**	O.A.
80S	4000	**84.55**	O.A.
57S	5000	**98.45**	O.A.

*0, 115, 220, 240.

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M679 – 240V, 36V 1.6A **£3.00** 80p
M865 – 100V Line to 4 Ω 10 watts **£1.90** £1.00
M1020 – 0-240V 12-0-12V @ 50ma **75p** 50p
M1126 – 120/240V: 9-0-9V @ 1A **£1.79** 60p
M9 – 0, 12, 15, 20, 24,30V 1A **£2.89** P&P £1.10

15V CT Range (7.5V-0-7.5V)

Ref			P & P
171	500 mA	**2·30**	0.60
172	1A	**3·26**	1.00
173	2A	**3·95**	1.00
174	3A	**4·13**	1.20
175	4A	**6·30**	1.20

NEW RANGE TRANSFORMERS
Pri 120/240V

2 windings 0-36V-48V/36V-0-36Vm 48V-0-48V 72V or 96V.

Amps	Ref.	Price	P&P
1.0	431	**8.12**	1.44
2.0	432	**13.35**	1.22
3.0	433	**16.17**	1.96
4.0	434	**20.65**	2.04
5.0	435	**29.30**	2.20
6.0	436	**36.69**	O.A.
8.0	437	**40.03**	O.A.

Split Bobbin Type. Pri 0-115, 0-115. Sec 0-12-15-20-24-30 to give 3, 4, 5, 6, 8, 10, 12, 15, 18, 20, 24, 30V.

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Metal Oxide Resistors – ¼W 5% **£1.00** 100. 30p P&P+VAT.
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0 1mA	**5·95**	0 1mA	**6·70**
0 30V	**5·95**	0 30V	**6·70**

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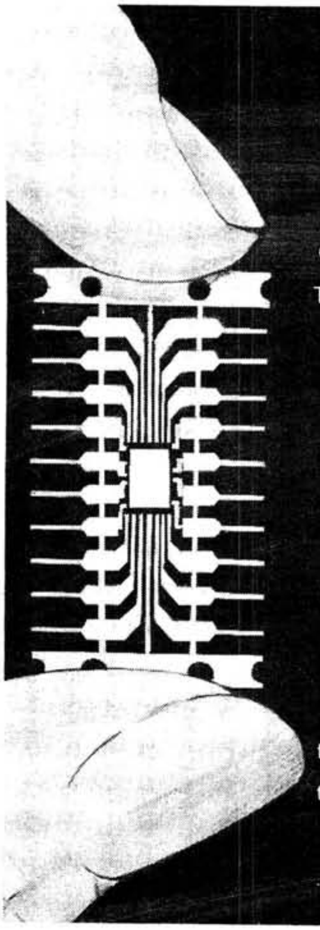

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5KΩ 500KΩ Single gang **70p**
10KΩ 500KΩ Dual gang **110p**
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0·25W 250Ω-4·7MΩ Vert. **10p**

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0·5W 2Ω2-5M1	E12	2p	1p
1W 2Ω2-10M	E12	5p	3p
2% Metal Film 10Ω-1M	E24	6p	4p
1% 0·5W 51Ω-1M	E24	10p	8p

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	Clad	Plain
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2½×5"	83p	—
3¾×3¾"	83p	—
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6"×12"	150p	200p	

FERRIC CHLORIDE 1 lb **195p** +40p p&p

DALO ETCH RESIST PEN plus Spare Tip **95p**

SOLDERCON PINS 100 pins **60p**; 500 pins **275p**

VERO WIRING PEN spool **310p**; spare spool **65p**; combs **6p**.

DIL SOCKETS

	Low profile	Wire wrap
8 pin	10p	25p
14 pin	10p	35p
16 pin	10p	46p
18 pin	16p	52p
20 pin	22p	65p
22 pin	25p	70p
24 pin	30p	78p
28 pin	35p	85p
36 pin	—	105p
40 pin	40p	109p

EDGE CONNECTORS TEXAS

	·1	·156
2×10 way	—	82p
2×15 way	—	98p
2×18 way	140p	120p
2×22 way	150p	125p
2×25 way	165p	160p
2×30 way	188p	—
2×36 way	197p	—
2×40 way	205p	—
2×43 way	250p	—

DENCO COILS
Dual Purpose 'DP' VALVE TYPE
Ranges: 1-5 Bl. Yl. Rd. Wht. **106p**
6-7 B, Y, R **95p**
1-5 Green **130p**
'T'-type (Transistor Tuning).
Ranges: 1-5 Bl. Yl. Rd. Wht. **128p**
B9A Valve Base **40p**
RDT2 **120p**
RFC 5 chokes **120p**
RFC 7 (19mH) **133p**
1FT 13/14/15/16/17 **110p**
1FT 18/1·6 **120p**
1FT 18/465 **135p**
TOC1 **110p**
MW 5FR **112p**
MW/LW 5FR **134p**

JACKSONS VARIABLE CAPS.
Dielectric 100/300pF **205p**
500pF **250p**
6:1 Ball Drive 4511/DAF **160p**
Dial Drive 4103 6:1/36:1 **775p**
Drum 54mm **55p**
0-1-365pF **325p**
00-2-365pF **395p**
00-2-500pF **550p**
0-2-365pF with slow motion Drive **450p**
00-2-208/176 **395p**
.. .. with slow motion drive **450p**
C804: 5pF; 10 **250p**
25pF **290p**
50pF **290p**
100;150pF **350p**
'L' 3×310pF **725p**
00-3×25pF **550p**

LINEAR IC's

702 75; 709C 8 pin 35; 710* 67; 733 75; 741 8 pin 17; 747C 14 pin 78; 748C 8 pin 36; 753 8 pin 185; 810 159; 9400CJ 350; AY-1-0212 595; AY-1-1313A 660; AY-1-1320 225; AY-1-5050 99; AY-1-5051 160; AY-3-1270 840; AY-3-8500 390; AY-3-8910 850; AY-5-1224A 235; AY-5-1230 450; AY-5-1317A 639; AY-5-8100 735; CA3011 110; CA3014 157; CA3018 68; CA3020 186; CA3023 191; CA3028A 80; CA3035 235; CA3036 115; CA3043 275; CA3045 365; CA3046 71; CA3048 214; CA3059 195; CA3075 213; CA3080E 65; CA3081 190; CA3089E 215; CA3090AQ 375; CA3123 150; CA3130 90; CA3140 48; ICL7106 795; ICL7107 975; ICL8038CC 340; ICM7205 1150; ICM7215 1050; ICM7216A 1950; ICM7216B 1950; ICM7216C 1950; ICM7217A 790; ICM7555 89; LD130 452; LF356 90; LM10 395; LM301A 26; LM308T 95; LM311H 70

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100mA –ve 5V 6, 8, 12, 15V **30p**
100mA –ve **65p**
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LM317K **350p**
LM323K **635p**
LM723 **38p**
78H05 **595p**
78HG05 **650p**
79HG **850p**
TBA625B **80p**

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SCRs THYRISTORS
1A/200V 58; 5A/100V 32; 5A/400V 40; 5A/600V 48; 8A/300V 60; 8A/600V 95; 12A/400V 95; 12A/800V 188; BT106 150; BT116 180; C106D 38; TIC44 24; TIC47 35; 2N4444 130

TRIACS
3A/100V 48; 3A/400V 56; 3A/800V 85p; 8A/100V 60; 8A/400V 69; 8A/800V 115; 12A/100V 78; 12A/400V 82; 12A/800V 135; 16A/400V 105; 16A/800V 220; 25A/400V 185; 25A/800V 295; 30A/400V 525; T2800D 120

DIAC
ST2 **25p**

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AA119 15; BY100 24; BY127 12; CR033 250; 0A9 40; 0A70 12; 0A79 15; 0A81 15; 0A85 15; 0A90 8; 0A91 8; 0A95 8; 0A200 8; 0A202 8; 1N914 4; 1N916 5; 1N4001/2 5; 1N4003/4 6; 1N4005/6 6; 1N4007 7; 1N4148 4; 3A/100V 15; 3A/400V 16; 3A/600V 17; 3A/1000V 19; 6A/400V 50; 6A/800V 65

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Z5J 180

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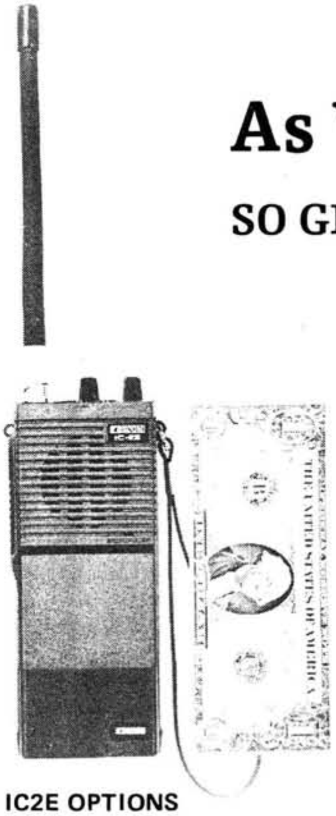

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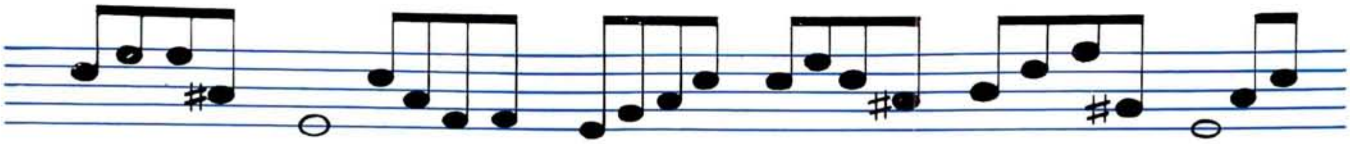

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